Project 135-301
Replacement of MNRR Bridge over Atlantic Street - Phase 2

- and -

Project 301-163
Stamford Yard Catenary Improvements and Track 7 Extension

Draft Special Provisions

March 30, 2016

Prepared for: **Connecticut Department of Transportation**

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NOTICE TO CONTRACTOR – ACCELERATED BRIDGE CONSTRUCTION

It is the intent of this Contract that the project be completed using accelerated bridge construction techniques. The design and proposed construction sequence are predicated upon an accelerated construction method that is shown and described within the Contract Plans and Specifications. The Contractor can choose to utilize the proposed sequence or develop his own approach and propose a method to accomplish accelerated construction, utilizing a staging or sequence other than that which is indicated in the Contract Documents. In either instance, the Contractor must carefully study the site, the schedule restraints, and logistical requirements in relation to his selected means and methods, and assure that he can successfully accomplish the work as described within the timeframe and schedules allowed. Regardless of whether the Contractor elects to use the proposed sequence or his own approach, the Contractor is responsible for meeting all specification, schedule, and coordination requirements shown in the contract documents.

NOTICE TO CONTRACTOR – CLOSURE OF LOCAL STREETS

To accommodate accelerated bridge replacement operations, specifically during the installation of the new bridge superstructures, the Contractor will be permitted to commence weekend and during the week of July 4 to July 12, 2019 closure of the following roadways:

Weekend Closure of Local Streets

The Contractor will be permitted to close Atlantic Street, Dock Street, Garden Street, Manhattan Street, John Street, South State Street, Canal Street, Elm Street and Pacific Street, and detour traffic around the site in accordance with the Maintenance and Protection of Traffic Plans for one 60 hour period of time starting at 5:00 PM on a Friday and ending at 5:00 AM the following Monday.

Week Closure of Local Streets

The Contractor will be permitted to close Atlantic Street and South State Street for the week period between Thursday July 4 and Friday July 12, 2019 to construct the bridge superstructure which includes the SPMT moves. Other roads listed in "Weekend Closure of Local Streets" may be closed during the SPMT moves as required.

The closures must occur between April 1 and November 30 of any year and shall not occur during any of the holiday weekends unless otherwise noted or approved as identified in Section 1.08 – Prosecution and Progress. The Contractor shall notify the Engineer at least 30 days in advance of any street closures and shall implement detour routes to direct traffic around the closed roadways. Detour routes shall be submitted in advance for approval by the Engineer.

STATE PROJECT NO. 135-301

REPLACEMENT OF METRO-NORTH RAILROAD OVER ATLANTIC STREET

Town of Stamford

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 July 2014 (otherwise referred to collectively as "ConnDOT Form 816") 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 Replacement of Metro-North Railroad over Atlantic Street in the Town of Stamford.

CONTRACT TIME AND LIQUIDATED DAMAGES

In order to minimize the hazard, cost and inconvenience to the traveling public, pollution of the environment and the detriment to the business area, it is necessary to limit the time of construction work, which interferes with traffic as specified in Article 1.08.04 of the Special Provisions.

There will be two assessments for liquidated damages and they will be addressed in the following manner:

1. For this contract, an assessment per day for liquidated damages, at a rate of _____ Dollars per day shall be applied to each calendar day the work runs in excess of the _____ allowed calendar days for the contract.

2. For this contract, an assessment per hour for liquidated damages shall be applied to each hour, or any portion thereof, in which the Contractor interferes with normal traffic operations during the restricted hours given in Article 1.08.04 of the Special Provisions. The liquidated damages shall be as shown in the following tables entitled “Liquidated Damages Per Hour” for each hour, or any portion thereof, in which the Contractor interferes with normal traffic operations during the restricted hours.

For the purpose of administering this contract, normal traffic operations are considered interfered with when:

1. Any portion of the travel lanes or shoulders is occupied by any personnel, equipment, materials, or supplies including signs.

2. The transition between the planes of pavement surfaces is at a rate of one inch in less than fifteen feet longitudinally.

LIQUIDATED DAMAGES PER HOUR

Railroad Operations		
If Working Periods Extends Into	A.M. Track Outage	P.M. Track Outage
1st Hour of Restrictive Period	$ xxx	$ xxx
2nd Hour of Restrictive Period	$ xxx	$ xxx
3rd Hour or any Subsequent Hour of Restrictive Period	$ xxx	$ xxx

Liquidated damages as shown for track outages apply for each hour, or part thereof, that the Contractor interferes with railroad operations during the non-allowable hours.

NOTICE TO CONTRACTOR - CONTRACT DURATION

The Contractor is hereby notified that this is not to be considered an ordinary project by any means and that due to the inconvenience to the traveling public that it causes, extra manpower, equipment and workshifts may be required to complete the work in accordance within the specified contract time shown in the Notice to Contractor – Contract Time Liquidated Damages.

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 - VOLUNTARY PARTNERING

The Connecticut Department of Transportation (ConnDOT) intends to encourage the foundation of a cohesive partnership with the Contractor and its principal subcontractors on this project. This partnership will be structured to draw on the strengths of each organization to identify and achieve reciprocal goals. The objectives are effective and efficient contract performance and completion within budget, on schedule, and in accordance with plans and specifications.

This partnership will be bilateral in makeup, and participation will be totally voluntary. Any cost associated with effectuating this partnering will be agreed to by both parties and will be shared equally.

To implement this partner initiative, the Contractor and ConnDOT will meet and plan a partnering development seminar/team building workshop. At this planning session arrangements will be made to determine attendees at the workshop, agenda of the workshop, duration and location. Persons required to be in attendance will be the ConnDOT District Engineer and key project personnel, the Contractor's on-site project manager and key supervision personnel of both the prime and principal subcontractors. The project design engineers and key local government personnel will also be required to have Regional/District and Corporate/State level managers on the project team.

Follow-up workshops will be held periodically throughout the duration of the Contract as agreed by the Contractor and ConnDOT.

The establishment of a partnership charter on a project will not change the legal relationship of the parties to the Contract nor relieve either party from any of the terms of the Contract.

ConnDOT and the Contractor will jointly select a facilitator to conduct the partnering workshops. The Contractor will obtain the services of the chosen facilitator and ConnDOT will reimburse the Contractor for fifty percent (50%) of the costs agreed to between ConnDOT and the Contractor.

NOTICE TO CONTRACTOR - PROCUREMENT OF MATERIALS

Upon award, the Contractor shall proceed with shop drawings, working drawings, procurement of materials, and all other submittals required to complete the work in accordance with the contract documents.

NOTICE TO CONTRACTOR - RAILROAD SPECIFICATIONS

The contractor is hereby notified that all railroad 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.

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.

NOTICE TO CONTRACTOR - SUPERPAVE DESIGN LEVEL INFORMATION

Hot-Mix Asphalt (HMA) and Polymer-Modified Asphalt (PMA) constructed according to the Superpave mix-design system are required to attain a Superpave Design Level and are required to use a Performance Graded (PG) binder. The Superpave Design Levels required for this project are listed in Table 1. The required PG binder is indicated for each mix with an "X" in the appropriate box in Table 1.

TABLE 1 – Superpave Design Level and Performance Graded (PG) Binder

Mix Designation	PG Binder		Atlantic Street	Route I-95 and Ramps	South State Street	Manhattan Street	Route _____ _____ _____ _____
	PG 64-22	PG 76-22	Design Level	Design Level	Design Level	Design Level	Design Level
HMA S0.25	-	-	-	-	-	-	-
HMA S0.375	X	-	-	3	2	-	-
HMA S0.5	X	-	2	3	2	2	-
HMA S1	X	-	2	3	2	2	-
PMA S0.25	-	-	-	-	-	-	-
PMA S0.375	-	-	-	-	-	-	-
PMA S0.5	-	-	-	-	-	-	-
PMA S1	-	-	-	-	-	-	-

Note: Please note that PMA mix designations typically use PG 64E-22 and HMA mix designations use PG 64S-22

Comment [r1]: Ownership of this special provision lies with Edgardo Block at 860-594-2495. No revisions are permitted without prior consent.

NOTICE TO CONTRACTOR – PEDESTRIAN ACCESS

The Contractor shall maintain the level of accessibility as currently exists during all the construction stages. Safe pedestrian access will be provided at all times throughout the construction by maintaining existing sidewalks, providing temporary sidewalks or providing pedestrian detours. At a minimum, pedestrian walkways will be provided on the north side of North State Street, both sides of Atlantic Street, both sides of Station Place, south side of Manhattan Street, both sides of Dock Street and both sides of Canal Street during non-working periods unless approved by the Engineer. No sidewalks currently exist on South State Street within the project limits and no sidewalks are proposed.

If sidewalks need to be closed due to work operations and or unsafe conditions, the Contractor shall erect “Sidewalk Closed” signs and provide clear detour route signage. All sidewalk closures and detour routes shall be submitted a minimum 48 hours prior to the anticipated sidewalk closure for review and approval by the Engineer

NOTICE TO CONTRACTOR – UNDER BRIDGE LIGHTING

The contractor is hereby notified that during construction under bridge lighting shall be provided at all times of sufficient levels to light the roadway and walkway areas.

NOTICE TO CONTRACTOR - 30-DAY SYSTEM OPERATIONAL TEST

Upon successful completion of the installation and testing of the Traffic Management System Cabinet (TMSC),Camera Assembly and Optical Video Data Transmitter approved by the Engineer, a 30-day system operational test shall commence.

During the course of this test, each item listed below must function in accordance with the specifications for the duration of the test. Each item listed below must be tested concurrently. The contractor shall refer to each item for additional testing, if required.

If a malfunction occurs within the stated time frame, then the Contractor shall make all necessary repairs to the system and re-establish proper operation. Upon approval of the Engineer, the 30-day system operational test will begin as new. The system must operate a full thirty (30) consecutive days without a malfunction before the system will be accepted by the Engineer. The Contractor shall coordinate the 30-day system operational test with other pertinent items in this specification and contract.

The Contractor shall maintain and submit to the Engineer a log of recording each 30-day system operational test until all items have successfully completed the 30-day test. The log shall contain a record of all 30-day system operational test equipment start date, reported and recorded failures and repairs to remedy failures of any of the items, re-start dates, and 30-day system operational test completion dates. The log shall contain a list all of the sites on the plans. The Contractor shall submit to the Engineer a weekly status of the log to the Engineer for approval until all of the sites have successfully completed the test. The Contractor shall report to the Engineer each 30-day system operational test successful completion on the day the test is completed. The Contractor shall maintain the log on a daily basis. The Contractor shall provide a copy of the log at the Engineer's request at any time to clarify or resolve any issues with the 30-day system operational test. The Contractor shall submit to the Engineer a proposed log format prior to start of any 30-day system operational test for review and approval by the Engineer.

The Contractor shall be responsible for coordination of the 30-day system operational test with the Bridgeport Operations Staff. The Contractor shall notify Mr. Robert Kennedy @ 860-594-3458 when each system is to begin a 30-day system operational test. The Contractor shall make available a telephone number to the Engineer and the Bridgeport Operations Staff for reporting failures. The Contractor shall be responsible for notifying Bridgeport Operations when a restart and successful completion of each CCTV, TFM or VMS is made.

The Bridgeport Operations Staff will report to the Contractor when the system experiences a failure. The Contractor is responsible for reporting any or all failures to the Engineer.

As-Built installation drawings shall be submitted to the Department identifying the location of IMS appurtenances including pull boxes, handholes, Camera Lowering Devices, Traffic Management System Cabinets and Service Cabinets. The Contractor shall mark-up the .pdf IMS

Plans in red to identify the As-Built installations. As-Built drawings of the Traffic Management System Cabinet shall be prepared using Microsoft Visio. All As-Built Plans shall be submitted on 24" X 36" and 11" X 17" color prints (2 copies each) and in electronic format. The 30 day system operational test shall not be completed until As-Built Drawings are accepted by Mr. Robert Kennedy, Bureau of Highway Operations.

Upon successful completion of the 30-day System Operational Test and approval by the Engineer, the system shall be supported by Item #1112250A – Equipment Operations until the successful completion of the entire construction project or as directed by the Engineer.

The Contractor shall coordinate the 30-day System Operational Test with other pertinent items in this contract and other ConnDOT contracts (If required). The 30-day System Operational Test will not be accepted until all As-Built drawings for IMS equipment installations have been submitted by the Contractor and accepted by the Engineer.

Item #	**Description**
CCTV	
1108637A	Traffic Management System Cabinet
1112210A	Camera Assembly
1108704A	Optical Video Data Transmitter

NOTICE TO CONTRACTOR – AQUARION WATER COMPANY PLANS

The Contractor's attention is hereby called to the fact that included in the plans are plan sheets furnished to the State by the Aquarion Water Company that encompass the proposed construction for both phases of the Atlantic Street project, including State project 135-301.

The proposed work shown on Aquarion Water Company plans that shall be included in this project (State project 135-326) includes the following:

- Sheet AWC-01 – All proposed work on Manhattan Street;
- Sheet AWC-04 – All proposed work east of Station 517+15 on South State Street;
- Sheet AWC-05 – All proposed work on South State Street and Canal Street.

The balance of the proposed work is not included in State project 135-326 and is shown for information only.

NOTICE TO CONTRACTOR – CSI FORMATTED SPECIFICATIONS

The Contractor is advised that included in these specifications are CSI formatted specifications which are specific to Item #0063521A – Rail Facility Upgrade (Site 1) which relates to the work required for the new railroad platform in Project 310-163.

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. The results of these investigations indicated the presence of total petroleum hydrocarbons (TPH), volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), RCRA-8 metals, poly-chlorinated biphenyls (PBCs), and pesticides in soils within proposed construction areas at concentrations above the Connecticut Department of Energy and Environmental Protection (CT DEEP) Remediation Standard Regulations (RSRs). Based on these findings, an Area of Environmental Concern (AOEC) and four (4) PCB AOECs have been identified within the proposed Project limits. Additionally, the reminder of the Project Area is considered a Low-Level Area of Environmental Concern (LLAOEC). Groundwater within the Project limits is also impacted with VOCs and SVOCs above applicable RSR numeric criteria. (It is noted that groundwater was limited in discovery during the investigation of overburden soils). The presence of the compounds at these concentrations will require material-handling measures for soils and groundwater beyond those required for normal construction operations and will be restricted to the methods described herein.

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 AOEC/PCB AOEC/LLAOEC locations. 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.

The Connecticut Department of Transportation, as Generator, will provide an authorized representative to sign all manifests and waste profile documentation required by disposal facilities for disposal of controlled materials and contaminated groundwater.

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. 0101175A – PCB Waste Handling

- Item No. 0101176A – Disposal of PCB Waste
- Item No. 0202315A – Disposal of Controlled Material
- Item No. 0204213A – Handling Contaminated Groundwater

The Contractor is alerted to the fact that a Department environmental consultant will be on site for excavation and dewatering activities within the AOEC/PCB AOEC/LLAOEC locations to collect soil and groundwater samples (if necessary), and to observe site conditions for the State. **The waste stockpile area (WSA) indicated on the plans is to be used exclusively for temporary stockpiling of excavated materials from within the project AOEC/ surplus excavated material from LLAOEC locations for determination of disposal classification. Soils from PCB AOECs will not be staged in the WSA.**

All suitable material excavated from the AOEC may be reused within the AOEC from which it was excavated as fill/backfill, in accordance with the following conditions: (1) such soil is deemed to be structurally suitable as fill by the Engineer; (2) such soil is not placed below the water table; (3) the CT DEEP groundwater classification of the area where the soil is to be reused as fill does not preclude said use; and (4) such soil is not placed in an area subject to erosion. Soils within the LLAOECs 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 LLAOEC locations. Soils excavated from PCB AOECs are slated for disposal and are not permitted for reuse.

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 – Reconstruction of Metro-North Railroad Bridge over Atlantic Street, Stamford, CT; prepared by HRP Associates, Inc., dated January 6, 2015.

NOTICE TO CONTRACTOR – FIRE DEPARTMENT, POLICE & EMERGENCY MEDICAL SERVICES

The Contractor shall contact the Fire Department, Police and Emergency Medical Services, prior to work and establish coordination necessary as to disruption of services during construction.

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 the Discharge of Stormwater and Dewatering Wastewaters associated with Construction Activities (Permit) issued on xxxxx. When construction activities will result in the disturbance of a total of 1 acre (0.4047 ha) or more of land regardless of phasing, the Connecticut Department of Transportation (Department) will incorporate a Stormwater Registration (Registration) and Stormwater Pollution Control Plan (SWPCP) as part of the Contract documents in order to insure compliance with all conditions of this Permit. The Permit's 'Construction activities' means activities including but not limited to clearing and grubbing, grading, excavation, and dewatering.

The Registration and SWPCP addresses pollution caused by soil erosion and sedimentation during construction as well as the long term post-maintenance use of the facility after construction is completed. The Contractor and all subcontractors will be required to sign a certified statement to comply with all applicable conditions of the Registration and SWPCP. There will be no additional payment for the Contractor to sign the certification statement and no additional payment for the Contractor to comply with the conditions of the Registration and SWPCP.

The District Engineer is responsible to sign the Registration and will be the permittee for all Department construction projects. For all local town/municipal projects, the District Engineer is not responsible to sign the Registration as the local town or municipality will be the signed permittee.

If the Contractor requires a modification to the SWPCP, it shall be in accordance with the 2002 Connecticut Guidelines for Soil Erosion and Sediment Control and the 2004 Connecticut Stormwater Quality Manual or as revised or amended. The Department shall approve or reject the modification to the SWPCP and notify the Contractor in writing as to any revisions or additional information required for approval within 30 days of the date of the Contractor's submission. No damage for delays will be granted to the Contractor based on time taken by the Department to review the Contractor's proposal, or to apply for or secure the Permit amendment, modification or revision as per Section 1.10 - Environmental Compliance, of the Standard Specifications for Roads, Bridges, and Incidental Construction Form 816 and any Supplements thereto. At no time shall the Contractor proceed with the proposed Permit amendment, modification, or revision unless the Engineer approves, in writing, the Contractor's request.

At a minimum, the Contractor along with qualified personnel (provided by the permittee) shall inspect the site for non stabilized areas, structural control measures, and locations where vehicles enter or exit the site at least once every seven calendar days and within twenty four hours of the end of a storm that is 0.1 inches (2.54 mm) or greater. If a potential source of pollution is identified, pollution preventive measures shall be implemented within twenty four hours and the SWPCP must be amended within three calendar days.
In order for the Contractor to meet the requirements set forth in the SWPCP, the Contractor shall comply with additional erosion and sedimentation control provisions included in the project.

Erosion and Sedimentation Control Provisions:

Unless specifically outlined in the Contract Plans and/or SWPCP, the Contractor is not allowed to disturb more than two (2) acres (0.8094 ha) of erodible material per discharge point at any one time regardless of phasing. If the Contractor elects to deviate from the Contract Plans and/or SWPCP to disturb more than two (2) acres (0.8094 ha) of erodible material per discharge point at any one time regardless of phasing, the Contractor must provide a sequenced staging plan outlining the proposed disturbed activities. In all cases, the Contractor must meet the following conditions:

- *If the area of disturbance is maintained less than two (2) acres* (0.8094 ha) *per discharge point*, the Contractor may disturb additional areas if and only if the previously disturbed areas are temporarily or permanently stabilized using acceptable measures such as the standard controls which are provided in the SWPCP or as shown on the Contract Plans.

- *If the construction activities create an area of disturbance to be at least two (2) acres* (0.8094 ha) *per discharge point but no more than five (5) acres (2.0235 ha) per discharge point*, the Contactor must submit to the Engineer a revised SWPCP for review and approval. The SWPCP must include locations of the temporary sedimentation trap/temporary sedimentation basin per discharge point with a capacity to contain 134 cubic yards per acre (102.5 m^3 per 0.4047 ha) of material. The Contractor shall design and construct the temporary sedimentation trap/temporary sedimentation basin in accordance with the 2002 Connecticut Guidelines for Soil and Sediment Control. The Contractor shall provide an inspection and maintenance plan for the temporary sedimentation trap/temporary sedimentation basin as part of the amended SWPCP.

- *If the area of disturbance has a potential to reach more than five (5) acres (2.0235 ha) per discharge point*, the Contactor must submit to the Engineer a revised SWPCP for review and approval. The SWPCP must include locations of the engineered sedimentation basin per discharge point with a capacity to contain 134 cubic yards per acre (102.5 m^3 per 0.4047 ha) of material. The Contractor shall design and construct the engineered sedimentation basin in accordance with the 2004 Connecticut Stormwater Quality Manual. The Contractor shall provide an inspection and maintenance plan for the engineered sedimentation basin as part of the amended SWPCP.

The permittee shall amend the SWPCP whenever there is a change in Contactors or subcontractors at the site, or a change in design, construction, operation, or maintenance at the site which has the potential for the discharge of pollutants. In all cases as described above, the amended SWPCP shall adhere to and comply with Section 1.10 - Environmental Compliance, of the Standard Specifications for Roads, Bridges and Incidental Construction Form 816 and any Supplements thereto. No additional payment will be made for any Permit amendment, modification, or revision which alters the Contract Plans, SWPCP, and/or estimated quantities as a result of the Department's approval of the modifications to the Contract by the Contractor. Changes or variations to the Contract Plans and/or SWPCP by the Contractor shall not result in any additional cost to the State.

NOTICE TO CONTRACTOR -- PROPRIETARY ITEMS

The Contractor is hereby notified that the following item shall be furnished by the specific manufacturer specified below or an equivalent manufacturer. The Contractor will be allowed to substitute any of the listed manufacturers with an equivalent, State approved manufacturer to eliminate delay.

Item No.	Item	Manufacturer
1108704A	Optical Video/Data Transmitter	Meridian Technologies, Inc.
1112210A	Camera Assembly	Vicon Industries, Incorporated
1112217A	Camera Lowering Device Assembly – Type B	MG-Squared, Incorporated
1113604A	Optical Fiber Cable - Single Mode, Loose Buffer Tube Cable, 6 Fiber	Corning Incorporated
1113621A	Optical Fiber Cable - Single Mode, Loose Buffer Tube Cable, 72 Fiber	Corning Incorporated

NOTICE TO CONTRACTOR – PROTECTION OF EXISTING UTILITIES

Existing utilities shall be maintained during construction except as specifically stated herein and/or noted on the plans and as coordinated with the utilities. The Contractor shall verify the location of underground, structure mounted and overhead utilities. Construction work within the vicinity of utilities shall be performed in accordance with current safety regulations.

The Contractor shall notify "Call Before You Dig", telephone 1-800-922-4455 for the location of public utility, in accordance with Section 16-345 of the Regulations of the Department of Utility Control.

Representatives of the various utility companies shall be provided access to the work, by the Contractor.

Contractors are cautioned that it is their responsibility to verify locations, conditions, and field dimensions of all existing features, as actual conditions may differ from the information shown on the plans or contained elsewhere in the specifications.

The Contractor shall notify the Engineer prior to the start of work and shall be responsible for all coordination with the Department. The Contractor shall allow the Engineer complete access to the work.

The Contractor shall be liable for all damages or claims received or sustained by any persons, corporations or property in consequence of damage to the existing utilities, their appurtenances, or other facilities caused directly or indirectly by the operations of the Contractor.

Any damage to any existing private and public utility, as a result of the Contractors operations, shall be repaired to the utilities and Engineer's satisfaction at no cost to the State or the Utilities, including all materials, labor, etc., required to complete the repairs.

The Contractor's attention is directed to the requirements of Section 1.07.13 – "Contractor's Responsibilities for Adjacent Property and Services".

Prior to opening an excavation, effort shall be made to determine whether underground installations, i.e., water, sanitary, gas, electric ducts, communication ducts, etc., will be encountered and, if so, where such underground installations are located. When the excavation approaches the estimated location of such an installation, the exact location shall be determined by careful probing or hand digging, and when it is uncovered, proper supports shall be provided for the existing installation. Utility companies shall be contacted and advised of proposed work prior to the start of actual excavation, as noted above.

NOTICE TO CONTRACTOR – PUBLIC UTILITY PLANS

The Contractor's attention is hereby called to the fact that included in the plans are plan sheets furnished to the State by various utility companies affected by the proposed construction. These sheets are not intended to show all proposed work in utility installations to be done by the various utility companies or municipal authorities or both before, during, or after the life of this contract. In addition to the work indicated on these plans, the utility companies and authorities may make adjustments to, or removal of, certain of their installations other than those indicated on the plans or may install facilities not indicated.

NOTICE TO CONTRACTOR – RAIL FACILITY UPGRADE (SITE NO. 1)

The Contractor is hereby advised that the Major Lump Sum Item #0063521A Rail Facility Upgrade (Site No. 1) covers all work for the Track 7 passenger platform canopy including, but not limited to, Architectural, Electrical and Communications, and Structural work as shown on the Contract Plans. Structural work includes all structural steel for the canopy. Precast concrete double tee beams, the steel bridge spanning Atlantic Street and all foundations are included under respective specifications for those elements of the work.

The contractor shall refer the Contract Plans for more information. **The intent of this specification is solely to indicate the CSI formatted specifications that apply for this Major Lump Sum Item.**
The following CSI formatted specifications shall apply at this location:

DIVISION 02

02 41 00 SELECTIVE BUILDING DEMOLITION

DIVISION 03 - CONCRETE

03 30 00 CAST-IN-PLACE CONCRETE
03 45 00 ARCHITECTURAL PRECAST CONCRETE

DIVISION 05 - METALS

05 10 00 STRUCTURAL METAL FRAMING
05 30 00 METAL DECKING
05 40 00 COLD-FORMED METAL FRAMING
05 50 00 METAL FABRICATION
05 52 00 METAL HANDRAIL AND GUARDRAIL SYSTEM
05 55 13 METAL STAIR TREADS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

07 14 16 COLD FLUID APPLIED WATERPROOFING
07 21 00 THERMAL INSULATION
07 22 00 ROOF AND DECK INSULATION
07 25 00 WEATHER BARRIER
07 50 00 SINGLE PLY MEMBRANE ROOFING
07 60 00 FLASHING AND SHEET METAL
07 71 23 ROOF SPECIALITIES
07 84 00 FIRESTOPPING

07 92 00 JOINT SEALANTS AND CAULKING

DIVISION 08 - OPENINGS

08 45 23 2¾" INSULATED TRANSLUCENT FIBERGLASS SANDWICH PANEL SKYLIGHT SYSTEM

DIVISION 09 - FINISHES

09 91 00 PAINTING

DIVISION 10 - SPECIALTIES

10 81 13 BIRD CONTROL DEVICES

DIVISION 16 - ELECTRICAL

16 44 00 PANEL BOARDS
16 46 10 DRY-TYPE DISTRIBUTION TRANSFORMERS

DIVISION 26 – ELECTRICAL

26 05 00 COMMON WORK RESULTS FOR ELECTRICAL
26 05 19 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
26 05 26 GROUNDING & BONDING
26 05 33 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS
26 05 53 IDENTIFICATION FOR ELECTRICAL SYSTEMS
26 27 26 WIRING DEVICES
26 28 16 ENCLOSED SWITCHES AND CIRCUIT BREAKES
26 51 00 INTERIOR LIGHTING

NOTICE TO CONTRACTOR - SERVICE CONNECTIONS (UTILITIES)

The Contractor is hereby notified that certain conditions pertaining to the installation of new telephone service and/or electrical service for the Traffic Management System Cabinets, Traffic Management System Mini-Hub Cabinet and Variable Message Sign Cabinet are required, as part of this contract.

Unless otherwise approved by the Engineer, the responsibilities for utility services for the Traffic Management System Cabinets, Traffic Management System Mini-Hub Cabinet and Variable Message Sign Cabinet shall be as follows:

POWER:

CL&P to provide electrical service cable from the service source, either utility pole or underground structure, to meter socket on Service Cabinet. (CL&P) to also provide meter under Service (Metered) item. The Contractor shall install 3" RMC with ¼" polyester pull cord between CL&P Manhole No. 16B located on Atlantic St. in Stamford and the meter socket. CL&P will pull the service conductors through the installed conduit to the meter socket.

The Contractor shall contact the following utility representative 30 days prior to required work or services:

Connecticut Light & Power
Attn.: Mr. Michael Parillo
Phone: 203-352-5431
Mobile: 860-416-6453
E-Mail: michael.parillo@nu.com

NOTICE TO CONTRACTOR – SUPPLEMENT TO BEST MANAGEMENT PRACTICES

The contractor is hereby required to follow Best Management Practices as directed in the Connecticut Department of Transportation Form 816, Standard Specifications for Roads, Bridges and Incidental Construction §1.10 (2004 as revised).

A downstream suspended debris boom in conjunction with an absorbent boom should be installed to catch floating contaminants.

Erosion and sedimentation controls must be in place and properly maintained as necessary

A responsible party (construction inspector) should be identified for maintenance, inspection, repair, and replacement and incorporation of new controls as may become necessary.

Servicing and refueling of machinery should be completed outside of the watershed area. If this is not possible, an appropriately designed impervious refueling area, with secondary containment, could be creased and located at least 100 feet away from a watercourse or wetland area.

Fuel and other hazardous material should not be stored within the watershed. Any fuel or hazardous materials that must be kept within the watershed during working hours should be stored in impervious surface utilizing secondary containment.

A fuel spill remediation kit should be stored on-site so that any spills may be contained and cleaned quickly.

7. There shall be no staging and storing of materials or equipment within the 100 year floodplain or floodway.

8. The Contractor shall make every effort to secure the work site before predicted major storms. See Form 816 §1.10.03 for the definition of major storms.

State Department of Transportation staff or representatives shall have unrestricted access to the site to inspect all Best Management Practices.

NOTICE TO CONTRACTOR - UTILITY COORDINATION

The Contractor is advised that construction activities will occur in the vicinity of Connecticut Light and Power (CL&P) high voltage lines. Outages are required when the Contractor is working within a minimum of 20' of CL&P high voltage lines. The Contractor shall be responsible for coordinating necessary outages, a minimum of (6) six months in advance of the required outage, through the CL&P Construction Representative in writing, with a copy of the request to the Engineer. CL&P outages may be required for the following activities:

- Installation of structural steel
- Steel (miscellaneous)
- Installation of Aerial ground wire and work on railroad feeder and signal wires
- Removal of aerial ground and/or along track jumper wire
- Structural Steel Repairs

NOTICE TO CONTRACTOR – UTILITY GENERATED SCHEDULE

Section 1.08.03 of the Contract special provisions contains utility related scheduling information. This information 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 Project Coordinator 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.

NOTICE TO CONTRACTOR - WORK ON RAILROAD PROPERTY

The Contractor acknowledges that work to be accomplished under this Contract is to be performed on Railroad territory, which consists of territory operated by Metro-North Commuter Railroad (Railroad). The Contractor's work must be accomplished simultaneously with ongoing daily railroad operations. Such operations include, but are not limited to, the passage of trains, storage of trains, flagging, inspection, repair, construction, reconstruction, and maintenance of the railroad right-of-way and facilities.

The Contractor is advised that the Railroad controls all activity in their respective right-of-way, and the Department expects that these conditions may cause delays and possibly a complete suspension of construction activity. If the Contractor is delayed or suspended in the completion of the work by railroad operations, the Contractor will be entitled to a time extension for every day that he can demonstrate that the delays affected the completion date of the contract. This extension of time will be considered non-compensable. The Contractor will not be entitled to any additional compensation for damages incurred for all direct and indirect costs including, but not limited to, all delay and impact costs, and inefficiencies as a result of railroad operational delays.

Additionally, the Contractor is advised, that this contract contains periods reserved exclusively for work that must be performed by the Railroad and the contractor will not be allowed on the tracks or to interfere with Railroad while that work is conducted. The Railroad shall notify the Engineer upon completion of their work and the Engineer shall notify the contractor when work may resume.

The Contractor shall be responsible for the coordination of the work of his various subcontractors. The Contractor shall coordinate his operations with those of the Railroad Company in carrying out railroad force account work.

The Contractor's employees, and the employees of all subcontractors, who will be entering the jobsite within railroad territory, must undergo a railroad safety training class, of approximately one hour, offered by the Railroad. The Engineer will arrange for the class; however, the Contractor is responsible for insuring that all employees on the jobsite have been trained. No additional compensation will be allowed to the Contractor for employees time for attending these classes. Refer to the special provisions and to Article 1.05.06 entitled "Cooperation with Utilities (Including Railroads)."

The Contractor must make his own arrangements with the Railroad for the use of railroad equipment or changes in railroad facilities made solely to facilitate the Contractor's operations. The expense incurred by making such arrangements shall not be a part of this contract.

All matters requiring Railroad Company approval or coordination shall be directed to:

Mr. David Willard
Assistant Director - Capital Projects
Metro-North Railroad Company
525 Water Street, 3rd Floor
Bridgeport, CT 06601

GENERAL INSURANCE INFORMATION FOR THE NEW HAVEN LINE:

For the purpose of complying with Section 1.03, the following information is provided:

Normal speed of passenger trains is **50 mph** in the area of the work. Normal speed of freight is **40 mph** in the area of the work.

In the Stamford Station area, there are in a 24 hour weekday period:

(250) Scheduled Metro-North Passenger Trains
(8) Extra Trains
(50) Amtrak Trains
(4) Freight Trains

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 1.03.02 - Award and Execution of Contract:

After the second sentence of the only paragraph add the following:

The successful bidder is hereby notified of the Department's intent to award this contract within __ days of the bid opening.

Article 1.03.07 – Insurance - is supplemented as follows:

The first paragraph is revised as follows:

Before the Contract is executed, the Contractor must file with the Commissioner a certificate of insurance, fully executed by an insurance company or companies satisfactory to the Commissioner, on a form acceptable to the Department, for the insurance policy or policies required below, which policy or policies shall be in accordance with the terms of said Certificate of Insurance. Continuance of the required insurance during the entire term of the Contract shall be the responsibility of the Contractor and is a condition of the Contract.

Add the following to the first paragraph:

"In addition, the contractor is required to file certificates of insurance with Metro-North Commuter Railroad at least 30 days prior to commencing any work within the Railroad right-of-way. Certificates are to be sent to: Ms. Melva Villa, Risk Analyst, Metro-North Railroad Risk and Insurance Management Department, 2 Broadway, 21st floor, New York, NY, 10004."

Add the following paragraphs after the first paragraph:

"The Contractor is warned that he will not be allowed on the railroad property by the Railroad Company if there are outstanding charges remaining against the contractor for Railroad Services rendered on prior projects. No request for an extension of time will be considered as a result of any delay to the Contractor's operations caused by the Contractor's indebtedness to the railroad. It is agreed that providing of any conductors, flagmen, or other employees shall not relieve the contractor from liability or payment for any damages caused by his operations.

If any insurance specified within this Article shall be provided on a claims-made basis, then in addition to coverage requirements, such policy shall provide that:

1) The policy retroactive date must coincide with or precede the Contractor's start of work (including subsequent policies purchased as renewals or replacements),
2) The Contractor will make every effort to maintain similar insurance for at least two years following project completion,
3) If insurance is terminated for any reason, the Contractor agrees to purchase an extended reporting provision of at least two years to report claims arising from Work performed in connection with this Contract, and,

4) The policy must allow for reporting of circumstances or incidents that might give rise to future claims.

"The Contractor shall assume any and all deductibles in the described insurance policies contained herein. The Contractor's insurers shall have no right of recovery or subrogation against the State or the Railroad and the described insurance shall be primary coverage."

For coverage provided as per Article 1.03.07, Subarticle 2, 3, 5, and 6 as amended herein, the State shall be named as additional insured."

Add the following after the second paragraph:

The Contractor shall produce, within five (5) business days, a copy or copies of all applicable insurance policies when requested by the State. In providing said policies, the Contractor may redact provisions of the policy that are proprietary. This provision shall survive the suspension, expiration or termination of this contract.

In Subarticle 1 - Worker's Compensation Insurance, after ". . . in accordance with the requirements of State law", add the following: ". . ., or with limits of liability of not less than $1,000,000 for each accident or illness, whichever is greater."

In Subarticle 2 – Commercial General Liability Insurance, delete the end of the first sentence after: ". . . which shall provide coverage . . ." (ie: "for each accident or occurrence . . . . . destruction of property."), and replace with: ". . . which shall provide coverage under this policy, or policies, with limits of liability of not less than $2,000,000 per occurrence, combined single limit for bodily injury, (including disease or death), personal injury and property damage (including loss of use) liability."

Add the following to Subarticle 2 – Commercial General Liability Insurance:

"Products, completed operations, independent Contractors, and contractual liability coverages are to be included and all railroad exclusions are to be deleted. The named as an additional insured with respect to operations to be performed shall be as noted in Subarticle 14."

Add the following to Subarticle 3 - Automobile Liability Insurance:

"A policy is issued to and covering the Contractor's tools and equipment, including automotive equipment used by the Contractor in the work which is the subject of this contract. Coverage shall be on all-risk basis. The State of Connecticut is to be named as an additional insured as respects its interest in the covered property, and the insurance shall include an insurer's waiver of subrogation in favor of each Party insured thereunder."

Replace Subarticle 4 - Owner's and Contractor's Protective Liability Insurance for and in the Name of The State with the following:

With respect to the Contractor's Project operations and also those of its subcontractors, the Contractor shall carry, for and on behalf of the State, insurance which shall provide coverage of at least $1,000,000 for each accident or occurrence resulting in damages from (1) bodily injury to or

death of persons and/or (2) injury to or destruction of property. Subject to that limit per accident or occurrence, the policy shall provide an aggregate coverage of at least $3,000,000 for all pertinent damages arising during the policy period.

Delete Subarticle 5 - Railroad Protective Liability Insurance, and replace with the following:

"**5. Railroad Protective Liability and Property Damage Liability Insurance:** The Contractor shall carry this insurance with respect to the Project operations it performs, and also those performed by its subcontractors, on ISO/RIMA Form, for and on behalf of (in the name of) those appearing in Subarticle 14. Those entities under Subarticle 14, shall be listed and named as additional insured on all policies taken for this project. The policy shall carry combined single limits for both coverages A and B of not less than $2,000,000 per occurrence for losses arising out of bodily injury or death, and for damage to or destruction of railroad property. "Physical Damage to Property" under the Railroad Protective shall mean the direct and accidental loss of or damage to rolling stock and their contents, mechanical construction equipment or motive power equipment, railroad tracks, roadbed, catenaries, signals, bridges, or buildings.

This policy shall be endorsed to the effect that for the purposes of this insurance, the employees of the Railroad Company, as listed below, shall be considered the same as regular employees of the Contractor: a) Any watchman, flagman, and similar employee who is employed by the Railroad and is specifically assigned or furnished by the Railroad for work in connection with the project, or, b) Any employee of the Railroad while operating the work trains or other equipment assigned to the project by the Railroad and while engaged in the performance of work directly involved in the Contract."

Revise Subarticle 7 – Termination or Change of Insurance as follows:

In the first sentence, after "…notify the Department…", add "and the Railroad…".

Delete subsections 8, 9, and 10 and replace them with the following:

8. Compensation:

There shall be no direct compensation allowed the Contractor on account of any premium or other charge necessary to obtain and keep in effect any insurance or bonds in connection with the Project, but the thereof shall be considered included in the general cost of the Project work.

Add Subarticle 11 after Subarticle 10, as follows:

"**11. Contractual Liability Insurance:** The Contractor shall provide Insurance to indemnify the State against all claims as described in Article 1.07.10."

Add Subarticle 12 after Subarticle 11, as follows:

"**12. Structural Injury and Builders Risk:** <u>For vertical (building) construction work only</u>, the Contractor shall furnish evidence of insurance to the Department with respect to the operations the Contractor performs, and also those performed by its subcontractors, it carries on its own

behalf Structural Injury Insurance providing for a total limit of $1,500,000 for all damages arising out of bodily injuries to or death of all persons in any one accident or occurrence, and, subject to that limit per accident, a total (or aggregate) limit of $3,000,000 for all damages arising out of injury to or destruction of property in any one accident or occurrence. In addition to structural injury coverage for property damages caused by covered perils, the Contractor must carry builder's risk (fire extended coverage) insurance, at a level not less than Fifty Percent (50%) of the Total Bid Amount for this project. Coverage shall be All Risk and on a Completed Value basis, including labor and materials in place, on site, in storage off-site, or in transit. Those entities appearing in Subarticle 14 and the Construction Contractors shall be named as insured with respects to their interests in the property."

Add Subarticle 13 after Subarticle 12, as follows:

"**13. Proof of Insurance:** Upon receipt of written request, the contractor shall furnish to the Railroad, a signed copy of the policy for Contractor's Commercial General Liability Insurance, Protective Liability Insurance and the Railroad Protective Liability Insurance. If any work is subcontracted, the Contractor shall furnish a signed copy of the policy for Contractor's Public Liability Insurance for each subcontractor requested."

Add Subarticle 14 after Subarticle 13, as follows:

"**14. Additional Insured:** Where required by the previous articles, the names of the "Additional Insured" shall be as indicated below:

Metro-North Commuter Railroad
Metropolitan Transportation Authority of New York (MTA)
Connecticut Department of Transportation (ConnDOT), Its Agents and Assigns
CSX Corporation
National Railroad Passenger Corporation (AMTRAK)
Providence and Worcester Railroad Company
Consolidated Railroad Corporation (CONRAIL)

Note: For projects with limits of construction that cross the Connecticut/New York State Line into New York, "American Premier Underwriters" shall also be shown as an additional insured."

Metro-North Railroad

STOP!

STOP THE DELA Y AND FAST TRACK THE INSURANCE REVIEW PROCESS BY FOLLOWING THESE INSTRUCTIONS CAREFULLY:

1. **FORWARD THIS SECTION TO YOUR INSURANCE BROKER FOR REVIEW AND HANDLING OF THE REQUIRED INSURANCE.**

2. **THE COMPLETED INSURANCE SUBMISSION SHOULD INCLUDE:**

   A. A METRO-NORTH RAILROAD CERTIFICATE OF INSURANCE, SIGNED AND NOTARIZED WITH ENTRY PERMIT NUMBER AND WORK LOCATION DISPLAYED. (SEE ATTACHED FORM)

   B. ADDITIONAL INSURED ENDORSEMENT (CG 20 26 07 04) OR EQUIVALENT MUST BE ATTACHED. INDEMNIFIED PARTIES WILL VARY BASED UPON LOCATION. (REFER TO ATTACHED TABLE OF ADDITIONAL/NAMED INSUREDS).

   C. RAILROAD PROTECTIVE LIABILITY (RRPL) MUST BE PRESENTED ON A BINDER NOT A CERTIFICATE AND MUST INCLUDE THE FOLLOWING INFORMATION:

      1) NAMED INSUREDS: INDEMNIFIED PARTIES WILL VARY BASED UPON LOCATION. (REFER TO ATTACHED TABLE OF ADDITIONAL/NAMED INSUREDS).
      2) PROJECT DESCRIPTION AND LOCATION
      3) CONTRACTOR NAME AND ADDRESS

3. **RETURN INSURANCE WITH EXECUTED AGREEMENT TO:**

James Horn c/o Metro North Railroad
420 Lexington Avenue, 12th Floor
New York NY 10017

BASIC INSURANCE GUIDELINES FOR METRO NORTH RAILROAD (MNRR) ENTRY PERMITS

Policies must be written by Carriers rated A-/VII or better to be acceptable to MNRR
Read your agreement for specific insurance requirements.

In order to expedite the approval process, we recommend that you forward the insurance section from your agreement to your insurance representative for review and compliance of the coverages required. MTA Risk & Insurance Management must approve insurance prior to commencement of work.

1. **Metro North Agency Form must be used** to provide evidence of insurance. The Certificate Must Include:
   - Agreement or Entry Permit Number;
   - Any deductible, self-insured retention, sub-limit or aggregate limit;
   - Insured's telephone number, contact person and e-mail address;
   - Notarized signature of an Authorized Representative of the Insurance Carrier or Producer.
   - The appropriate checked (√) boxes for the Additional Insureds as applicable.

2. Minimum Coverage: Refer to Your Agreement for Specific Insurance Requirements:

A. Workers' Compensation:

- NY State Insurance Fund iorm is acceptable;
- If a company is domiciled in a state other than New York, coverage must be extended to include New York State;
- If your company is exempt from Workers' Compensation, supporting documentation from NYS or your company's accountant and or attorney is acceptable.

B. General Liability:

- Contractor's policies (and its subcontractor's policies, if applicable) shall apply on a primary and not on an excess or contributing basis with any policies which may be available to the MNRR and must be exhausted before implicating any MNRR policy available. Any Umbrella/Excess Policy used to meet minimum contract requirements must follow form of the underlying policy and be extended to "drop down" to become primary in the event the primary policy is exhausted.

Provide a physical copy of the Additional Insured Endorsement (I.S.O. Form CG 20 26 07 04 version or equivalent. Endorsement (s) must include policy number(s)

- - Additional Insureds for your work location are listed in the table below.

C. Business Automobile Liability

- Required if your vehicle enters Metro North property. The policy shall be extended to include employees of any insured acting in the scope of their employment.

D. Railroad Protective Liability (RRPL) An Original Policy is required. A detailed Insurance Binder (ACORD or Manuscript) will be accepted pending issuance of the Original Policy, which must be provided within 30 days of the Binder Approval. Named Insureds for your work location are listed in the table below

Do Not Submit Evidence of RRPL on a Certificate of Insurance.

Binder must be provided for the RRPL to be replaced by a complete policy within 30 days:

The Binder Must Include:

- Agreement or Entry Permit Number;
- Contractor Name and Address with contact information;
- List of Named Insureds (refer to table of Named Insureds);
- Description and Location of Project;
- Signature of an Authorized Representative of the Insurance Carrier or Producer.

ALL COMPLETED INSURANCE DOCUMENTS DESCRIBED ABOVE MUST BE FORWARDED TO:

James Horn c/o MNR
420 Lexington Avenue, 12th Floor
New York, NY 10017
212 499 4504

Except that as otherwise provided in this Article and/or the Specifications, the Permitee and/or their Contractor shall procure, at its sole cost and expense, and shall maintain in force at all times during the term of this Agreement, through the FINAL COMPLETION of contract, policies of insurance as herein below set forth, written by companies with an A.M. Best Company rating of A-/"VII" or better, and approved by the Metro-North Railroad/MTA and shall deliver evidence of such policies. These policies must: (i) be written in accordance with the requirements of the paragraphs below, as applicable; (ii) be endorsed in form acceptable to include a provision that the policy will not be canceled, materially changed, or not renewed, unless at least thirty (30) days prior written notice to the Metro-North Railroad/MTA c/o MTA Risk and Insurance Management Department - Standards, Enforcement & Claims Unit, 2 Broadway - 21st floor, New York, NY 10004 and (iii) state or be endorsed to provide that the coverage afforded under the Permitee and/or their Contractor's policies shall apply on a primary and not on an excess or contributing basis with any policies which may be available to the Metro-North Railroad/MTA, and also that the Permitee and/or their Contractor's policies, primary and excess, must be exhausted before implicating any Metro-North Railroad/MTA policy available, (iv) In addition, the Permitee's and/or their Contractor's policies shall state or be endorsed to provide that, if a subcontractor's policy contains any provision that may adversely affect whether the Permitee's and/or their Contractor's policies are primary and must be exhausted before implicating any Metro-North Railroad/MTA policy available, the Permitee's and/or their Contractor's and subcontractor's policies shall nevertheless be primary and must be exhausted before implicating any Metro-North Railroad/MTA policy available. At least two (2) weeks prior to the expiration of the policies, the Permitee and/or their Contractor shall endeavor to provide evidence of renewal or replacement policies of insurance, with terms and limits no less favorable than the expiring policies. Except as otherwise indicated in the detailed coverage paragraphs below, self insured retentions and policy deductibles shall not exceed $100,000, unless such increased deductible or retention is approved by Metro-North Railroad/MTA. The Permitee and/or their Contractor shall be responsible for all claim expense and loss payments within the deductible or self insured retention on the same basis as would be the case if commercial insurance was available for the loss. The insurance monetary limits required herein may be met through the combined use of the insured's primary and umbrella/excess policies.

A. Workers' Compensation Insurance (including Employer's Liability Insurance with limits of not less than $2,000,000, which limit may be met by a combination of primary and excess insurance) meeting the statutory limits of the laws of the state in which the work is to be performed.

B. Commercial General Liability Insurance (I.S.O. 2001 Form or equivalent approved by Metro-North Railroad) in the Permitee's and/or their Contractor's name with limits of liability in the amount of at least $3,000,000 each occurrence/$3,000,000 General Aggregate Limit (other than products-completed operations)/$3,000,000 Products/Completed Operations Aggregate Limit on a combined single limit basis for injuries to persons (including death) and damage to property. The limits may be provided in the form of a primary policy or combination of primary and umbrella/excess policy. When the minimum contract amounts can only be met when applying the umbrella/excess policy, the umbrella/excess policy must follow form of the underlying policy and be extended to "drop down" to become primary in the event primary limits are reduced or aggregate limits are exhausted. Such insurance shall be primary and

noncontributory to any other valid and collectible insurance and must be exhausted before implicating any Metro-North Railroad/MTA policy available.

Such policy should be written on an occurrence form, and shall include:

- Contractual coverage for liability assumed by the Permitee and/or their Contractor under this agreement;
- Personal and Advertising Injury Coverage;
- Products-Completed Operations;
- Independent Contractors Coverage;
- "XCU" coverage (Explosion, Collapse, and Underground Hazards) where necessary;
- Contractual Liability Exclusion, applicable to construction or demolition operations to be performed within 50 feet of railroad tracks, must be voided, where necessary;
- Coverage for claims for bodily injury asserted by an employee of an additional insured and any Employer Liability Exclusion which may otherwise operate to exclude such coverage shall be voided in this respect; and
- Additional Insured Endorsement (I.S.O. Form CG 20 26 07 04 version or equivalent approved by the Metro-North Railroad) listing:
  - See Attached Additional Insured/Named Insured Table for the required

Additional Insureds at Entry Permit/Work location.

C. <u>Business Automobile Liability Insurance</u> - (l.S.O. Form CA 00 01 10 01 or equivalent approved by the Railroad). If vehicle enters Agency's property or is used as part of service provided, in the Permitee's and/or their Contractor's name with limits of liability in the amount of $2,000,000 each accident for claims for bodily injuries (including death) to persons and for damage to property arising out of the ownership, maintenance or use of any owned, hired or non-owned motor vehicle. The policy shall be extended to include employees of any insured acting in the scope of their employment.

- If the project involves transporting and/or disposing of any hazardous material or waste off of the jobsite, the Permitee and/or their Contractor or any subcontractor performing such work must add the MCS-90 to the automobile policy. The CA9948 endorsement is also required if transporting to a site outside of NYS. (**Additional pollution liability insurances maybe required, which are identified in below paragraphs.**
- The policy limits of liability must be increased to at least $5,000,000 each occurrence pursuant to federal, state or local laws, rules and regulations, and
- Copies of the MCS-90 and CA9948 endorsements, if applicable, shall be provided for review as part of the insurance submission.

D. Railroad Protective Liability Insurance (ISO-RIMA or equivalent form approved by the Metro-North Railroad), covering the work to be performed at the designated job site and affording protection for damages arising out of bodily injury or death, physical damage to or destruction of property, including damage to the Insured's own property and conforming to the following:

- The following are the "Named Insureds" for this coverage:

See Attached Additional Insured/Named Insured Chart for the required Named Insureds at Entry Permit/Work location.

- The limit of liability shall be at least $2,000,000 each occurrence, subject to a $6,000,000 annual aggregate;

- Policy must be endorsed to provide coverage for claims arising from injury to employees covered by Federal Employer's Liability Act (FELA).

- Policy Endorsement CG 28 31 - Pollution Exclusion Amendment is required to be endorsed onto the policy when environmental-related work and/or exposures exist.

- Indicate the Name of the Permitee and/or their Contractor to perform the work, the name of the Metro-North Railroad for whom the work is being performed and the Contract description and number.

- Evidence of Railroad Protective Liability Insurance, must be provided in the form of the Original Policy. A detailed Insurance Binder (ACORD or Manuscript Form) will be accepted pending issuance of the Original Policy, which must be provided within 30 days of the Binder Approval.

Environmental Coverages will be required ONLY when environmental exposures are part of the work.

E. Contractor's Pollution Liability - In the case of a contract involving environmentally regulated substances or hazardous material exposure(s), the Permitee and/or their Contractor shall provide Contractor's Pollution Liability Insurance with respect to the work and activities of the Permitee and/or their Contractor or its Subcontractors, including but not limited to handling, transporting or disposing of any hazardous substances and/or environmentally regulated materials and any sudden and/or non-sudden pollution or impairment of the environment, including clean-up costs and defense. This insurance shall have limits of liability specifically written for this contract in the amount of at least $5,000,000. The Permitee and/or their Contractor shall comply with all federal, state, and/or local laws, rules and regulations and shall obtain any additional coverages required by federal, state, or local government agencies. The Contractor's Pollution Liability Insurance shall be in effect from the time the MetroNorth Railroad permits the work relating to the Hazardous Substances or other environmentally regulated substances and materials to begin through the completion of the work.

i. This insurance shall name the following entities as additional insured's:

Metro-North Railroad and the Metropolitan Transportation Authority (MTA) including its subsidiaries and affiliates.

ii. This insurance may be supplied by the Subcontractor performing the Work, if the Permitee and/or their Contractor is not performing any of the relevant Work and providing all applicable additional insureds are named.

iii. The Permitee and/or their Contractor or its Sub-contractor performing the Work shall obtain all permits, licenses and other forms or documentation which are required and forward them to the Project Engineer. The insurance shall be submitted to MTA Risk and Insurance Management Department pursuant to requirements referenced in the Insurance Article.

iv. In the event that the Permitee and/or their Contractor or its Subcontractors transports from the Site hazardous substances or any other environmentally regulated substance that requires a governmentally regulated manifest, the **MCS-90 Endorsements** shall be attached to the auto liability policy (the CA9948 is also required, if hauling outside of NYS). Both shall be furnished on a primary basis with limits of liability of at least $5,000,000 per occurrence providing coverage for bodily injury or property damage including liability for environmental restoration resulting from negligence in the operation, maintenance or use of any motor vehicle involved in the transportation of hazardous substances or any other environmentally regulated substance as required pursuant to any federal, state or local laws, rules and regulations. **A copy of each endorsement, if applicable, shall be submitted for review as part of the insurance submission showing the $5M limits.**

v. Any additional insurance policies necessary to obtain required permits or otherwise comply with applicable law, ordinances or regulations regarding the performance of the work should be provided to the Metro-North Railroad.

F. **Pollution Legal Liability (Non-Owned Disposal Site Coverage) -** If the project activities include the disposal of waste or other hazardous substance from the work site, the Permitee and/or their Contractor shall maintain or cause to be maintained the following insurance:

i. The Permitee and/or their Contractor shall provide a certificate of insurance to Metro North Railroad listing the disposal facility as an insured location or

- Alternatively, the Permitee and/or their Contractor may designate the disposal site, and provide a certificate of insurance from the disposal facility to the Metro-North Railroad.

ii. The Metro-North Railroad and Metropolitan Transportation Authority are to be named as additional insureds on these policies with limits of liability of at least $5,000,000 per occurrence

iii. If coverage is not provided under a stand alone policy, but is included in the general liability policy, a Non-Owned Disposal Site endorsement must be referenced on the insurance certificate and a copy thereof submitted with the insurance.

The Permitee and/or their Contractor shall furnish evidence of all policies before any work is started to the Metro-North Railroad:

C/o MTA Risk & Insurance Management

Standards Enforcement & Claims Unit.

2 Broadway - 21st Floor

New York, NY 10004

Certificates of Insurance may be supplied as evidence of such aforementioned policies required by this Article, except the Railroad Protective Liability Policy, designated as Policy D). **The Railroad Protective Liability Insurance Policy** must be provided in the form of the **Original Policy**. A detailed Insurance Binder may be provided, **ACORD** or **Manuscript Form, pending issuance of the Original Policy. The Original Policy must be submitted to MTA RIM within 30 days of the Binder Approval.** However, the Metro-North Railroad reserves the right to request copies of such policies herein described above. If requested by the Metro-North Railroad, the Permitee and/or their Contractor shall deliver to the Metro-North Railroad, within forty-five (45) days of the request, a copy of such policies, certified by the insurance carrier as being true and complete.

If a Certificate of Insurance is submitted, it must: (1) be provided on the Metro-North Railroad Certificate of Insurance Form or MTA Certificate of Insurance Form for Joint Agency Agreements; (2) be signed by an authorized representative of the insurance carrier or producer and notarized; (3) disclose any deductible, sublimit, self-insured retention, aggregate limit or any exclusions to the policy that materially change the coverage; (4) indicate the Additional Insureds and Named Insureds as required herein. The Permitee and/or their Contractor must provide a physical copy of the Additional Insured Endorsement (I.S.O. Form CG 20 26 07 04 version or equivalent, as applicable and the endorsement(s) must include policy number(s); (5) reference the Contract by number on the face of the certificate; and (6) expressly reference the inclusion of all required endorsements.

Nothing herein contained shall be deemed to limit the Permitee and/or their Contractor liability to the limits of liability, or coverage of the Policies above their renewals, or replacement.

If, at any time during the period of this Agreement, insurance as required is not in effect, or proof thereof is not provided to the Metro-North Railroad, the Metro-North Railroad shall have the options to: (i) direct the Permitee and/or their Contractor to suspend work or operation with no additional cost or extension of time due on account thereof; or (ii) treat such failure as an Event of Default.

ADDITIONAL INSURED/NAMED INSURED TABLE

LOCATION/STATION	CONNECTICUT – NEW HAVEN LINE AND BRANCHES
NEW HAVEN LINE New Haven-State Street New Haven Milford Stratford Bridgeport Fairfield Southport Green's Farms Westport East Norwalk South Norwalk Rowayton Darien Norton Heights Stamford Old Greenwich Riverside Cos Cob Greenwich	Metro-North Railroad (MNRR), Metropolitan Transportation Authority (MTA)*, State of Connecticut and CT Department of Transportation (CDOT), National Railroad Passenger Corporation (AMTRAK), CSX Transportation, Inc. & New York Central Lines, LLC, Providence & Worchester Railroad Company (P&W) Housatonic Railway.
New Canaan Branch New Canaan Talmadge Hill Springdale Glenbrook	Metro-North Railroad (MNRR), Metropolitan Transportation Authority (MTA)*, State of Connecticut and CT Department of Transportation (CDOT) Providence & Worchester Railroad Company (P&W)
Danbury Branch Danbury Bethel Redding Branchville Cannondale Wilton Merritt 7	Metro-North Railroad (MNRR), Metropolitan Transportation Authority (MTA)*, State of Connecticut and CT Department of Transportation (CDOT) Providence & Worchester Railroad Company (P&W)
Waterbury Branch Waterbury Naugatuck Beacon Falls Seymour Ansonia Derby Shelton	Metro-North Railroad (MNRR), Metropolitan Transportation Authority (MTA)*, State of Connecticut and CT Department of Transportation (CDOT), Providence & Worchester Railroad Company (P&W)

*Metropolitan Transportation Authority means the Metropolitan Transportation Authority including its subsidiaries and affiliates.

Station List With Line

Ansonia	Waterbury
Beacon Falls	Waterbury
Branchville	Danbury
Bridgeport	New Haven
Cannondale	Danbury
Cos Cob	New Haven
Danbury Bethel	Danbury
Darien	New Haven
Derby Shelton	Waterbury
East Norwalk	New Haven
Fairfield	New Haven
Glenbrook	New Canaan
Green's Farms	New Haven
Greenwich	New Haven
Merritt 7	Danbury
Milford	New Haven
Naugatuck	Waterbury
New Canaan	New Canaan
New Haven	New Haven
New Haven-State Street	New Haven
Norton Heights	New Haven
Old Greenwich	New Haven
Redding	Danbury
Riverside	New Haven
Rowayton	New Haven
Seymour	Waterbury
South Norwalk	New Haven
Southport	New Haven
Springdale	New Canaan
Stamford	New Haven
Stratford	New Haven
Talmadge Hill	New Canaan
Waterbury	Waterbury
Westport	New Haven
Wilton	Danbury

☐ Capital Contract
☐ Operating Contract
☐ Entry Permit or Film

Metro-North Railroad
CERTIFICATE OF INSURANCE

AGREEMENT or CONTRACT #:	AGREEMENT or CONTRACT NAME/DESCRIPTION:	
INSURANCE PRODUCER: ADDRESS: PHONE #:	CERTIFICATE ISSUANCE DATE:	DATE RECEIVED BY MTA RM: MTA REFERENCE #:

INSURED: ADDRESS: PHONE #:	CO LTR	COMPANIES AFFORDING COVERAGE
	A	
	B	
	C	
CERTIFICATE HOLDER: Metro-North Railroad/MTA Attention: Risk & Insurance Management ADDRESS: 2 Broadway 21st Floor New York, NY 10004 PHONE#: (646) 252-1430	D	
	E	
	F	
	G	

COVERAGES (See Notes 1 and 2)

CO LTR	TYPE OF INSURANCE	POLICY NUMBER	EFFECTIVE DATE	EXPIRATION DATE	LIMITS	
	GENERAL LIABILITY ☐ Comprehensive Form ☐ Underground Expl.& Collapse Hazard ☐ Products/Completed Operations ☐ Contractual Liability ☐ Independent Contractors ☐ Fifty Foot Exclusion Voided ☐ Personal & Advertising Injury ☐ SIR/Deductible $____				BI & PD COMBINED OCCURRENCE	$
					GENERAL AGGREGATE	$
					PRODUCTS/COMPLETED OPERATIONS AGGREGATE	$
					OTHER	$
	AUTOMOBILE LIABILITY ☐ Any Auto ☐ Owned Autos ☐ Hired Autos ☐ Non-Owned Autos				BODILY INJURY (Per Occurrence)	$
					PROPERTY DAMAGE (Per Occurrence)	$
					BODILY INJURY/PROPERTY DAMAGE COMBINED SINGLE LIMIT (Each Accident)	$
	GARAGE LIABILITY ☐ Any Auto				AUTO ONLY EACH ACCIDENT	$
					OTHER THAN AUTO ONLY — EA ACC	$
					OTHER THAN AUTO ONLY — AGG	$
	EXCESS LIABILITY ☐ Umbrella Form ☐ Other Than Umbrella Form ☐ SIR/Deductible $____				EACH OCCURRENCE	$
					AGGREGATE	$
	WORKER'S COMPENSATION AND EMPLOYER'S LIABILITY ☐ USLH ☐ Jones Act ☐ "All States" Coverage				☐ STATUTORY LIMITS	
					EMPLOYER'S LIABILITY	$
	BUILDER'S RISK				CONTRACT VALUE OF $	
	PROFESSIONAL LIABILITY ☐ Includes Pollution Liability ☐ Deductible $____					$
	OTHER: ____					$
	OTHER: ____					$
	OTHER: ____					$

RAILROAD PROTECTIVE LIABILITY INSURANCE IS NOT ACCEPTED ON CERTIFICATE OF INSURANCE FORMS:
PROVIDE DETAILED BINDER AND/OR POLICY

CERTIFICATE OF INSURANCE	MNR	(Continued) Page 2

LIABILITY COVERAGES:

ADDITIONAL INSUREDS (See Note 3) Check all that apply ☒
Coverage: Commercial Liability, Garage Liability, Excess/Umbrella Liability Contractor's Pollution Liability, Pollution Legal Liability, etc.

For all MNR

- ☐ Metro-North Commuter Railroad Company
- ☐ Metropolitan Transportation Authority, including its subsidiaries and affiliates.
- ☐ Connecticut Department of Transportation (CDOT)
- ☐ The State of Connecticut
- ☐ Midtown Trackage Ventures LLC
- ☐ Midtown TDR Ventures LLC
- ☐ National Railroad Passenger Corp. (Amtrak)
- ☐ NJ Transit Rail Operations Inc.
- ☐ New Jersey Transit Corporation
- ☐ CSX Transportation Inc. & New York Central Lines LLC
- ☐ Delaware & Hudson Railway Company, Inc
- ☐ Norfolk Southern Railway Company & Pennsylvania Lines LLC
- ☐ Housatonic Railroad Company
- ☐ Providence & Worcester Railroad Company
- ☐ Danbury Terminal Railroad Co.
- ☐ Maybrook Railroad Company
- ☐ Other: _____

PROPERTY COVERAGES:

(See Note 3) Check all that apply ☒

- ☐ **NAMED INSUREDS**
  Coverage: Property, etc.
- ☐ **ADDITIONAL NAMED INSUREDS/LOSS PAYEES**
  Builder's Risk, etc.
- ☐ **LOSS PAYEES**
  Coverage: Crime Insurance, Valuable Papers

- ☐ Metro-North Commuter Railroad Company
- ☐ Metropolitan Transportation Authority, including its subsidiaries and affiliates.
- ☐ Connecticut Department of Transportation (CDOT)
- ☐ The State of Connecticut
- ☐ Midtown Trackage Ventures LLC
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- ☐ Housatonic Railroad Company
- ☐ Providence & Worcester Railroad Company
- ☐ Danbury Terminal Railroad Co.
- ☐ Maybrook Railroad Company
- ☐ Other: _____

NOTE 1: The subscribing insurance company(s), authorized to do business in the State of New York, certifies that insurance of the kinds and types and for limits of liability herein stated, covering the Agreement/Contract herein designated, has been procured by and furnished on behalf of the Insured and is in full force and effect for the period listed on the front of this Certificate of Insurance. In addition, the subscribing insurance company(s) certifies that the insurance limits for General Liability Insurance are not amended by deductible clauses of any nature except as has been disclosed to and approved by the Metro-North; and that coverage is afforded for the Insured's obligations under that provision of the contract/agreement providing for indemnification of the Indemnified Parties, including the Metro-North, named therein. When applicable, any exclusion applying to construction or demolition operations on or within fifty (50) feet of a railroad (stations, yards, tracks, etc.) has been voided; and any employer liability exclusion which may otherwise operate to exclude claims for bodily injury asserted by an employee of an additional insured shall be voided.

NOTE 2: The subscribing company(s) agrees that no policy referred to herein shall be changed or canceled until thirty (30) days written notice has been sent to the following address: Metro-North Railroad//MTA c/o MTA Risk and Insurance Management Department, 2 Broadway, 21st Floor New York, NY 10004.

NOTE 3: All references to Named Insureds and Additional Insureds include those entities' directors, officers, employees, partners, agents, subsidiaries and affiliates.

NOTE 4: This certificate is issued to the Certificate Holder in consideration of the Agreement/Contract entered into with the named insured. It is understood and agreed that the certificate holder relies on the certificate as basis for continuing such Agreement/Contract with the name insured.

AUTHORIZED INSURER/PRODUCER _____

BY _____
(signature of authorized insurer/Producer)

TITLE _____

STATE OF)
) s.s.
COUNTY OF)

On this _____ day of _____ 20___, before me personally came _____, to me known, who being duly sworn, did depose and say that he/she resides in _____, that he/she is the _____ of the corporation and described in and which executed the foregoing Certificate of Insurance, that he/she is fully authorized to execute the foregoing Certificate of Insurance.

_____
(Notary Public)

CERTIFICATES OF INSURANCE MUST BE COMPLETED BY AUTHORIZED INSURANCE REPRESENTATIVES ONLY.

☐ Capital Contract
☐ Operating Contract
☐ Entry Permit or Film

Metro-North Railroad
CERTIFICATE OF INSURANCE

AGREEMENT or CONTRACT #:	AGREEMENT or CONTRACT NAME/DESCRIPTION:	
INSURANCE PRODUCER: ADDRESS: PHONE #:	CERTIFICATE ISSUANCE DATE:	DATE RECEIVED BY MTA RIM: MTA REFERENCE #:

INSURED: ADDRESS: PHONE #:	CO LTR	COMPANIES AFFORDING COVERAGE
	A	
	B	
	C	
CERTIFICATE HOLDER: Metro-North Railroad/MTA Attention: Risk & Insurance Management ADDRESS: 2 Broadway 21st Floor New York, NY 10004 PHONE#: (646) 252-1430	D	
	E	
	F	
	G	

COVERAGES (See Notes 1 and 2)

CO LTR	TYPE OF INSURANCE	POLICY NUMBER	EFFECTIVE DATE	EXPIRATION DATE	LIMITS	
	GENERAL LIABILITY ☐ Comprehensive Form ☐ Underground Expl.& Collapse Hazard ☐ Products/Completed Operations ☐ Contractual Liability ☐ Independent Contractors ☐ Fifty Foot Exclusion Voided ☐ Personal & Advertising Injury ☐ SIR/Deductible $_____				BI & PD COMBINED OCCURRENCE	$
					GENERAL AGGREGATE	$
					PRODUCTS/COMPLETED OPERATIONS AGGREGATE	$
					OTHER	$
	AUTOMOBILE LIABILITY ☐ Any Auto ☐ Owned Autos ☐ Hired Autos ☐ Non-Owned Autos				BODILY INJURY (Per Occurrence)	$
					PROPERTY DAMAGE (Per Occurrence)	$
					BODILY INJURY/PROPERTY DAMAGE COMBINED SINGLE LIMIT (Each Accident)	$
	GARAGE LIABILITY ☐ Any Auto				AUTO ONLY EACH ACCIDENT	$
					OTHER THAN AUTO ONLY — EA ACC	$
					OTHER THAN AUTO ONLY — AGG	$
	EXCESS LIABILITY ☐ Umbrella Form ☐ Other Than Umbrella Form ☐ SIR/Deductible $_____				EACH OCCURRENCE	$
					AGGREGATE	$
	WORKER'S COMPENSATION AND EMPLOYER'S LIABILITY ☐ USLH ☐ Jones Act ☐ "All States" Coverage				☐ STATUTORY LIMITS	
					EMPLOYER'S LIABILITY	$
	BUILDER'S RISK				CONTRACT VALUE OF $	
	PROFESSIONAL LIABILITY ☐ Includes Pollution Liability ☐ Deductible $_____					$
	OTHER: _____					$
	OTHER: _____					$
	OTHER: _____					$

RAILROAD PROTECTIVE LIABILITY INSURANCE IS NOT ACCEPTED ON CERTIFICATE OF INSURANCE FORMS:
PROVIDE DETAILED BINDER AND/OR POLICY

CERTIFICATE OF INSURANCE | MNR | (Continued) Page 2

LIABILITY COVERAGES:

ADDITIONAL INSUREDS (See Note 3) Check all that apply ☒
Coverage: Commercial Liability, Garage Liability, Excess/Umbrella Liability Contractor's Pollution Liability, Pollution Legal Liability, etc.

For all MNR

- ☐ Metro-North Commuter Railroad Company
- ☐ Metropolitan Transportation Authority, including its subsidiaries and affiliates.
- ☐ Connecticut Department of Transportation (CDOT)
- ☐ The State of Connecticut
- ☐ Midtown Trackage Ventures LLC
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- ☐ CSX Transportation Inc. & New York Central Lines LLC
- ☐ Delaware & Hudson Railway Company, Inc
- ☐ Norfolk Southern Railway Company & Pennsylvania Lines LLC
- ☐ Housatonic Railroad Company
- ☐ Providence & Worcester Railroad Company
- ☐ Danbury Terminal Railroad Co.
- ☐ Maybrook Railroad Company
- ☐ Other: _____

PROPERTY COVERAGES:

(See Note 3) Check all that apply ☒

- ☐ **NAMED INSUREDS**
  Coverage: Property, etc.
- ☐ **ADDITIONAL NAMED INSUREDS/LOSS PAYEES**
  Builder's Risk, etc.
- ☐ **LOSS PAYEES**
  Coverage: Crime Insurance, Valuable Papers

- ☐ Metro-North Commuter Railroad Company
- ☐ Metropolitan Transportation Authority, including its subsidiaries and affiliates.
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- ☐ Midtown Trackage Ventures LLC
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- ☐ Housatonic Railroad Company
- ☐ Providence & Worcester Railroad Company
- ☐ Danbury Terminal Railroad Co.
- ☐ Maybrook Railroad Company
- ☐ Other: _____

NOTE 1: The subscribing insurance company(s), authorized to do business in the State of New York, certifies that insurance of the kinds and types and for limits of liability herein stated, covering the Agreement/Contract herein designated, has been procured by and furnished on behalf of the Insured and is in full force and effect for the period listed on the front of this Certificate of Insurance. In addition, the subscribing insurance company(s) certifies that the insurance limits for General Liability Insurance are not amended by deductible clauses of any nature except as has been disclosed to and approved by the Metro-North; and that coverage is afforded for the Insured's obligations under that provision of the contract/agreement providing for indemnification of the Indemnified Parties, including the Metro-North, named therein. When applicable, any exclusion applying to construction or demolition operations on or within fifty (50) feet of a railroad (stations, yards, tracks, etc.) has been voided; and any employer liability exclusion which may otherwise operate to exclude claims for bodily injury asserted by an employee of an additional insured shall be voided.

NOTE 2: The subscribing company(s) agrees that no policy referred to herein shall be changed or canceled until thirty (30) days written notice has been sent to the following address: Metro-North Railroad//MTA c/o MTA Risk and Insurance Management Department, 2 Broadway, 21st Floor New York, NY 10004.

NOTE 3: All references to Named Insureds and Additional Insureds include those entities' directors, officers, employees, partners, agents, subsidiaries and affiliates.

NOTE 4: This certificate is issued to the Certificate Holder in consideration of the Agreement/Contract entered into with the named insured. It is understood and agreed that the certificate holder relies on the certificate as basis for continuing such Agreement/Contract with the name insured.

AUTHORIZED INSURER/PRODUCER _____

BY _____
(signature of authorized Insurer/Producer)

TITLE _____

STATE OF)
) s.s.
COUNTY OF)

On this _____ day of _____ 20___, before me personally came _____ to me known, who being duly sworn, did depose and say that he/she resides in _____, that he/she is the _____ of the corporation and described in and which executed the foregoing Certificate of Insurance, that he/she is fully authorized to execute the foregoing Certificate of Insurance.

_____
(Notary Public)

CERTIFICATES OF INSURANCE MUST BE COMPLETED BY AUTHORIZED INSURANCE REPRESENTATIVES ONLY.

GENERAL PROCEDURE FOR ACCESS TO RAILROAD PROPERTY CT

All outside parties who need to perform construction or maintenance on or adjacent to Metro-North Railroad property must comply with the following:

1) **Permit Application:** Parties requiring an entry permit shall submit a written request to the Chief Maintenance of Way Officer defining the location, scope of work and duration of activities on or adjacent to Railroad facilities. Address the letter to:

   Assistant Vice President-Chief Engineer
   Metro-North Railroad
   420 Lexington Avenue, 12th Floor
   New York, NY 10017

2) **Insurance:** Furnish proof of insurance in a form acceptable to and approved by the Director of MTA Risk and Insurance Management no less than 20 working days prior to the intended start of work (see Section C of this specification) to:

   MTA/'Metro-North Railroad
   Attn: Risk & Insurance Management
   Standards, Enforcement and Claims Unit
   2 Broadway, 21st Floor
   New York, NY 10004
   Tel: (646) 252-1430

Applicant shall obtain confirmation of receipt and approval of the insurance certificate from the Director of MTA Risk and Insurance Management.

3) **Payment:** Upon review of the scope of work provided with the permit application, Metro-North will prepare an estimate of the cost of providing Railroad Protective Personnel and all other expenses related to the project. Supply payment, in full, of Metro-North's estimated cost of Railroad Force Account Services no less than 20 working days prior to the intended start of work. Obtain confirmation of receipt by the Chief Maintenance of Way Officer. Since the payment is based on an estimated cost, unexpended funds if any, will be subject to reimbursement. On the contrary, should the actual work exceed the estimated cost, an additional payment shall be submitted to continue Railroad Force Account Services.

4) **Technical Submittals:** Supply copies of construction shop drawings, calculations and supporting documentation to:

   Mr. David B. Willard, P.E.
   Assistant Director, Structural Engineering
   Metro-North Railroad Capital Engineering
   Bridgeport, Connecticut Office
   525 Water Street, 3rd Floor
   Bridgeport, CT 06601
   Tel: (203) 337-3606 / Fax: (203) 337-3609

   Ms. Julie Thomas
   Connecticut Department of transportation
   Property Management
   50 Union Ave., 4th Floor West
   New Haven, CT 06519
   Tel: 203-497-3383
   Fax: 203-789-6956

Upon receipt of the submittals, allow 15 working days from date of receipt for Metro-North's review of the submittals prior to requesting a conference to schedule that activity. Once the above requirements have been satisfied, contact the Assistant Director, Structural Engineer no less than 15 working days prior to the start of work to schedule a pre-construction conference at (203) 337-3606. When all is in order, the Bridgeport Office Department will schedule Railroad coordination and support services. (See Sections A and B of "Construction Management 1 & C Specifications")- No work will commence until the applicant receives permission from the designated Railroad Representative at the site to proceed with the work.

(Rev. J/2/10) [Jim-CT]

CONSTRUCTION SPECIFICATION -1 & C SECTION A

METRO-NORTH RAILROAD COMPANY

CONTRACTOR REQUIREMENTS FOR WORK AFFECTING THE RAILROAD

The contractor shall be governed by the State of Connecticut Department of Transportation Standard Specification for Roads, Bridges and Incidental Construction, Form 814 (or latest edition), with the following additions:

1. AH matters requiring Railroad Company approval or coordination of construction methods shall be directed to: **Metro-North Railroad Company. Connecticut Bridges Program Office, 525 Water Street, Bridgeport. Connecticut 06601.**

2. The contractor shall obtain design and construction approval of construction methods from the railroad. He shall submit detailed plans appurtenant data and calculations for any operation on or adjacent to the Railroad property prior to the start of work. Metro-North will evaluate the effect of this work on the operating Railroad. The plan shall locate and identify all utilities, above and below ground at the work site. He shall make necessary plan revisions, schedule changes, additions, deletions, etc. at his own expense. The contractor shall remove at his own expense any pipe, wire, or structural facility installed without Metro-North approval or which deviates from the Plan approved by Metro-North.

Under the direction of a Railroad representative (engineer, inspector) the contractor shall - at no cost to the Railroad - perform pre and post construction surveys of tracks and structures to establish existing horizontal and vertical clearances. The elevations shall reference an established survey benchmark which will remain undisturbed throughout the construction. It may be necessary for the contractor to monitor movements of tracks structures on a more frequent basis - monthly, weekly or daily as determined by the Railroad representative. Copies of the field notes must be delivered to the Railroad on a regular basis.

Under the direction of a Railroad representative (engineer, inspector) the contractor shall - at no cost to the Railroad - take pre and post construction photographs of the entire work site and track area, two sets of which will be delivered to the Railroad. The photographs shall be gloss prints 8 inches by 10 inches in size. They shall also be labeled on their reverse sides. The label shall include project title, Project Identification Number (PIN), Bridge Identification Number (BIN) or contract number, name of contractor, date and direction photograph was taken. Each photograph shall also be numbered for identification.

3. Sheeting shall be required on all excavations where the side of the excavation is intercepted by the Railroad live load influence line. The live load influence line is defined as a line originating at the bottom outside edge of tie and extending downward at a slope of 1 (vertical) on I Vi (horizontal). Such excavations must be designed to withstand, in addition to all static loads such as structural dead load, soil pressure and hydrostatic pressure, a Railroad live load of Cooper E-80 or other loading magnitude as may be directed by the Railroad.

Moreover, sheeting alongside active track systems shall maintain lateral support. Lateral support shall consist of a compacted stone ballast shoulder level with the top of tie for at least one (1) foot from the end of tie supported by a slope no steeper than one (1) vertical to two (2) horizontal. Timber sheeting left in place shall be treated with wood preservative in accordance with the American Wood Preservers Association Standards for timber in contact with soil.

4. Protective scaffolding shall be necessary where, at the sole discretion of the Railroad, such scaffolding is necessary to protect the Railroad or the general public from possible falling debris, paint or other materials; to protect personnel working above the right-of-way or to provide a platform for personnel, materials and or equipment. A protective scaffold intended to contain finely broken concrete decking shall be designed for a live load of 200 pounds per square foot applied uniformly over the entire structure, and a 2 kip concentrated load placed anywhere on the structure. The two loads are not to be applied simultaneously for design purposes. Design of the scaffold intended for any other purpose shall be submitted to Metro-North for approval. The design shall contain details of any construction activities supported or protected by the scaffold. Loads or rigging which exceed the capacity of the scaffold shall be subject to the conditions of Section B "Rigging." All materials for protective scaffolding must be fire retardant. The contractor must supply the Railroad with certification from the manufacturer or supplier that lumber meets or exceeds the ASTM E-84 fire retardant specification for exterior application 30-minute duration. Plans and calculations for sheeting and scaffolding must be submitted to the Railroad for approval prior to construction. Further, plans and calculations must be stamped by a Professional Engineer licensed in the state in which the project is located.

5. The contractor shall safeguard the tracks, rolling stock and other equipment and plant of the Railroad from being damaged in any manner and will be held financially responsible for same. He shall not perform any operations which might foul the Railroad until he has complied with the Railroad requirements.

6. An operating track will be considered fouled when, in the sole opinion of the Railroad, demolition, blasting or construction activity on or adjacent to a main track or controlled siding may interfere with the safe movement of trains at normal speed. A crane, derrick or a similar piece of equipment located on Railroad right-of-way or on adjacent property shall be considered as fouling the track when the position in which it is working is such that without regard to the manner in which it is intended to carry out the operation, failure or malfunction could cause damage or obstruction within the operating area. Similarly, Railroad utilities (power, communications and signal lines) will be considered fouled when, in the sole opinion of the Railroad, the contractor's operation could interfere with these utility lines.

7. The contractor shall give sufficient advance notice so that the Railroad may arrange to supply special supervisory and protective forces.

Section 12 "Protective Personnel" defines the advance notice requirements for operations requiring protective services. The Railroad will provide protective forces to the extent possible considering operational and maintenance priorities. The Railroad makes no guarantee that protection personnel will be available to meet the contractor's preferred schedule. Further, no such work may actually commence until the assigned Railroad representative affirmatively advises the contractor that the necessary protective forces are stationed and that he may proceed.

8. The contractor will not store materials or equipment upon Railroad right-of-way without first obtaining written permission of the Railroad. The contractor shall secure construction materials and equipment which could be used by vandals to obstruct Railroad operation in a vandal-proof enclosure. The contractor shall protect the work site with fences, barricades, barriers, watchmen or other means necessary to bar access to operating areas via the work site.

9. The contractor must furnish an English-speaking supervisor at each job location who is capable of communicating (including translating if necessary) instructions from the flagman or other Metro-North representative to the contractor's personnel on the job. Such supervisor must remain on the site at all times while work is being performed or any contractor employees are on or about the Railroad right-of-way.

10. The contractor shall comply with any and all Federal, State and Local laws, regulations and rules governing environmentally controlled substances and construction practices. De-watering operations shall comply with applicable regulatory controls and shall be subject to Metro-North review and approval. The contractor shall comply with Federal and State regulations for containment, storage and disposal of hazardous/industrial wastes. He shall comply with Metro-North Procedure 50-601, Item "O," Environmental Controls. The contractor shall indemnify and hold harmless the Railroad from any loss, liability or expense on account of claims which result from the handling, transportation, disposal or abatement of asbestos, asbestos containing material or asbestos contaminated materials, lead paint materials and other environmentally regulated substances and material in the possession of contractor or his subcontractors where said claim, is not the result of negligence of an Indemnified Party.

11. The Metro-North Safety Department offers an orientation class for all contractor personnel who have reason to enter Railroad property. The contractor can obtain training material from the Safety Department.

The contractor shall comply with the requirements of all applicable Federal, State, Local and Railroad jurisdictions to provide a suitable work environment for workmen and for the general public. He shall prepare and submit a comprehensive "Safety Plan" which will:

1. Designate a company representative(s) who will prepare and implement a program of compliance.

2. Supply personal safety equipment for all workmen employed by the contractor or his subcontractors and enforce use of this equipment by contractor personnel.

3. Train all employees and subcontractor employees with emphasis upon unusual conditions found in the Railroad environment.

12. Protective Personnel

Metro-North will furnish flagmen, inspectors, maintenance personnel and similar labor (protective personnel) as required by Metro-North to protect the operation of train traffic during the contractor's construction activities. The contractor must obey the instructions from Metro-North flagmen or other representatives on the job site promptly. Failure to follow instructions from Railroad personnel on the site will lead to withdrawal of Metro-North's Entry Permit, thus closing the job site to the contractor and its employees. The Railroad will at its sole discretion, determine the need for and the availability of protective, support personnel. The contractor must notify the assigned Railroad inspector no less than 14 calendar days in advance of undertaking an approval construction activity which may require protective personnel. If the contractor notifies Metro-North less than 14 days in advance, the Railroad may be unable to supply protective personnel and/or the Railroad may incur additional costs in accordance with existing collective bargaining agreements in order to fulfill a request. The cost of protective personnel and any additional penalty costs incurred by the railroad due to late notification shall borne by the contractor or agency responsible to reimburse Railroad costs. Requests to cancel construction activities and protective personnel must be received and acknowledged by the assigned Railroad inspector no less than 96 hours prior to the start of the scheduled construction activity. Any costs incurred by Metro-North due to late cancellation notice shall be borne by the contractor or agency responsible to reimburse Railroad costs.

13. The Railroad will, at its sole discretion, remove tracks from service and de-activate high voltage traction power facilities to permit certain construction activities which can only be performed at times when the Railroad can schedule this track use. In general, the Railroad can de-activate single tracks at night between the hours of 2:30 AM and 5:00 AM. Construction activities which require de-activating all tracks of a main line system must be performed on weekend nights at times specified by the Railroad. Requests for additional "track use" will be evaluated subject to operating and maintenance priorities. Requests to de-activate track(s) and/or high voltage power systems must be received and acknowledged by the assigned Railroad inspector no less than 14 days prior to the scheduled activity. Metro-North will only consider requests for "track time" to facilitate construction activities that have been approved by the Construction Management Department.

14. Highway-rail mounted equipment and "work trains" are generally prohibited from use by non-Railroad agencies on Metro-North mainlines tracks.

15. The contractor shall adhere to Metro-North security practices. He shall identify all contractor/subcontractor personnel who have reason to enter a designated security area of Railroad property. He shall supply a listing of the names of all personnel who have reason to enter Railroad property. The list shall be updated whenever there is a change in personnel. He shall supply each workman with company insignia which shall be worn on outer garments whenever workmen are on Railroad property. Contractor personnel failing to wear identifying insignia shall be removed from the property.

16. An Entry Permit shall be necessary before non-Railroad personnel enter Railroad property. The project owner shall contact the office of the Chief Engineer of Maintenance to initiate the process at:

    Metro-North Railroad
    Engineering Department
    420 Lexington Avenue
    12th Floor
    New York, New York 10017

17. A Force Account Agreement shall be necessary between Metro-North and the project owner to provide for reimbursement of Railroad protective costs incidental to the construction project. The project owner shall contact the:

    Metro-North Railroad
    Connecticut Bridges Program Office
    525 Water Street
    Bridgeport, Connecticut 06601

The project owner shall deposit with Metro-North payment of the full amount of the estimated cost of Railroad services prior to entering the property.

CONSTRUCTION SPECIFICATION -1 & C SECTION B

Requirement for Erection. Demolition and Other Rigging
Operations Over or Adjacent to Railroad Right-of-Way

The contractor must furnish the following information to obtain written approval prior to the start of any rigging operation over or adjacent to the Railroad right-of-way:

1. Plan view showing locations of cranes, boom length and rigging operating radii, with delivery or disposal vehicle weight and locations shown.

2. Crane rating sheets showing cranes to be adequate for 150% of the lift. Crane and boom nomenclature shall be indicated. Include manufactures' recommended data for special applications such as barge mounted equipment.

3. Plans and computations showing weight of pick. Include weight of rigging equipment.

4. Location plan showing obstructions, indicating that the proposed swing is possible, A profile of overhead utility lines or obstructions demonstrating that the rigging operation is possible. Computations and plans demonstrating that foundations for equipment and temporary structures are adequate and protect subsurface utilities and structures.

5. Plans and calculations showing locations and structural adequacy of mats, barges, planking or special decking as may be required by the Railroad.

6. Written statement from crane owner giving date of last crane condition and safety inspection and the results of said inspection.

7. Data sheet listing number, type, size, arrangement and capacity of slings, spreader bars or other connecting equipment. Copies of catalog or information sheets of specialized equipment.

8. A complete procedure, indicating the order of lifts and repositioning or rehitching of the cranes and partial pre-cutting of structural members.

9. Temporary support of any components or intermediate stages including bolting data shall be shown.

10. A time schedule of each stage or lift, as well as a schedule for the entire lifting procedure.

11. All plans and calculations submitted to the Railroad as required above shall be stamped by a Professional Engineer licensed in the state where the work is performed.

In general, unless otherwise directed by the Railroad, operations directly over or adjacent to the operating right-of-way which foul the operating area, or which in the event of a failure could fall across the operating area will be performed between approximately 2:30 AM and 5:00 AM. Operations involving a track and power outage across all tracks may be performed only on weekends -at times specified by the Railroad.

The contractor shall locate and mark the exact crane location in the field at least two working days prior to the intended operation. He shall verify the radii and clearances for critical picks, and he shall confirm the stability of the foundation for crane outriggers and supports. Any deviation from this plan must be approved, in writing, by the Metro-North Engineer prior to the date that the work will be scheduled.

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, however, the contractor is hereby put on notice that it is the Department's intent to issue the Notice to Proceed no later than 24 calendar days after the date of the execution of the Contract by the Department.

SECTION 1.04 – SCOPE OF WORK

Article 1.04.05 – Extra Work:

Add the following after the fourth sentence:

Bonding costs shall not be included in the Contractor's compensation request. However, if the Contractor incurs or will incur increased bonding costs related to the extra work, the Contractor shall request separate compensation for such costs. The Contractor's request shall be itemized and include a certified statement from the bonding company stating that the value of the work will require an increase in bonding coverage and detail the additional costs (within allowable contract amount limitations). If satisfactory substantiation is provided, a new item for increased bonding costs will be incorporated into the contract by means of a construction order.

SECTION 1.05 - CONTROL OF THE WORK

Article 1.05.02 - Plans, Working Drawings and Shop Drawings: Amend as follows:

Add the following:

Each submittal shall include the name and contact information for an individual familiar with the submittal and who will be available to answer questions should they arise during the review.

Sub-article 1.05.02 (2) – Working Drawings: is supplemented by the following:

Delete the first paragraph and add the following:

When required by the contract documents or when ordered by the Engineer, the Contractor shall prepare and submit in digital format complete set(s) of working drawings for review before fabrication. When working drawing submittals include materials, parts, fabrications, etc. supplied by others, any shop drawings, catalog cuts, assembly drawings, etc. for those materials, parts, fabrications, etc., shall be included for information only with the working drawing submission, to the following:

Mr. Domenic LaRosa, P.E.
Assistant District Engineer – District 3
Connecticut Department of Transportation

Sub-article 1.05.02 (3) – Shop Drawings: is supplemented by the following:

Delete the first paragraph and add the following:

When required by the contract documents or when ordered by the Engineer, the Contractor shall prepare and submit in digital format complete set(s) of shop drawings for review and approval before fabrication. When shop drawing submittals include materials, parts, fabrications, etc. supplied by others, any shop drawings, catalog cuts, assembly drawings, etc. for those materials, parts, fabrications, etc., shall be included for information only with the shop drawing submission, to the Engineer for review and approval before fabrication.

The Contractor shall submit one (1) copy of the transmittal only for all submittals of shop drawings, catalog cuts, data sheets and other descriptive literature to the following:

Mr. Domenic LaRosa, P.E.
Assistant District Engineer – District 3
Connecticut Department of Transportation

Mr. Donald R. Costello, P.E.
AECOM
500 Enterprise Drive
Rocky Hill, Connecticut 06067
(860) 529-8882

Traffic Signals

When required by the contract documents or when ordered by the Engineer, The Contractor shall prepare and submit in digital format complete set(s) of shop drawings, catalog cuts, data sheets and other descriptive literature for all State owned traffic signal and illumination items to the Division of Traffic for approval before fabrication, to the following:

State Owned Traffic Signals:
Mr. Charles S. Harlow
Connecticut Department of Transportation
Division of Traffic
2800 Berlin Turnpike
P.O. Box 317546
Newington, Connecticut 06131-7546
(860) 594-2788

Illumination

When required by the contract documents or when ordered by the Engineer, The Contractor shall prepare and submit in digital format complete set(s) of shop drawings, catalog cuts, data sheets and other descriptive literature for all State owned highway illumination items to the Division of Traffic for approval before fabrication, to the following:

State Owned Highway Illumination:
Mr. Timothy M. Wilson
Manager of Highway Design
Bureau of Engineering and Construction
Connecticut Department of Transportation

2800 Berlin Turnpike
P.O. Box 317546
Newington, Connecticut 06131-7546

Delete the third and fourth paragraphs and add the following:

After review of such drawings, the Engineer will digitally stamp each drawing as "Approved," "Approved as Noted," or "Revise and Resubmit." Each drawing stamped as “Approved” or “Approved as Noted” will be returned in digital format to the Contractor for its

use. No resubmission of a drawing stamped "Approved as Noted" is required, but the Engineer's notes must be appropriately taken into account and implemented by the Contractor.
The Contractor shall transmit three (3) copies of the "Approved" or "Approved as Noted" shop drawings, catalog cuts, data sheets and other descriptive literature to the following:

Mr. Domenic LaRosa
Assistant District Engineer
Connecticut Department of Transportation

In the case of a drawing that is reviewed and stamped "Revise and Resubmit," the drawing will be returned in digital format to the Contractor, which shall take into account and implement all comments; the Contractor shall then resubmit in digital format the revised drawings for review and approval.

If the Contractor proposes a revision of a previously-submitted shop drawing that has been stamped "Approved" or "Approved as Noted," the Contractor shall submit in digital format the revised drawing incorporating any original Engineers notes for the Engineer's review. Any such resubmitted shop drawing shall clearly indicate, in a revision block, the date and precise nature of the revision, as well as its location on the revised drawing.

Article 1.05.06—Cooperation with Utilities (Including Railroads) – is supplemented as follows:

Add the following after the last paragraph:

"Special Requirements Regarding Work in Metro-North territory:"

Description:

This section covers authority, definitions, regulatory requirements, traffic regulation and coordination of the Contractor's work schedule with the operation of train service, construction equipment and safety requirements for working within railroad right-of-way, and provisions for storage of materials and equipment and worker safety rules. Subsequent to the Engineer's Pre-construction meeting and prior to commencement to contract activities, a working on the railroad meeting will be held by the Engineer to emphasis these Specifications.

Permission to Enter Upon Railroad Property

Permission is hereby granted to the Contractor to enter property of the State, under the custody and control of the Department and managed by Metro-North Commuter Railroad Company (hereinafter called "Railroad"), a public benefit corporation and subsidiary of Metropolitan Transportation Authority (hereinafter called "MTA"). The purpose of this permission shall be solely for those outlined in this contract and under the following terms and conditions:

I. Location and Access. Permission is hereby granted to the Contractor and its subcontractor(s), if any, to enter the property within the Project Limits identified on the Contract Plans (hereinafter called the "Property").

II. Liability. The Contractor covenants and agrees to at all times indemnify, protect and save harmless the "Additional Insureds", as defined under Article V, from and against any and all losses, damages, detriments, suits, claims, demands, costs, and charges which the "Additional Insureds" may directly or indirectly suffer, sustain, or be subjected to by or on account of the Contractors entry upon, occupancy or use of the Property, or the conduct thereon of the Contractor, its subcontractors, officers, employees, agents or invitees, whether such loss or damage be suffered or sustained by the "Additional Insureds" directly or persons (including employees of "Additional Insureds" or Corporations who may seek to hold the "Additional Insureds" liable therefore), and whether attributable to the fault, failure or negligence of the "Additional Insureds" or otherwise.

III. Consideration. The Contractor will pay to the Railroad, the sum of Zero Dollars ($0.00) for the right to enter upon the Property.

IV. Terms of Permit. The Railroad reserves the right to revoke this permission at any time. Unless subsequently modified, this shall begin with Notice to Proceed and shall end at Contract Completion Date at which time it shall expire automatically. Under no

circumstances shall this temporary permission be construed as granting the Contractor any rights, title or interest of any kind or character in, on, or about the land or premises of MTA or Railroad thereafter. The Permittee agrees to notify the Railroad when use of the Property or work is completed.

V. Definitions of Terms and Permissible Abbreviations:

Authority of the Railroad Engineer - This supplements Form 816, Section 1.05.01 in that all contract work upon or affecting railroad property, right-of-way or facilities, shall also be subject to the approval of the Senior Director, Capital Programs of the Railroad or his duly authorized representative, through coordination with the Engineer.

Additional Insureds - Those individuals or entities appearing under Article 1.03.07, Paragraph 14 of the Specifications.

Conductor/Flagman - A Railroad employee qualified on the Rules of the Operating Department and qualified on the physical characteristics of the portion of the railroad involved. He/she is the contact employee qualified to obtain the use of track. Each conductor/flagman will have the proper flagging equipment, up-to-date Railroad Operating Rules, Timetables and Safety Rules.

Coordination of Work - This supplements Form 816, Section 1.05.06 in that the Contractor shall be responsible for the coordination of the work of his sub-contractors with respect to the railroad property, right-of-way or facilities.

Groundman - Class “A” employee of the Railroad’s Power Department authorized to de-energize/re-energize and ground high tension power lines.

Horizontal Clearance Point - A point 10 feet from the centerline of a track.

Obstruction - An entering of the traffic envelope, also referred to as fouling.

Occupancy - Any use of track other than direct crossing.

On or Adjacent to - shall be interpreted to include space on, above and below the railroad right-of-way operated by the Railroad, as well as space on, above, and below adjacent property which the Railroad determines to affect the safe operations of service.

Qualified Railroad Employee - For the purpose of these specifications, a Qualified Railroad Employee is a Railroad employee qualified to remove track or tracks from service.

Railroad - Whenever the term "Railroad" is used without further qualification, it shall be taken to mean Metro-North Commuter Railroad Company.

Right-of-Way - The limits of railroad property on either side of tracks.

The Safety Rules - All work shall be performed in accordance with rules, regulations, procedures, and safe practices of the Railroad, FRA, OSHA, NESC and all other government agencies having jurisdiction over this project.

Track - The space between the rails plus not less than 4 feet outside each rail.

Traffic Envelope - The area encompassed by the vertical and the horizontal clearance points.

Vertical Clearance Point - A point 22 feet and 6 inches above the top of a running rail unless otherwise authorized by the Railroad.

Use of Track - Obtaining permission from the proper authority of the Railroad for track occupancy.

1 – Requirements for Performing Work on or Adjacent to the Railroad Right-of-Way

(a) General

(1) The Contractor should note that the proposed work involves construction operations on or adjacent to property owned by State and operated by the Railroad. In working near an operating railroad, great care must be exercised and the Railroad's safety rules must be strictly observed.

(2) If while completing the work covered by this contract, the tracks or other facilities of the Railroad are endangered, the Contractor shall immediately do such work as directed by the Railroad through the Engineer to restore safety. Upon failure of the Contractor to carry out such orders immediately, the Railroad may take whatever steps as are necessary to restore safe conditions. The cost and expense to the Railroad of restoring safe conditions, or of any damage to the Railroad's trains, tracks or other facilities caused by the Contractor's or subcontractor's operations, shall be considered a charge against the Contractor and shall be paid for by him, or may be deducted from any monies due or that may become due him under this contract.

(b) Rules and Regulations

(1) Railroad traffic shall be maintained at all times, and the Contractor shall conduct all of his operations on or adjacent to the Railroad right-of-way fully within the rules, regulations, and requirements of the Railroad. The Contractor shall be responsible for acquainting himself with such requirements as the Railroad may demand. The Contractor shall include in his bid any expenses occasioned by delay or interruption of his work by reason of the operation or maintenance of the Railroad facilities.

(2) The Contractor shall obtain verification of the time and schedule of track occupancy from the Railroad before proceeding with any construction or demolition work on or adjacent to the Railroad right-of-way.

(3) All work to be done on or adjacent to the Railroad right-of-way shall be performed by the Contractor in a manner satisfactory to the Railroad and shall be performed at such times and in such manner as not to interfere with the movement of trains or traffic upon the tracks of the Railroad. The Contractor shall use all necessary care to avoid accidents, damage, delay or interference with the Railroad's trains or property.

(4) If deemed necessary by the Railroad, it may furnish or assign an inspector who will be placed on the work during the time the Contractor or any subcontractor is performing work under the contract on Railroad property.

(5) Before proceeding with any construction of demolition work on or adjacent to the Railroad Right-of-Way, a pre-construction meeting shall be held at which time the Contractor shall submit for approval of the Railroad, plans, computations, and a detailed description of his method and procedure for accomplishing the specific construction work required under this contract, including methods of protecting Railroad traffic. Such approval shall not serve, in any way, to relieve the Contractor of his responsibility for the adequacy and safety of his methods and procedures for conducting the work.

(6) The Contractor shall conduct his work and handle his equipment and materials in such manner that neither fouls a live track or wire line without the written permission of the Railroad.

(7) Equipment shall be considered to be potentially fouling the track when located in such a position that its failure, with or without load, brings the equipment within the traffic envelope. No equipment shall be placed in this position without prior approval of the Railroad.

(8) Equipment of the Contractor to be used:

(A) Equipment of the Contractor to be used adjacent to the tracks shall be in first-class condition so as to fully prevent failures of defective equipment that might cause delay in the operations of trains or damage to Railroad facilities. His equipment shall not be placed or put into operation adjacent to tracks without first obtaining permission from the Railroad. Under no circumstances shall any equipment or materials be placed or stored within 25 feet from the near rail of a track in operation, unless approved, in advance, by the Railroad.

(B) High rail equipment of the Contractor to be used on the tracks shall be subject to prior approval of the Railroad. The equipment must be inspected and

approved in advance at the Railroad's facility by Railroad inspectors. The equipment inspection must be renewed every three months.

(C) On track vehicles shall be equipped with a Railroad approved tow bar and coupler. Multiple vehicles shall move in tandem and coupled when directed by the Railroad. Movement of on track vehicles shall proceed only under the direct supervision of a Qualified Railroad Employee.

(9) Materials and equipment belonging to the Contractor shall not be stored on Railroad property without first having obtained permission from the Engineer and Railroad. Such permission will be on the condition that the Engineer and Railroad will not be liable for damage to such materials and equipment from any cause. The Contractor shall keep the tracks adjacent to the site clear of all refuse and debris that may accumulate from his operations and shall leave the Railroad property in the condition existing before the start of his operations.

(10) The Contractor shall coordinate with the Engineer and the Railroad in order to determine the type of protection required to insure safety and continuity of Railroad traffic incidental to the particular methods of operation and equipment to be used on the work.

(11) The Railroad will require protection during all periods when the Contractor is working on, or over, the right-of-way of the Railroad, or as may be found necessary in the opinion of the Railroad. When protection is required, refer to Paragraph 1(g).

(12) It shall be expressly understood that this contract includes no work for which the Railroad is to be billed by the Contractor, and it shall be further understood that the Contractor is not to bill the Railroad for any work which he may perform, unless the Railroad gives a written request that such work be performed at its expense.

(13) Upon completion of the work, and before final payment is made, the Contractor shall remove from within the limits of the Railroad's right-of-way, all machinery, equipment, surplus materials, falsework, rubbish and temporary buildings, and other property of the Contractor/sub-contractor, and shall leave the right-of-way in a condition satisfactory to the Railroad.

(c) Railroad Protective Services - will be provided in accordance with the Roadway Worker's Protective Act, Title 49, Part 214, Sub-part C. Railroad protective services will also be performed to insure safe operations of trains when construction work would, in the Railroad's opinion, be a hazard to Railroad operations.

(d) Definition of Hazard – the Railroad has furnished the statements quoted below, explaining when they consider a hazard to operations exists:

"Protective services will be required whenever the Contractor is performing work on or adjacent to the Railroad tracks or right-of-way, such as excavating, sheeting, shoring, erection and removal of forms, handling materials, using equipment which by swinging or by failure could foul the track, and when any other type of work being performed, in the opinion of the Railroad, requires such service."

(e) Contractor Requirements for Work Affecting the Railroad

(1) All matters requiring Railroad Company approval or coordination shall be directed to the Engineer or a duly authorized representative thereof, for forwarding to the Railroad Engineer.

(2) Detailed plans and appurtenant data and calculations for any operation which, in the opinion of the Railroad, affect the Railroad, must be submitted to the Engineer or a duly authorized representative thereof, for forwarding to the Railroad Engineer for approval prior to commencement of the work. All plans and calculations submitted must be stamped by a Connecticut registered Professional Engineer.

(3) Permissible Track Outages - are identified in the SECTION 1.08 – PROSECUTION AND PROGRESS – Article 1.08.04 – "Limitation of Operations" - Contractor Requirements for Work Affecting the Railroad contained within the General Provisions of the Contract. The times identified are the times that the track may be removed from service. **If power outages are required, the de-energizing/re-energizing and grounding of the wires will subtract approximately forty-five minutes from the start and forty-five minutes at the end of the indicated outage period for a total of up to ninety minutes.**

(4) The Contractor shall maintain a minimum of 1 foot level shoulder from ends of ties to maintain lateral track support for all excavations and shall not excavate any slope steeper than 1 (vertical) on 2 (horizontal) from the edge of the shoulder. Sheeting shall be required on all excavations where the side of the excavation is intercepted by the Railroad live load influence line. The live load influence line is defined as a line originating at the bottom edge of tie and extending downward at a slope of 1 (vertical) on 1½ (horizontal). Such excavations must be designed to withstand, in addition to all common loads such as soil pressure and hydrostatic pressure, a railroad live load of Cooper E-80.

(5) The Contractor shall be required to design and install protective scaffolding over the right-of-way where, at the sole discretion of the Railroad, such scaffolding is necessary to protect the Railroad from possible falling debris; paint or other materials; to protect personnel working about the right-of-way or to provide a platform for personnel, materials and/or equipment. Said scaffolding shall be designed for live load of 200 pounds per square foot applied uniformly over the entire structure and a 2 kips concentrated load placed anywhere on the structure. The two loads are not to be applied simultaneously for design purposes.

(6) All excavation area shall be located by the Contractor and inspected by the Railroad for the purpose of determining conflicts with underground facilities. Exploratory trenches, a minimum of 3 feet deep and 15 inches wide in the form of an "H" with outside dimensions matching and outside of sheeting dimensions are to be hand dug, as directed by the railroad. In some locations, excavations may exceed 3 feet in depth. Specialty excavations such as screw anchors, cat pole foundations, etc will require additional trenching to ensure all possible conflicts are located. These trenches are for exploratory purposes only and are to be backfilled and compacted immediately. All work outlined above must be done in the presence of a Railroad inspector.

(7) Cavities adjacent to sheet piling, created by driving of sheet piling, shall be filled with sand and any distributed ballast must be restored and tampered immediately.

(8) Sheet piling shall be cut off at top of tie during construction and at 3 feet below bottom of tie after construction just prior to completion of back filling.

(9) Plans and calculations for sheeting and scaffolding must be submitted to the Engineer for forwarding to the Railroad for approval prior to construction. Further, plans and calculations must be stamped by a Connecticut registered Professional Engineer.

(f) Requirements for Erection, Demolition and Other Rigging Operations On or Adjacent to Railroad Right-of-Way

The Contractor will be required to furnish the following information to the Engineer or a duly authorized representative thereof, for forwarding to the Railroad Engineer for approval prior to the start of any rigging operation over or adjacent to the Railroad right-or-way:

(1) Plan view showing locations of cranes, boom length and rigging operating radii, with delivery or disposal locations shown.

(2) Crane rating sheets showing crane(s) to be adequate for 150% of the lift. Crane and boom nomenclature is to be indicated.

(3) Plans and computations showing weight of pick.

(4) Location plan showing obstructions, indicating that the proposed swing is possible.

(5) Plans showing locations and details of mats, planking or special decking as may be required by the Railroad.

(6) Written statement from crane owner giving the date of last crane condition and safety inspection and the results of said inspection.

(7) Data sheet listing number, type, size and arrangement of slings, spreader bars or other connecting equipment. Include copies of catalog or information sheets of specialized equipment. All such equipment shall be shown adequate to safely carry 150% of the calculated loading.

(8) A complete procedure is to be included, indicating the order of lifts and repositioning or rehitching of the crane or cranes.

(9) Temporary support of any components or intermediate stages is to be shown.

(10) A time schedule of the various stages must be shown, as well as a schedule for the entire lifting procedure.

(11) All erection, demolition and rigging plans and calculations submitted to the Railroad must be stamped by a Connecticut licensed Professional Engineer.

(12) Operations directly on or adjacent to the operating right-of-way will be performed only at times and under conditions specified by the Railroad's representative.

(g) Ordering Protective Personnel

The Railroad will furnish Protective Service Personnel (conductors, flagmen, groundmen, inspectors, maintenance and/or other railroad personnel deemed necessary) to protect the operation of train traffic during the Contractor's construction activities. Railroad Protective Services will also be provided in conformance with the Roadway Worker's Protective Act as stated in Paragraph 1(c). There will be no charge to the Contractor for Railroad Protective Services provided. The providing or failing to provide Protective Services shall not relieve the Contractor from liability or payment for any damage caused by his or his subcontractor's operations conducted in their absence.

(1) The Contractor must obey all instructions from Railroad representatives on the job site promptly. Failure to follow instructions shall be deemed sufficient cause for closing the job site to the Contractor and its employees.

(2) The Railroad will, at its sole discretion, determine the need for and the availability of protective personnel. The Railroad will provide protective personnel to the extent possible considering its operational and maintenance priorities. The Railroad does not guarantee that protective personnel will be available to meet the Contractor's preferred schedule. Further, no work will commence until the assigned Railroad representative affirmatively advises the Contractor that the necessary protective personnel are stationed and that he may proceed.

(3) The assessment of the need for protective services will be based upon a weekly Railroad Construction Coordination Meeting. At these meetings, the Contractor shall provide a Bi-weekly Schedule that will begin on the following Saturday. Based on that schedule, the Railroad will determine the Protective Services required for the two-week period. Protective Services will be reserved for the following week beginning on the Saturday and ordered for the second week of the schedule. It will be the Contractor's responsibility to perform work in accordance with the submitted schedule. Variations from the submitted schedule may result in additional and unnecessary costs to the Engineer, Railroad and Contractor.

(A) The Contractor shall base his operations on a 5 consecutive day work week. The hours of operation during this time shall remain constant. Multiple shifts may be worked.

(B) The Contractor must demonstrate maximum use of Protective Service Personnel ordered. Failure to do so may result in the inability to consistently obtain services.

(C) The Contractor shall be responsible for forwarding all Protective Service requests from his subcontractors and suppliers in his Bi-weekly schedule submittal.

(4) Requests to cancel construction activities, and subsequently the scheduled Protective Service Personnel, will be also submitted at the weekly Railroad Construction Coordination Meeting. At these meetings, the previously scheduled Protective Services for the week beginning on the following Saturday may be cancelled. This will be the only time for cancellation. Once cancelled, no re-ordering of Protective Services for the following week will be allowed.

(5) Weather conditions will be considered the only basis upon which the Railroad will accept the Contractor's cancellation of scheduled work and will only be recognized on items of work which have been clearly identified and determined to be weather dependent in the Contractor's schedule. Activities not presented on the Bi-weekly schedule at the weekly Railroad Construction Coordination Meeting will not be able to commence until it has been inserted into the schedule and presented at the next meeting.

(6) Work that requires the support of Railroad personnel shall not be scheduled on the following days, unless the work is of an emergency nature:

Holiday's Observed:	*Independence Day	*Christmas Day
*New Year's Day	*Labor Day	*NewYear's Eve
*President's Day	*Thanksgiving Day	
*Good Friday	*Day Following Thanksgiving Day	
*Memorial Day	*Christmas Eve	

* The Saturday and Sunday preceding a Monday holiday.

* The Saturday and Sunday following a Friday holiday.

* The Friday and Monday preceding and following a weekend holiday.

(h) Requirements for Requesting Track Outages

Track outages as described in the plans and specifications must be requested at the weekly Railroad Construction Coordination Meeting.

(1) All procedures, material and equipment must be approved and on site prior to the Railroad accepting the track outage request(s). This applies to all track outage requests.

(2) Track outages will be granted based on need for constructability not for convenience.

(3) The Contractor must demonstrate the maximum use of track outages by coordinating his activities and work so that various elements and multiple activities are performed during approved outages. Failure to consistently utilize track outages may cause the inability to gain approval of future requests for outages.

(4) No new track outages may be initiated the weekend preceding or following these holidays:

Thanksgiving, Christmas and New Year's.

However, long-term continuous outages may extend through these periods.

(i) Catenary and Transmission Systems/Power Outages

(1) Catenary and Transmission Systems - The Contractor shall assume that all the wires on the Railroad Company are energized at all times and must be governed by the restrictions imposed by the Railroad with respect to such electrical circuits. Should it become necessary, in the opinion of the Railroad Engineer to de-energize any wire or wires to insure safety of operation, such wires will be de-energized by the Railroad only during such period that will not interfere with the Railroad's operation. When the de-energizing and re-energizing of wires is deemed necessary, a representative of the Power Department of the Railroad must be on duty and present to arrange for the same. He will notify the Contractor in writing when the wires have been de-energized and also when said wires are to be re-energized.

(A) The Contractor is advised that the overhead electrification will remain in place for the duration of the entire project, except where called for on the drawings and in the specifications.

(B) Track rails of the Railroad are energized. Particular care must be taken to see that no contact is made between adjoining rails with any material, which is a good conductor of electricity when dry, or material of any nature when wet. Particular care is necessary when any work involving the use of chains, steel rods, cables, pipes, etc., is done. Since the Contractor shall assume the wires and rails of the Railroad will be energized at all times, the Contractor shall require all of his employees, sub-contractors, and others to sign a form similar to the form shown in the Contractor Requirements for Work Affecting the Railroad contained within the General Provisions of the Contract.

(2) Power Outages

(A) Catenary Power Outages - A catenary power outage must be scheduled concurrently with a track outage for the track and is restricted to the same periods as specified in the plans and specifications.

(B) Railroad Power and Signal Distribution Feeder Outages - Outages for feeders can be allowed only during off-peak hours. These outages should be requested at the weekly Railroad Construction Coordination Meeting. One set of power and signal feeders, either the north or south side of the railroad, must remain energized at all times.

NOTE: During peak hours (5:00 a.m. to 10:00 a.m. and 3:30 p.m. to 10:00 p.m., Monday through Friday) of railroad traffic, both the north and south sets of power and signal feeders must be energized.

(j) Safety for Contractor's Employees Working on or Adjacent to the Right-of-Way of the Railroad

(1) Personal Protection Equipment

(A) Approved hard hats, reflectorized vest and clothing must be worn by all Contractor employees while on the Right-of-Way, in yard, shop facilities, and construction and/or work sites. Approved safety eyewear must be worn by all Contractor employees while on Right-of-Way, in yard, shop facilities and construction and/or work sites and in the operating control cab of a moving locomotive or train. Any exclusion must be jointly approved by Railroad's department head and Director of Safety.

(B) Other protective equipment such as goggles, face shields, safety belts, floatation vests, gloves and respirators shall be issued by the Contractor when required.

Protection devices for hearing conservation may be used when determined necessary and safe to do so.

(2) Possession or Use of Intoxicants and Illegal Substances

The use of intoxicants, alcohol, narcotics, marijuana, amphetamines, hallucinogens or other illegal substances while working within the Railroad Right-of-Way, is prohibited and is sufficient cause for immediate removal from the Railroad property. Contractor employees under medication before or while on duty, must be certain that such use will not affect the safe performance of their duties.

(3) Surveying Equipment

(A) Measuring tape must be non-metallic to avoid shunting the signal system electric circuits. This will occur when a metallic object is laid across the top of two rails of any track.

(B) Electrically rated fiberglass elevation rods must be used to avoid injury in the event contact is made with energized catenary or signal/communication lines. Elevations of catenary wires must be obtained by or under direct supervision of a qualified Railroad Groundman.

(4) Conduct On or About Track

(A) Contractor employees must not enter the track envelope unless it is absolutely necessary in performance of their duty. If it is deemed necessary, than the Contractor employees must walk on tracks or cross tracks only when accompanied by or with permission from a Qualified Railroad Employee of the Railroad. Always use approved walkways when available; otherwise identify and take the shortest safe route after looking in both directions. If more than one track is to be crossed, stop and look before crossing each track.

(B) The possession of an umbrella on or about tracks is prohibited.

(C) Do not rest any object on your shoulder while in close proximity to a moving train or high-rail equipment.

(D) Expect equipment to move on any track, in any direction, at any time. Contractor employees must look in both directions and have permission from a Qualified Railroad Employee before:

1. Fouling track
2. Crossing track
3. Going between or around end of equipment or structure

4. Moving out from between or under equipment of structure
5. Getting on or off equipment
6. Performing any other applicable operation

(E) When required by a conductor/flagman or other Qualified Railroad Employee to vacate tracks, the Contractor employees must comply immediately.

(5) Catenary Electric Systems

(A) All overhead wires must be considered energized (LIVE) at all times except when it is known they have been de-energized and properly grounded.

(B) Until the wires are de-energized, properly grounded, and a Groundman has notified that the overhead wires are such, all Contractor employees must not approach within 10 feet of transmission systems wires, catenary system or signal power wires.

(C) At the beginning of each tour of duty, the Groundman will instruct the Contractor foreman and each Contractor employee, in the crew, of the dangers surrounding them, calling their particular attention to any hazards to be avoided in performance of the work.

(D) Whether due to inadequate knowledge of the English language or for any other reason, a Contractor employee who, in the opinion of the Groundman, does not understand the instructions given, shall not be permitted to work or observe.

(E) When clearances have been obtained and the wires, equipment or apparatus properly grounded, the Groundman will indicate to the Contractor foreman and the crew the location of wires, equipment or apparatus from which power has been removed and the location of the grounding devices applied. The Groundman must obtain on standard form, the signature of the Contractor foreman indicating that he and the crew have been so instructed, and will confine their work within the limits as outlined to them by the Groundman.

(F) When the Groundman leaves his crew for any reason, he must notify the Contractor foreman and each person in the crew to stop all work in the vicinity of the wires, personally assuring himself that all persons have moved to a safe distance away from the work area before his departure. The Groundman will obtain the signature of the Contractor foreman on standard form, that he and the crew have been informed that the Groundman is leaving the gang and they will not resume work until advised to do so on return of the Groundman.

(G) When the clearances are to be released, the Groundman will inform the Contractor foreman and each person in the crew and will personally observe that all persons have moved to a safe distance from the wires, equipment or

apparatus to be energized, before removing the grounding devices. The Groundman will obtain the signature of the Contractor foreman, on a standard form, stating that he and the gang have been advised that the wires, equipment or apparatus have been energized, and that they will remain at a safe distance from them until informed otherwise by the Groundman.

(H) The Groundman will inform the Contractor foreman if any Contractor employee on the job is unsafe and will not comply with instructions. If trouble is experienced with the Contractor foreman in maintaining safe working conditions, the Groundman will immediately notify his supervisor.

(6) Aerial Catenary Construction by Qualified Contractor Employees

(A) Aerial catenary work addressed in this Section shall include all overhead wire work shown in the contract.

(B) Aerial catenary work by the Contractor shall be done in accordance with the Railroad's safety rules and in accordance with the National Electric Safety Code. Failure to comply with these rules could result in removal of "Qualified" privileges and or removal from the project.

(C) Due to the specialty nature of the work, limited construction periods available, and high quality of work required, the aerial catenary construction is to be done only by qualified Contractor employees (except as outlined in section (E). Only Contractor employees that meet the requirements of the International Brotherhood of Electrical Worker's standards for Journeyman Lineman and who have successfully completed a Metro-North power orientation class shall be considered a Qualified Employee. The Power orientation class will be given periodically and will require less than one-half day to complete. Approval for qualification shall be determined by Metro-North and that approval shall not be unreasonably withheld.

(D) Metro-North approved Journeyman Lineman shall be issued identification as workers qualified to perform aerial catenary work. Qualified Contractor employees shall work according to the Railroad's MN-290 Electrical Operating Instructions. Metro-North approved Journeyman Lineman are authorized and expected to work within 3 feet of 13.5 kV energized overhead catenary. Contractor employees shall not de-energize circuits, place initial grounds, or provide protection for others.

(E) Apprentice Lineman shall be permitted to assist qualified Journeyman Lineman and work under their direct supervision within the following guidelines:

i. The number of apprentice linemen allowed to work on the catenary will be one less than the total number of Metro-North Railroad Power Department

Class "A" employees assigned to each contractor work operation. Additional groundmen will not be assigned to facilitate the use of Apprentices. (ex. 3,5 men crews are working a section of wire removal under the power outage protection of 2 Metro-North Railroad Power Department Class "A" employees, This contractor work operation can utilize one apprentice lineman.)

ii. No additional track or power outages shall be granted for the protection of apprentice Linemen.

iii. The Apprentice Linemen shall maintain an extended reach minimum approach distance of 10 feet to all railroad transmission wires, Catenary system, and signal power wires until such wires are de-energized, tested for potential, properly grounded, and proper protection afforded by a qualified Power Department Class "A" employee.

iv. The Contractor and his Safety Officer shall enforce the minimum approach distances and submit to the engineer a program to monitor and audit compliance of this procedure.

Apprentice Lineman are prohibited from coming closer than 10 feet from all overhead wires or circuits regardless of whether they have been de-energized or not.

(7) Safety Program and Plan

(A) Prior to the commencement of work the Contractor shall submit a "Working on the Railroad Safety Plan" that will include a Program which implements the plan. The submission shall be made to the Engineer or a duly authorized representative and forwarded to the Railroad for compliance with this specification. This plan is separate to the Health and Safety Plan required for other aspects of the project (i.e., lead, excavations, etc.).

(B) Each employee of the Contractor, subcontractor or others on site shall be given an initial Railroad Safety Training session administered by a Railroad Safety Representative prior to being allowed to work on the project. All employees receiving this training will receive a Registered Hard Hat sticker that will identify them as a trained employees.. No Contractor employees are permitted on the Railroad Right-of-Way without evidence of this training. Contractor employees shall renew this training annually. The training session will be held on the Railroad Right of Way or conducted at a location mutually agreed upon between the Railroad Safety Representative and the Contractor. At this session the following will be furnished to the employee:

1. Safety Orientation for Contractor Employees Working on Railroad Property produced by the Safety Engineer of the Railroad.
2. Safety Inspection Checklist
3. List of the applicable publications referenced in these specifications with respect to safety and where they are located for review if necessary. The list shall include, but not be limited to, such regulatory standards and mandates, i.e., OSHA, NIOSH, DOL, NFPA, EPA, FRA, MSDS, etc.
4. Copy of the applicable corporate safety plan.
5. Copy of the project Railroad Safety Plan or other project related plans.

NOTE: The employee shall sign the standard form for acknowledgement of the above-noted documents.

(C) All contractor employees entering the railroad right-of-way must attend and acknowledge the daily job briefings prior to commencing any work. The qualified railroad employees will conduct the job briefings.

(D) The Contractor shall hold "TOOL BOX" safety meetings for their employees at least once a week that will be documented and attendees listed.

(E) The Contractor supervisor shall attend a monthly Railroad Safety Meeting.

2. Insurance Requirements – Metro-North Railroad

The Contractor engaged in work on the project shall be required to comply with the requirements set forth under Article 1.03.07 – Insurance of the Specifications Form 816, its supplements and special provisions contained herein.

3. Cost Associated with this Specification

(a) There shall be no direct payment for compliance to this specification. All costs associated with any regulatory requirements, traffic regulation, specification administration, coordination, materials and incidentals required to fulfill the requirements of this specification will be considered as included in the general cost of the work and distributed in all items.

(b) Any work, material's supplied, inspections and protective services by the Railroad as described in the plans and specification, expressly needed for the construction of the project, will be compensated to the Railroad by the Engineer under a separate agreement."

SECTION 1.06 - CONTROL OF MATERIALS

Article 1.06.01 - Source of Supply and Quality:

Delete the last paragraph and replace with the following:

For the following items the Contractor shall submit a complete description of the item, together with eight (8) copies of shop drawings, cuts and other descriptive literature which completely illustrates such items presented for formal approval. Such approval shall not change the requirements for a certified test report, materials certificate and certificate of compliance as may be called for.

Light Standards
- Conductors
- Luminaires
- Conduit
- Cable In Duct
- Fuses and Fuse Holders
- Precast Foundation
- Temporary Illumination Unit
- Aerial Cable
- Handhole
- Junction Box

Required catalog cuts for all items listed above shall be submitted in one package at the same time. All approvals or disapprovals and comments will be returned in one package.

When required by the contract documents or when ordered by the Engineer, the Contractor shall prepare and submit eight (8) sets of catalog cuts and/or shop drawings for all **illumination items** in one package at the same time to the following for approval prior to ordering or fabrication.

Mr. Gregory Dorosh
Principal Engineer – Facilities Design
Bureau of Engineering and Construction
Connecticut Department of Transportation
P.O. Box 317546
Newington, Connecticut 06131-7546

Incident Management System (IMS) Items:

For the following items required for the Incident Management System, the Contractor shall submit a complete description of the item, together with either in paper (hard copy) form or in an electronic portable document format (.pdf) one (1) copy of shop drawings, cuts, data sheets and other descriptive literature which completely illustrates such items presented for formal approval.

Such approval shall not change the requirements for a certified test report, and materials certificate as may be called for.

Approval of the Shop Drawings and catalog cuts shall not change the requirements for a certified test report, materials certificate and certificate of compliance as may be called for.

Shop drawings shall be submitted on 8-1/2 inch by 11 inch sheets, 11 inch by 17 inch sheets or on 24 inch by 36 inch standard plan sheets. Shop drawings and data sheets shall be required for, but not limited to the following

- _ Structural supports
- _ Surface Mounted Conduit and Appurtenances
- _ Conduit, pulling tape, supports, brackets, hangers, clamps and any hardware involved with the supports and including complete fabrication details.
- _ Field fastener details including chemical and mechanical anchors
- _ Hand holes and covers
- _ Pullboxes and pullbox covers
- _ Fiber Optic Modems
- _ Camera Assembly. Schematics of the wiring between the camera and the equipment cabinet shall also be provided.
- _ Camera power supply
- _ Camera Video Cables, Data Cables, Power Cables and Connectors
- _ Traffic Flow Monitors
- _ Cast Iron Handhole Cover
- _ Cast Iron Junction Box
- _ Fiberglass Junction Box
- _ Traffic Management System Cabinets
- _ Traffic Management System Mini-hub Cabinets
- _ Auxiliary Termination Cabinets
- _ Transformers
- _ Steel CCTV Poles
- _ Camera Lowering Device Assembly
- _ Remote Control Flashing Lights
- _ Service Cabinets
- _ Meter Sockets
- _ Conductors
- _ Fiber Optic Cable
- _ Fiber Patch Cords
- _ Fiber Optic Connectors
- _ Fiber Optic Splice Enclosures
- _ Optical Fiber Termination Patch Panels
- _ Optical Video/Data Transmitter
- _ Optical Video/Data Receiver

- _ Network Customer Service Unit
- _ Video encoders and de-coders
- _ Surge Panels
- _ Ethernet switch
- _ Ethernet Port Sharing Device
- _ Cat 6 Cable
- _ CCTV Coax Cable
- _ Coax Cable Connectors
- _ CCTV Twisted Pair cable
- _ CCTV Twisted pair connectors
- _ RJ 45 and RJ 48 Connectors
- _ Modify Existing Operations Center Control System including all materials, schematics, diagrams and drawings.
- _ Motorists Aid Variable Message Signs, cabinets, cables, diagrams, schematics etc.

Required catalog cuts for all items listed above shall be submitted in one package at the same time. All approvals or disapprovals and comments will be returned in one package.

Please forward to:

Mr. John F. Korte
Connecticut Department of Transportation
Highway Operations Section
2800 Berlin Turnpike
P.O. Box 317546
Newington, Connecticut 06131-7546

Article 1.06.05 - Shipping Materials: Add the following:

All vehicles transporting materials on highways and bridges in the State shall comply with all the vehicle regulations of the Connecticut General Statutes and regulations of Connecticut State Agencies as they apply to vehicle length, width, height and weight.

Any vehicle, either loaded or unloaded, will not be allowed to travel across any bridge or on any highway when such vehicle exceeds the legal limits or posted limits of such bridge or highway without a permit. The owner of the vehicle must apply to the Department for a permit for such travel, as provided in the statutes.

The General Statutes include the following limitations:

> Vehicle Width (Section 14-262(a)(1)) - The width of a vehicle and combination vehicle and trailer, including its load, is limited to 8.5 feet (2590 mm), without a permit.

Vehicle Length (Section 14-262(c)) - The length of the semitrailer portion of a tractor-trailer unit, including its load, is limited to 48 feet (14,630 mm), without a permit.

Vehicle Height (Section 14-264) - The height of a vehicle, with its load, is limited to 13.5 feet (4110 mm) without a permit, excepting on Atlantic Street the vehicle height shall not exceed 12'-4" (320mm).

Vehicle Weight (Section 14-267a(b)(7)) - The gross vehicle weight (weight of vehicle including its load) is limited to 40 tons (36,280 kg) on 5 axles for vehicles with a 51 foot (15,540 mm) wheelbase, without a permit.

Axle Weights of Vehicles (Section 14-267a) – For the above five axle vehicle, weight on a single axle may not exceed 11 tons (10,160 kg) or in the case of axles spaced less than 6 feet (1828 mm) apart, 9 tons (8160 kg).

On Department projects, in accordance with the Commissioner's policy, any member or component, either temporary or permanent, that measures 120 feet (36,570 mm) or less and weighs no greater than 60 tons (54,430 kg), is transportable via an authorized permit route established by the Department provided the individual axle weights on the vehicle and trailer transporting the member or component do not exceed 20,000 lb. (9070 kg).

Members and components, shown in the contract documents, that exceed the above length and weight limits have been reviewed by the Department's Oversize and Overweight Permits Section and are transportable via an authorized permit route established by the Department provided the individual axle weights on the vehicle and trailer transporting the member or component do not exceed 20,000 lb.

All permits to transport materials are subject to shipping times established by the Department's Oversize and Overweight Permits Section.

Applications for permits, required to transport materials, shall be submitted a minimum of two weeks prior to their required use, to the Department's Oversize and Overweight Permits Sections.

Article 1.06.07 - Certified Test Reports and Materials Certificate

1. For the materials in the following items, a Certified Test Report will be required confirming their conformance to the requirements set forth in these plans or specifications or both. Should the consignee noted on a Certified Test Report be other than the Prime Contractor, the Materials

Certificates shall be required to identify the shipment.

Item # 508: Shear Connectors
Materials: Welded Studs

Item # 601: Asphaltic Plug Expansion Joint System
Materials: Backer Rod
Binder Material

Item # 601: Class "F" Concrete
Material: Joint Sealer (Sealant conforming to listed Federal Specifications)

Item # 602: Deformed Steel Bars (Epoxy Coated)
Materials: Epoxy Resin Coating

Item # 603: Structural Steel
Materials: Longitudinal Charpy V-Notch Tests
Welding Electrodes
Each Paint Coating

Item # 822: Temporary Precast Concrete Barrier Curb (Structure)
Material: Chemical Anchor Materials

Illumination Items
Light Standards
Conductors
Cable in Duct
Anchor Bolts
Aerial Cable
Temporary Illumination Unit

2. For the materials in the following items, a Materials Certificate will be required confirming their conformance to the requirements set forth in these plans or specifications or both.

Item # 511: Polyvinyl Chloride Plastic Pipe Weepholes
Materials: PVC Pipe
Solvent Cement
Non-Shrink Grout

Item # 601: Modify Bridge Parapet
Materials: Chemical Anchor Material

Item # 60l: Asphaltic Plug Expansion Joint System
Materials: Complete Proprietary System

Item # 601: Class "F" Concrete

Materials: Joint Sealer

Item # 602: Drilling Holes and Grouting Dowels and Anchor Bolts
Materials: Non-Shrink Grout Anchorage Materials

Item # 603: Field Touch-Up Painting
Materials: Paint

Item # 603: Structural Steel
Materials: Each Paint Coating

Item # 822: Temporary Precast Concrete Barrier Curb (Structure)
Materials: Concrete Reinforcing Anchor Bolts, Nuts & Washers

Illumination Items:

Light Standards
- Conductors
- Cable in Duct
- Luminaires
- Conduit
- Anchor Bolts
- Service Items

Aerial Cable
Temporary Illumination Unit

SECTION 1.07 - LEGAL RELATIONS AND RESPONSIBILITIES

Article 1.07.05 - Load Restrictions:

Delete all three paragraphs and replace them with the following:

"(a) Vehicle Weights: This sub article will apply to travel both on existing pavements and pavements under construction. The Contractor shall comply with all legal load restrictions as to vehicle size, the gross weight of vehicles, and the axle weight of vehicles while hauling materials. Throughout the duration of the contract, the Contractor shall take precautions to ensure existing and newly installed roadway structures and appurtenances are not damaged by construction vehicles or operations.

Unless otherwise noted in contract specifications or plans, on and off road equipment of the Contractor, either loaded or unloaded, will not be allowed to travel across any bridge or on any highway when such a vehicle exceeds the statutory limit or posted limit of such bridge or highway. Should such movement of equipment become necessary the Contractor shall apply for a permit from the Department for such travel, as provided in the Connecticut General Statutes (CGS). The movement of any such vehicles within the project limits or detour routes shall be submitted to the Engineer for project record. Such permit or submittal will not excuse the Contractor from liability for damage to the highway caused by its equipment.

The Contractor is subject to fines, assessments and other penalties that may be levied as a result of violations by its employees or agents of the legal restrictions as to vehicle size and weight.

(b) Storage of Construction Materials/Equipment on Structures: Storage is determined to be non-operating equipment or material. The Contractor shall not exceed the statutory limit or posted limit for either an existing or new structure when storing materials and/or construction equipment. When a structure is not posted, then the maximum weight of equipment or material stored in each 12 foot wide travel lane of any given span shall be limited to 750 pounds per linear foot combined with a 20,000 pound concentrated load located anywhere within the subject lane. If anticipated storage of equipment or material exceeds the above provision, then the Contractor shall submit his proposal of storage supported by calculations stamped by a Professional Engineer registered in the State of Connecticut, to the Engineer for approval 14 days prior to the storage operation. Operations related to structural steel demolition or erection shall follow the guidelines under Section 6.03. All other submittals shall include a detailed description of the material/equipment to be stored, the quantity of storage if it is stockpiled materials, the storage location, gross weight with supporting calculations if applicable, anticipated duration of storage, and any environmental safety, or traffic protection that may be required. Storage location on the structure shall be clearly defined in the field. If structures are in a state of staged construction or demolition, additional structural analysis may be required prior to authorization of storage."

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."

Article 1.07.13 - Contractor's Responsibility for Adjacent Property, Facilities and Services is supplemented as follows:

The following company and representatives shall be contacted by the Contractor to coordinate the protection of their utilities on this project 30 days prior to the start of any work on this project involving their utilities:

Aquarion Water Company of Connecticut
Mr. Carlos Vizcarrondo,
Relocations Coordinator
600 Lindley Street
Bridgepott, CT 06606
PHONE: (203) 337-5950 E-MAIL: cvizcarrondo@aguarionwater.com

Cablevision of Connecticut, LP
Mr. George Rebentisch,
Construction Manager
122 River Street
Bridgeport, CT 06604
PHONE: (203) 696-4765 E-MAIL: grebenti@cablevision.com

Northeast Utilities Service Company
Mr. Michael Parillo,
NU Representative
Northeast Utilities (Eversource)
Norwalk, CT 06851
PHONE:(203)977-4203 EMAIL: michael.parillo@nu.com

Northeast Utilities Service Company
Mr. Wayne D. Gagnon,
Engineering Manager - System Projects
107 Selden Street
Berlin, CT 06037
PHONE: (860) 665-2473 E-MAIL: gagnowd@nu.com

Northeast Utilities Service Company- Transmission Department
Mr. Daniel J. Garstka,
Senior Engineer - Transmission Siting
56 Prospect Street
Hartford, CT 061 03
PHONE: (860) 728-4533 E-MAIL: garstdj@nu.com

The Southern New England Telephone Company, dba Frontier Communications of Connecticut
Mr. Eric Clark,
Construction Manager - Statewide Structure Access
1441 North Colony Road
Meriden, CT 06450-1979
PHONE: (203) 238-7407 E-MAIL: erc532@ftr.com

Stamford Water Pollution Control Authority
Mr. William P. Brink, P.E., BCEE
Executive Director
111 Harbor View Avenue
Stamford, CT 06902-5913
PHONE: 203-977-5809 E-MAIL: wbrink@ci.stamford.ct.us

Verizon Business Network Services, Inc.
Stephen Parretti
Senior Engineer
P.O. Box600
Charlton, MA 01507
PHONE: 774-289-9304 E-MAIL: Stephen.parretti@verizonbusiness.com

Yankee Gas Services Company (Eversource)
Mr. Steven P. Testa,
Construction Manager
107 Selden Street, Mail Stop: NUS2
Berlin, CT 06037
PHONE: (860) 665-6214 E-MAIL: Steven.Testa@nu.com

City of Stamford Traffic
Mr. Mani Poola
Traffic Engineer
Government Center 7th Floor
888 Washington Boulevard
Stamford, CT. 06904
PHONE: (203) 977-4237 E-MAIL: MPoola@ci.stamford.ct.us

City of Stamford
Ms. Nancy Pipicelli
Street Lighting Administrator
City of Stamford
Stamford, CT 06901
PHONE: (203) 977-4203 E-MAIL: NPipicelli@ci.stamford.ct.us

All work shall be in conformance with Rules and Regulations of the Public Utility Regulatory Authority (PURA) concerning Traffic Signals attached to Public Service Company Poles.

SECTION 1.08 – PROSECUTION AND PROGRESS

Article 1.08.01 – Transfer of Work or Contract: *Add the following after the last paragraph:*

The Contractor shall pay the subcontractor for work performed within thirty (30) days after the Contractor receives payment for the work performed by the subcontractor. Also, any retained monies on a subcontractor's work shall be paid to the subcontractor within thirty (30) days after satisfactory completion of all the subcontractor's work.

For the purpose of this Item, satisfactory completion shall have been accomplished when:

(1) The subcontractor has fulfilled the contract requirements of both the Department and the subcontract for the subcontracted work, including the completion of any specified material and equipment testing requirement or plant establishment period and the submission of all submittals (i.e.: certified payrolls, material samples and certifications, required state and federal submissions, etc.) required by the specifications and the Department, and
(2) The work done by the subcontractor has been inspected and approved by the Department and the final quantities of the subcontractor's work have been determined and agreed upon.

If the Contractor determines that a subcontractor's work is not complete, the Contractor shall notify the subcontractor and the Engineer, in writing, of the reasons why the subcontractor's work is not complete. This written notification shall be provided to the subcontractor and the Engineer within twenty-one (21) days of the subcontractor's request for release of retainage.

The Engineer will institute administrative procedures to expedite the determination of final quantities for the subcontractor’s satisfactorily completed work.

The inspection and approval of a subcontractor's work does not eliminate the Contractor's responsibilities for all the work as defined in Article 1.07.12, "Contractor's Responsibility for Work."

The inspection and approval of the subcontractor’s work does not release the subcontractor from its responsibility for maintenance and other periods of subcontractor responsibility specified for the subcontractor’s items of work. Failure of a subcontractor to meet its maintenance, warranty and/or defective work responsibilities may result in a finding that the subcontractor is non-responsible on future subcontract assignments.

For any dispute regarding prompt payment or release of retainage, the alternate dispute resolution provisions of this article shall apply.

The above requirements are also applicable to all sub-tier subcontractors and the above provisions shall be made a part of all subcontract agreements.

Failure of the Contractor to comply with the provisions of this section may result in a finding that the Contractor is non-responsible on future projects.

Article 1.08.03 – Utility Schedules – Add the following: Eversource Electric Distribution, Aquarion Water Company, Frontier Communications, Eversource Gas Work Schedules

rev. 5/20/2013	UTILITY WORK SCHEDULE		
CTDOT Project Number:	135-301	Town:	Stamford
Project Description:	CTDOT Reconstruction of Atlantic St		
CTDOT Utilities Engineer:	Derek Brown		
Phone: 860-594-2555		Email:	Derek.Brown@ct.gov
Utility Company:	The Connecticut Light and Power Company		
Prepared By:	Michael Parillo	Date Prepared:	07/07/2014
Phone: 203-352-5431		Email:	michael.parillo@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.

Install Approximately 1550' of 12 Position, 5" PVC Duct Bank amongst 10 Manholes (6 New). Civil work on South State St and Atlantic St was assumed to take 1 day for 50' of installed duct bank, and on Manhattan St, 1 day for 25' of installed duct bank. All MH Installations were assumed to take 3 days per location using information contained on the latest drawing forwarded to CL&P via email on 6/10/14. All CL&P work outside of the re-route of the 1G16 feeder cannot begin until the completion of the 2 pipe jacks underneath the MNRR railroad.

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..

- June 1 - Sept. 1 is the Summer Moratorium. No Cutover can be planned during this period.
- Attached schedule assumes 40 hr work week, 8 or 10 hour work days.
- Weather dependant and assumes no weather extremes
- Assumes no road closures
- Assumes no coordination with MNRR or MNRR Flaggers
- Assumes minor to moderate ledge during civil work
- Assumes no delay with AT&T or other utility facility conflicts during inst./transfer of cable
- Favorable Elec. Distrib. operating condition for cable cutover with other CL&P Capital Work
- Assuming the abandoning of 4 existing MH's and associated duct in vicinity of MNRR bridge

UTILITY WORK SCHEDULE

CTDOT Project Number:	135-301		
Utility Company:	The Connecticut Light and Power Company		
Prepared By:	Michael Parillo	Total Calendar Days:	140

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)
NA	Notice to Proceed	NONE	
NA	State contractor marking out critical elevations /project landmarks (i.e curblines / retaining wall)	Notice to Proceed	
NA	Acquire Town/State Permits & Order Material	Notice to Proceed	21
303 + 00 - 301 + 00	Inst. 200' of 12 Position duct bank from Existing MH 503 to New MH EE (CIVIL ONLY). Install MH EE.	42"/48" RCP/Steel Pipe Jack Install Completion	15
303 + 00 - 301 + 00	Inst. 200' of 12 Position duct bank from Existing MH 502 to New MH FF (CIVIL ONLY). Install MH FF.	42"/48" RCP/Steel Pipe Jack Install Completion	15
505 + 00 - 508 + 50	Inst. 350' of 12 Position duct bank from New MH CC to New MH AA (CIVIL ONLY). Install MH CC.	42"/48" RCP/Steel Pipe Jack Install Completion	14
508 + 50 - 512 + 00	Inst. 350' of 12 Position duct bank from New MH AA to Existing MH 500 (CIVIL ONLY). Inst. MH AA.	42"/48" RCP/Steel Pipe Jack Install Completion	14
510 + 50 - 512 + 00	Inst. 150' of 12 Position duct bank from New MH DD to New MH BB (CIVIL ONLY). Install MH DD.	42"/48" RCP/Steel Pipe Jack Install Completion	8
205 + 00 - 208 + 00	Inst. 300' of 12 Position duct bank from New MH BB to Existing MH 17 (CIVIL ONLY). Inst. MH BB.	42"/48" RCP/Steel Pipe Jack Install Completion	11
303 + 00 - 301 + 00 505 + 00 - 512 + 00	Pull Cable from MH 503 to MH 500 & Complete Cutover of 1G05 Cirucit	Civil Completion	21
303 + 00 - 301 + 00 505 + 00 - 512 + 00	Pull Cable from MH 503 to MH 500 & Complete Cutover of 1G08 Cirucit	1G05 Cutover Completion	21

UTILITY WORK SCHEDULE

CTDOT Project Number:	135-301		
Utility Company:	The Connecticut Light and Power Company		
Prepared By:	Michael Parillo	Total Calendar Days:	203

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)
303 + 00 - 301 + 00 505 + 00 - 512 + 00	Pull Cable from MH 503 to MH 500 & Complete Cutover of 1G12 Cirucit	1G08 Cutover Completion	21
303 + 00 - 301 + 00 505 + 00 - 512 + 00	Pull Cable from MH 503 to MH 500 & Complete Cutover of 1G09 Cirucit	1G12 Cutover Completion	21
303 + 00 - 301 + 00 505 + 00 - 512 + 00	Pull Cable from MH 503 to MH 500 & Complete Cutover of 1G01 Cirucit	1G09 Cutover Completion	21
303-301,512-510+50 205 + 00 - 208 + 00	Pull Cable from MH 502 to MH 17 & Complete Cutover of 1G14 Cirucit	1G01 Cutover Completion	21
303-301,512-510+50 205 + 00 - 208 + 00	Pull Cable from MH 502 to MH 17 & Complete Cutover of 1G11 Cirucit	1G14 Cutover Completion	21
303-301,512-510+50 205 + 00 - 208 + 00	Pull Cable from MH 502 to MH 17 & Complete Cutover of 1G03 Cirucit	1G11 Cutover Completion	21
303-301,512-510+50 205 + 00 - 208 + 00	Pull Cable from MH 502 to MH 17 & Complete Cutover of 1G06 Cirucit	1G03 Cutover Completion	21
303-301,512-510+50 205 + 00 - 208 + 00	Pull Cable from MH 502 to MH 17 & Complete Cutover of 1G07 Cirucit	1G06 Cutover Completion	21
303-301,512-510+50 205 + 00 - 208 + 00	Pull Cable from MH 502 to MH 17 & Complete Cutover of 1G10 Cirucit	1G07 Cutover Completion	21
Out of Project Boundaries	Pull Cable from MH 502 to MH 13 & Complete Cutover of 1G16 Cirucit	NONE	14

rev. 5/20/2013

UTILITY WORK SCHEDULE

CTDOT Project Number:	135-326	Town:	Stamford
Project Description:	Replacement of MNRR Bridge over Atlantic Street - Phase 1		
CTDOT Utilities Engineer:	Derek Brown		
Phone: 860-594-2555		Email:	Derek.Brown@ct.gov

Utility Company:	Aquarion Water Company of Connecticut		
Prepared By:	Carlos J. Vizcarrondo	Date Prepared:	Jun-15
Phone: 203 337-5950		Email:	cvizcarrondo@aquarionwater.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.

The Aquarion Water Company will utilize the State's Contractor to cut, plug and abandon water mains in Manhattan Street (8") and South State Street (12") that are in conflict with utility and storm drainage work proposed under Project 135-326. The abandoned 8" water main in Manhattan Street will not be replaced. Approximately 835 feet of 12" water main in South State Street will be replaced by the State's Contractor extending from Canal Street westerly toward the limit of construction for future Project 135-301 on Atlantic Street.

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..

There are no building services on the water main segments to be abandoned. There are two hydrants connected to the water main in South State Street. Maintenance of fire flow to these hydrants is mandatory unless approved in writing by the City of Stamford.

UTILITY WORK SCHEDULE

CTDOT Project Number: 135-326

Utility Company: Aquarion Water Company of Connecticut

Prepared By: Carlos J. Vizcarrondo Total Calendar Days: 23

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)
301+45 Manhattan	Cut and Cap Existing 8 inch Water Main.	None.	2
302+75 Manhattan	Cut and Cap Existing 8 inch Water Main.	None.	2
510+90 South State	Cut and Cap Existing 12 inch Water Main.	None.	2
520+35 South State	Cut and Cap Existing 12 inch Water Main. Abandon 12 inch Water Main in South State Street.	None.	2
521+50 Canal Street	Offset 16 inch Water Main to 1.5 feet below proposed Storm Drain.	To be completed in conjunction with Storm Drain installation.	5
512+00 To 520+35	Install 835 feet of new 12 inch Water Main along South State Street.	State Contractor to excavate roadway to bottom of subgrade for water company.	10

UTILITY WORK SCHEDULE

CTDOT Project Number:	135-301/326		
Utility Company:	Frontier Communications		
Prepared By:	Kenneth L. Sherman	Total Calendar Days:	150

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)
205+75	Test Pits to determine new manhole #331 for rebuild size that can fit.	Receiving funding and permits	2
511+05	Test Pits to determine new manhole size that can fit.		2
302+10	Test Pits to determine new manhole size that can fit.		2
203+00	Test Pits to determine new manhole size that can fit.		2
208+58 to 205+75	New duct structure (4-4"P) from manhole #17 to new manhole #331.	Frontier Communications to rebuild mh #331 first.	6
205+75	Breakout old conduit structures, removal existing manhole #331.		33
205+75 to 511+05	Install new manhole #331 and lower ex. Conduits and place new conduits to new manhole on South State St.		58
511+05	Install new manhole on South State Street. Breakout and shift existing structures.		4
* 511+05 to 302+10	Install conduits and spacers in boring caisson.	State Contractors must be completed with bore.	see below
302+10	Install new manhole on Manhattan Street. Breakout and shift existing structures.	Eversource must be out of their old duct structure	9
	*NOTE: AT&T work in this area		32

UTILITY WORK SCHEDULE

CTDOT Project Number:	135-301/326		
Utility Company:	Frontier Communications		
Prepared By:	Kenneth L. Sherman	Total Calendar Days:	184

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)
203+00	Install new manhole on Atlantic Street. Breakout and shift existing structures.		6
302+10 to 203+00	Lower and shift ex. Conduits, place new Conduits to new MH on Manhattan St. to new MH on Atlantic St.		28
203+00 to 201+45	Lower and shift ex. Conduits into new MH on Atlantic St.		7
204+90	Abandon-in-Place Manhole #25 (brick) in place lower 3' below existing grade		2
203+80	Abandon-in-Place Manhole #18 (brick) in place lower 3' below existing grade		2
203+60	Abandon-in-Place Manhole #598 (brick) in place lower 3' below existing grade		2
108 to 302	Place cables from MH #331 Atlantic Street to new MH on Manahatten Street	Conduit work completed	25
302 to 203	Place cable from new MH on Manhattan to new MH on Atlantic Street aouth of RR bridge.	Conduit work completed	2
108	Splice new cables into existing at new MH #331	Cables being placed	50
302	Splice new cables into existing at new MH on Manhattan Street	Cables being placed	55
203	Splice new cables from New MH on Manhattan Street to New MH on Atlantic south of RR Bridge	Cables being placed	5

Article 1.08.04 – Limitations of Operations – Add the following:

TIME RESTRICTIONS

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 that will interfere with described traffic operations on all project roadways as follows:

On the following State observed Legal Holidays:
New Year's Day
Good Friday, Easter*
Memorial Day
Independence Day (except during the period Thursday July 4, 2019 to Friday July 12, 2019 Atlantic street and South State Street can be closed to traffic)
Labor Day
Columbus Day
Thanksgiving Day**
Christmas Day

The following restrictions also apply:

On the day before and the day after any of the above Legal Holidays.

On the Friday, Saturday and Sunday immediately preceding any of the above Holidays celebrated on a Monday.

On the Saturday, Sunday and Monday immediately following any of the above Holidays celebrated on a Friday.

* From 6:00 p.m. the Thursday before the Holiday to 8:00 p.m. the Monday after the Holiday.

** From 6:00 a.m. the Wednesday before the Holiday to 8:00 p.m. the Monday after the Holiday.

During all other times

Atlantic Street, South State Street, Canal Street, Manhattan Street and all other roadways
Monday through Friday between 5:00 a.m. and 9:00 a.m. and between 3:00 p.m. and 8:00 p.m. and Saturday and Sunday between 10:00 a.m. and 6:00 p.m.

To accommodate construction of the MNR Bridge and lowering of Atlantic Street, South State Street and Manhattan Street, the Contractor will be allowed to close the roadways and detour traffic around the site in accordance with the detour routes in the Maintenance and Protection of Traffic Plans during night time periods starting at 9:00 pm and ending at 5:00 AM the following day and weekends extending from Friday 9:00 PM to Monday 5:00AM.. The detour shall not take place during a Holiday period.

The Contractor will be allowed to halt traffic for a period not to exceed 10 minutes to mobilize equipment or to receive deliveries during off peak travel periods with the approval of the Engineer.

For other work as shown on the Maintenance and Protection of Traffic Plans or as approved by the Engineer the Contractor may implement the detour routes for road closures as shown in the plans. The Contractor shall notify the Engineer at least 30 days in advance of the start of the roadway closure.

The Contractor shall bear responsibility for becoming informed of any City of Stamford Holidays and other restricted periods, which may affect the work schedule (winter moratoriums, Thanksgiving Day Parade and parade preparation period which normally consists of the two week period prior to the parade).

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.

Atlantic Street, South State Street and Manhattan Street
After full width is of South State Street is constructed, the SPMT roll in will be performed over the period of June 28, 2019 to July 5, 2019. During this period Atlantic Street and South State Street will be closed.

After the new Bridge is in place, Stage 3 roadway work lowers Atlantic Street, South State Street and Manhattan Street. Over the initial period, until the vertical clearance between the new bridge and roadway is increased to at least the existing posted clearance of 12’-4”, Street the Contractor shall close Atlantic Street and South State Street. To complete the lowering, the work shall proceed by incremental lowering during off peak traffic periods.

Contractor Requirements for Work Affecting the Railroad

In general, unless otherwise authorized by the Railroad, the Contractor’s construction activities and operations directly over and/or adjacent to the operating railroad right-of-way can be performed only during the following track outage periods shown below.

Where the availability of four track outages are indicated in sections 2(a) and 2(b) below, one of the adjacent tracks will not be available to the Contractor and will remain in train service. The adjacent track to remain in train service will be the platform track for each of the passenger stations affected by the outage. During these outages all four tracks will have the catenary de-energized, and diesel train service will be operational through the outage area.

Where the availability of adjacent track outages are indicated in sections 2(a) and 2(b) below, only one of the listed adjacent track outages can be used by the Contractor per each track outage request.

Outage	Time

2 (a) Allowable Track Outages with one track continuously out of service for Section C-1a:

Track Continuously Out of Service (C-1a)	Available Off-Peak Track Outages on Adjacent Tracks		
	Adj. Track(s)	Outage Period	
7	3	0015 – 0400	(Stage 1 for 366A)
5	3	0015 – 0530	(Stage 1 for 370B North Foundation)

2 (b) Allowable Off-Peak Track Outages

Track	Allowable Off Peak Outage Period
5 or 5 & 3	0015 – 0400
3 or 3 & 1	0015 – 0400
1 or 1 & 2	0015 – 0400
2 or 2 & 4	0015 – 0430
4	0015 – 0430

2 (c) Allowable 4-Track Off-Peak Outages

Friday or Saturday Night	0015 – 0400

NOTES:

a. The above outages are not guaranteed by Metro-North Railroad at all times.
b. The Contractor's plan for demolition, erection, and any operation adjacent to or within the Railroad Right of Way shall be submitted to the Engineer for Railroad approval, prior to start of work.
c. No full track and/or power outages will be permitted on weekends either immediately before or after major holidays, nor any weekend between Thanksgiving and New Years day.
d. The track outage periods shown above are the times that the track(s) may be taken out of train service. Refer to Section 1.05.06(1)(e)(3) for additional restrictions regarding power outages requiring de-energizing, grounding and re-energizing of the wires.

2. All work involving rail, ties, and other track components on active tracks, unless specifically designated otherwise within the contract, will be performed by Railroad employees. The contractor may not remove abandoned (out of service) track unless given prior written approval from the Railroad and the Engineer.

3. The Contractor shall assume that the wires and rails of the Railroad will be energized at all times.

Article 1.08.13 - Acceptance of Work and Termination of the Contractor's Responsibility: *Replace the entire Article 1.08.13 with the following:*

The Contractor's responsibility for non-administrative Project work will be considered terminated when the final inspection has been held, any required additional work and final cleaning-up have been

completed, all final operation and maintenance manuals have been submitted, and all of the Contractor's equipment and construction signs have been removed from the Project site. When these requirements have been met to the satisfaction of the Engineer, the Commissioner will accept the work by certifying in writing to the Contractor, that the non-administrative Project work has been satisfactorily completed.

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 (QCP) 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), or those defined on the basis of composition, such as those containing 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.

Polymer Modified Asphalt (PMA): A bituminous concrete mixture containing a polymer modified asphalt binder in accordance with contract specifications. All PMA mixtures shall incorporate a qualified warm mix technology.

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 gradation, temperature, or volumetric properties.

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 QCP requirements are defined in Section M.04.

2. Recycled Materials: Reclaimed Asphalt Pavement (RAP), Crushed Recycled Container Glass (CRCG), Recycled Asphalt Shingles (RAS), or crumb rubber (CR) from recycled tires may be incorporated in bituminous concrete mixtures in accordance with Section M.04 and Project Specifications. CRCG and RAS shall not be used in 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 shall 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; Mix type and level Curb mixtures for machine-placed curbing must state "curb mix only".
e. If RAP is used, the plant printouts shall include the RAP dry weight, percentage and daily moisture content.
f. If RAS is used, the plant printouts shall include the RAS dry weight and percentage daily moisture content.
g. The delivery ticket for all mixes produced with Warm Mix Technology must indicate the additive name, and the injection rate (water or additive) incorporated at the HMA plant. The delivery ticket for all mixes produced with pre-blended WMA additive must indicate the name of the WMA Technology.
h. Net weight of mixture loaded into truck (When RAP and/or RAS is used the moisture content shall be excluded from mixture net weight).
i. Gross weight (Either equal to the net weight plus the tare weight or the loaded scale weight).
j. Tare weight of truck – Daily scale weight.
k. Project number, purchase order number, name of Contractor (if Contractor other than Producer).
l. Truck number for specific identification of truck.
m. Individual aggregate, Recycled Materials, and virgin asphalt high/target/low weights. For drum plants and silo loadings, the plant printouts shall be produced at 5 minute intervals maintained by the vendor for a period of three years after the completion of the project.
n. 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 is uniform for all wheels.

Lighting: For paving operations, which will be performed during hours of darkness, the paving equipment shall be equipped with lighting fixtures as described below, or with approved lighting fixtures of equivalent light output characteristics. Lighting shall maximize the illumination on each task and minimize glare to passing traffic. The Contractor shall provide generators on rollers and pavers of the type, size, and wattage, to adequately furnish electric power to operate the specified lighting equipment. The lighting options and minimum number of fixtures are listed in Tables 4.06-1 and 4.06-2:

TABLE 4.06-1: Paver Lighting

Option	Fixture Configuration	Fixture Quantity	Requirement
1	Type A	3	Mount over screed area
	Type B (narrow) or Type C (spot)	2	Aim to auger and guideline
	Type B (wide) or Type C (flood)	2	Aim 25 feet behind paving machine
2	Type D Balloon	2	Mount over screed area

TABLE 4.06-2: Roller Lighting

Option	Fixture Configuration*	Fixture Quantity	Requirement
1	Type B (wide)	2	Aim 50 feet in front of and behind roller
	Type B (narrow)	2	Aim 100 feet in front of and behind roller
2	Type C (flood)	2	Aim 50 feet in front of and behind roller
	Type C (spot)	2	Aim 100 feet in front of and behind roller
3	Type D Balloon	1	Mount above the roller

*All fixtures shall be mounted above the roller.

Type A: Fluorescent fixture shall be heavy-duty industrial type. Each fixture shall have a minimum output of 8,000 lumens. The fixtures shall be mounted horizontally, and be designed for continuous row installation.

Type B: Each floodlight fixture shall have a minimum output of 18,000 lumens.

Type C: Each fixture shall have a minimum output of 19,000 lumens.

Type D: Balloon light: Each balloon light fixture shall have a minimum output of 50,000 lumens, and emit light equally in all directions.

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 continuously remix the bituminous concrete mixture throughout the placement process.

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. 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.

5. 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.

Permanent Transitions: 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 50 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 40, 45, or 50 MPH
    (1) Leading and Trailing = 4 feet per inch of vertical change (thickness)
c) Posted speed limit is 35 MPH or less
    (1) Leading and Trailing = 3 feet per inch of vertical change (thickness)

Note: Any temporary transition to be in-place over the winter shutdown period or during extended periods of inactivity (more than 14 calendar days) shall conform to the greater than 50 MPH requirements shown above.

6. 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 QCP.

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
S1	+/- ⅜ inch
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: Immediately before application, the area to be tacked shall be cleaned by sweeping or by other means acceptable to the Engineer. A thin uniform coating of tack coat shall be applied to the pavement immediately before overlaying and be allowed sufficient time to break (set) prior to any paving equipment or haul vehicles driving on it. 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.

When placing a lift with a specified thickness less than one and one-half (1 ½) inches, or a wedge course, the Contractor shall provide a minimum rolling pattern as determined by the development of a compaction curve. The procedure to be used shall be documented in the Contractor's QCP for placement and demonstrated on the first day of placement.

The use of the vibratory system on concrete structures is prohibited. When approved by the Engineer, the Contractor may operate a roller using an oscillatory system at the lowest frequency setting.

If the Engineer determines that the use of compaction equipment in the dynamic 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.

Rollers operating in the dynamic mode shall be shut off when changing directions.

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 of the mat and joints shall not exhibit segregation, rutting, cracking, disintegration, flushing or vary in composition as determined by the Engineer.

7. Longitudinal Joint Construction Methods: 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 S1mixes. Method II Butt Joint (see Figure 4.06-2) shall be used for lifts less than 1½ inches or greater than 3 inches, and S1mixes. 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. The difference in elevation between the two faces of any completed longitudinal joint shall not exceed ¼ of an inch in any location.

Method I - Notched Wedge Joint:

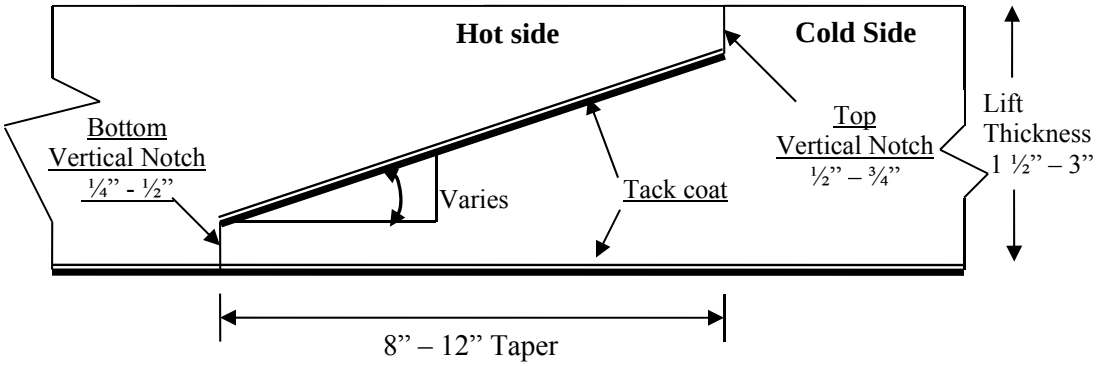

FIGURE 4.06-1: Notched Wedge Joint

A notched wedge joint shall be constructed as shown in Figure 4.06-1 using a device that is attached to the paver screed and is capable of independently adjusting the top and bottom vertical notches. The device shall have an integrated vibratory system.

The taper portion of the wedge 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 evenly compacted using equipment other than the paver or notch wedge joint device.

The taper portion of the wedge joint shall 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.

If Method I, Notched Wedge Joint cannot be used on lifts between 1.5 and 3 inches, Method III Butt Joint may be substituted according to the requirements below for "Method III – Butt Joint with Hot Pour Rubberized Asphalt Treatment."

Method II - Butt Joint:

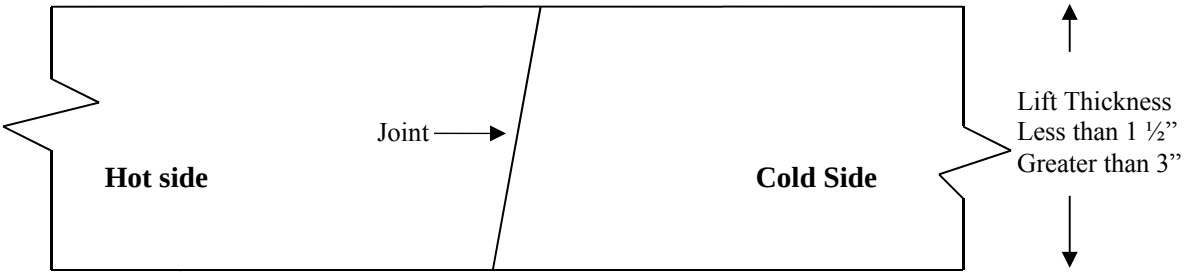

FIGURE 4.06-2: Butt Joint

When adjoining passes are placed, the Contractor shall utilize equipment that creates a near vertical edge (refer to Figure 4.06-2). 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: If Method I Wedge Joint cannot be used due to physical constraints in certain limited locations; the contractor may submit a request in writing for approval by the Engineer, to utilize Method III Butt Joint as a substitution in those locations. There shall be no additional measurement or payment made when the Method III Butt Joint is substituted for the Method I Notched Wedge Joint. When required by the contract or approved by the Engineer, Method III (see Figure 4.06-3) shall be used.

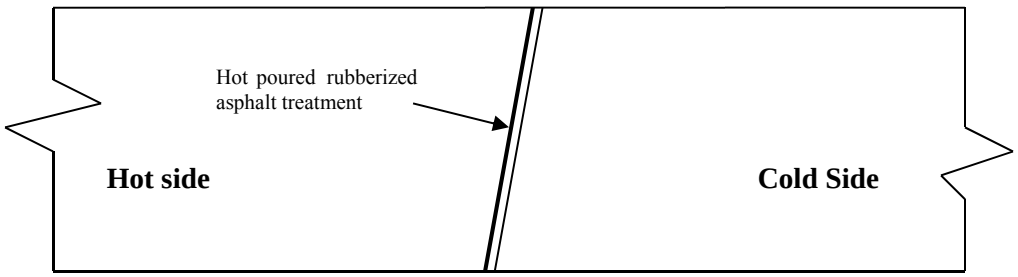

FIGURE 4.06-3: Butt Joint with Hot Poured Rubberized Asphalt Treatment

All of the requirements of Method II must be met with Method III. In addition, the longitudinal vertical edge must be treated with a rubberized joint seal material meeting the requirements of ASTM D 6690, Type 2. The joint sealant shall be placed on the face of the "cold side" of the butt joint as shown above prior to placing the "hot side" of the butt joint. 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.

8. Contractor Quality Control (QC) Requirements:

The Contractor shall be responsible for maintaining adequate quality control procedures throughout the production and placement operations. Therefore, the Contractor must ensure that the materials, mixture and work provided by Subcontractors, Suppliers and Producers also meet contract specification requirements.

This effort must be documented in Quality Control Plans and 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 Standard QCP for production shall consist of the quality control program specific to the production facility.

There are three components to the QCP for placement: a Standard QCP, a Project Summary Sheet that details project specific information, and if applicable a separate Extended Season Paving Plan as required in Section 9 "Temperature and Seasonal Requirements".

The Standard QCP for both production and placement shall be submitted to the Department for approval each calendar year and.at a minimum of 30 days prior to production or placement.

Production or placement shall not occur until all QCP components have been approved by the Engineer.

Each QCP shall 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. The QCPs shall also include the name and qualifications of any outside testing laboratory performing any QC functions on behalf of the Contractor.

Approval of the QCP does not relieve the Contractor of its responsibility to comply with the project specifications. The Contractor may modify the QCPs as work progresses and must document the changes in writing prior to resuming operations. These changes include but are not limited to changes in quality control procedures or personnel. The Department reserves the right to deny significant changes to the QCPs.

QCP for Production: Refer to Section M.04.03-1.

QCP for Placement: The Standard QCP, Project Summary Sheet, and Extended Season Paving Plan shall conform to the format provided by the Engineer. The format is available at http://www.ct.gov/dot/lib/dot/documents/dconstruction/pat/qcp_outline_hma_placement.pdf.

The Contractor shall perform all quality control sampling and testing, provide inspection, and exercise management control to ensure that bituminous concrete placement conforms to the requirements as outlined in its QCP during all phases of the work. The Contractor shall document these activities for each day of placement.

The Contractor shall submit complete field density testing and inspection records to the Engineer within 48 hours 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. The core holes shall be filled to the same requirements described in Sub article 4.06.03-10.

9. Temperature and Seasonal Requirements: Paving, including placement of temporary pavements, shall be divided into two seasons, "In-Season" and "Extended-Season". In-Season paving occurs from May 1 – October 14, and Extended Season paving occurs 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 sub base temperature is below 40°F regardless of the season.
- Should paving operations be scheduled during the Extended Season, the Contractor must submit an Extended Season Paving Plan for the project that addresses minimum delivered mix temperature considering WMA, PMA or other additives, maximum paver speed, enhanced rolling patterns and the method to balance mixture delivery and placement operations. Paving during Extended Season shall not commence until the Engineer has approved the plan.

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. All material placed in a lift shall be compacted to the degree specified in Tables 4.06-9 and 4.06-10. The density of each core will be determined using the production lot's average maximum theoretical specific gravity (Gmm) established during the testing of the parent material at the plant. When there was no testing of the parent material or any Gmm exceeds the specified tolerances in the Department's current QA Program for Materials, the Engineer will determine

the maximum theoretical density value to be used for density calculations. Bituminous concrete HMA S1 mixes 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.

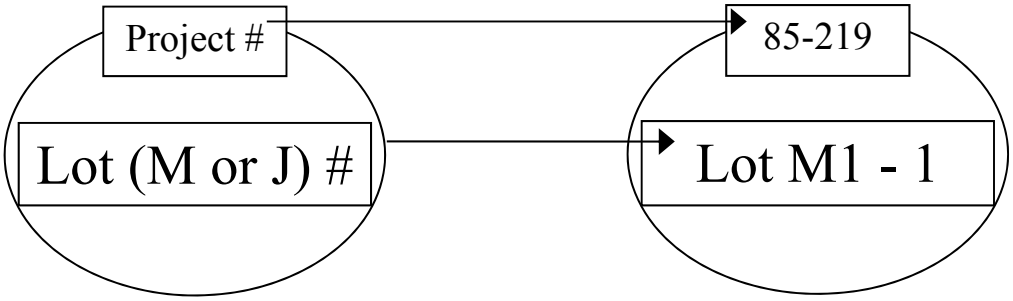

FIGURE 4.06-4: Labeling of Cores

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

Notes:
[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.
[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.

Method I, Notched Wedge Joint cores shall 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.

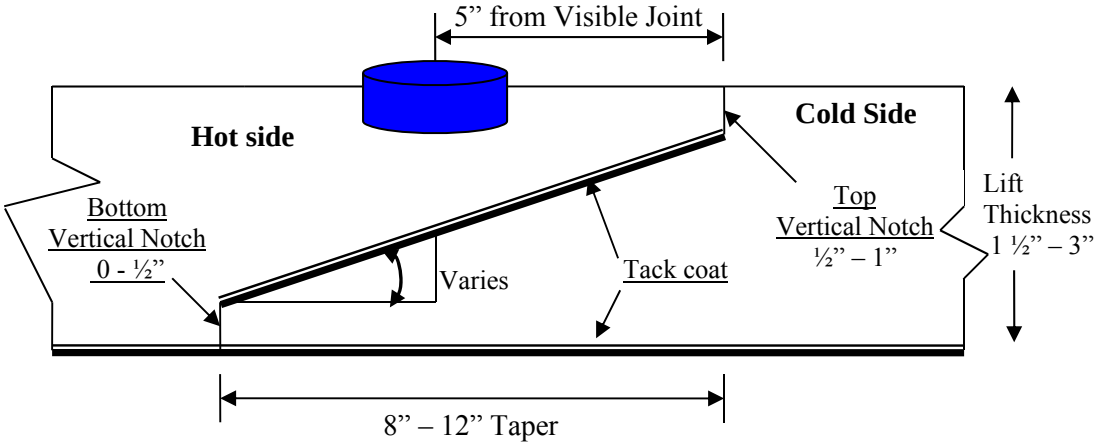

FIGURE 4.06-5: Notched Wedge Joint Cores

When Method III Butt Joint is utilized, cores shall be taken from the hot side so the edge of the core is within 1 inch of the longitudinal joint.

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.

Each core hole shall be filled within four hours 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 using a bituminous concrete mixture at a minimum temperature of 240ºF containing the same or smaller nominal maximum aggregate size and compacted with a hand compactor or other mechanical means to the maximum compaction possible. The bituminous concrete fill shall be compacted to ⅛ inch above the finished pavement.

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, theoretical maximum density (Gmm), 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 test results for a subject lot or sub lot may be replaced with the Department's

results 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.

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 7 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. No request for Dispute Resolution will be allowed for a Density Lot in which any core was not taken within the required 5 calendar days of placement. 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 14 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 randomly located within the respective original sub lot. 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 match the specified lift 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. 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: The quantity of bituminous concrete representing the production lot will be adjusted based on test results and values listed in Tables 4.06-6 and 4.06-7 , . The Department's Division of Material Testing will calculate the daily adjustment value for T_{SD}.

The adjustment values in Table 4.06-6 and 4.06-7 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 = $AdjAV_t = [AdjAV_1 + AdjAV_2 + AdjAV_i + \ldots + AdjAV_n)] /n$

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 4.06-6: Adjustment Values for Air Voids

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	$\leq$ 2.2 or $\geq$ 5.8

Positive air void adjustment values will not be calculated for any test that fails to meet gradation or binder content tolerances of the JMF in Table M.04.03– 5.

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

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 4.06-7: Adjustment Values for Binder Content

Adjustment Value ($AdjAV_i$) (%)	**S0.25, S0.375, S0.5, S1 Pb (refer to Table M.04.02-5)**
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 in a lift of pavement specified to be 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).

No positive adjustment will be applied to a Density Lot in which any core was not taken within the required 5 calendar days of placement.

Tons Adjusted for Density (T_D) = $[\{(PA_M \times .50) + (PA_J \times .50)\} / 100]$ 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 tack coat based on the density 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, or from the automated metering system on the delivery vehicle.

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. HMA S* or PMA S*: The furnishing and placing of bituminous concrete will be paid for at the Contract unit price per ton for "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 cleaning the surface to be paved, including mechanical sweeping, 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 acceptance testing 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 are not equal to zero. A positive or negative adjustment will be applied to monies due the Contractor.

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 Bituminous Concrete Adjustment Cost item if included in the bid proposal or estimate is not to be altered in any manner by the Contractor. If the Contractor should alter the amount shown, the altered figure will be disregarded and the original estimated cost will be used 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.

4. The cutting of bituminous concrete pavement will be paid in accordance with Article 2.02.05.

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 S*	ton
PMA S*	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.

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.04.03-7.

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 Safety Data Sheet (SDS) 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 and elongated shall be determined in accordance with ASTM D 4791 and shall not exceed 10% by weight when tested to a 5:1 ratio, as shown in Tables M.04.02-2 thru M.04.02-4.

2. Fine Aggregate:

a. 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.

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 material.

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.

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. Performance Graded Asphalt Binder:

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 332 and shall be graded or verified in accordance with AASHTO R 29. 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. Neat Performance Grade (PG) Binder:

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 such as re-refined motor oil, and shall indicate such information on each bill of lading and certified test report.

ii. The asphalt binder shall be PG 64S-22.

c. Modified Performance Grade (PG) Binder:

Unless otherwise noted, the asphalt binder shall be Performance Grade PG 64E-22 asphalt modified solely 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(δ) 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 332 (including Appendix X1) and AASHTO R 29.

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 332 and shall be graded or verified in accordance with AASHTO R 29 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.

5. Emulsified Asphalts:

a. General:
   i. Emulsified asphalts shall be homogeneous and be free of contaminants such as fuel oils and other solvents. Emulsions shall be properly stored to prevent damage or separation.
   ii. The blending at mixing plants of emulsified asphalts from different suppliers is strictly prohibited. Contractors who blend emulsified asphalts will be classified as a supplier and will be required to certify the emulsion in accordance with AASHTO PP 71. The emulsified asphalt shall meet the requirements of AASHTO M 140(M) or AASHTO M 208 as applicable.

b. Supplier Approval:
   i. The request for approval of the source of supply shall list the location where the material is manufactured, the handling and storage methods, and certifications in accordance with AASHTO PP 71. Only suppliers that have an approved "Quality Control Plan for Emulsified Asphalt" formatted in accordance with AASHTO PP 71 will be allowed to supply emulsified asphalt to Department projects.
   ii. The supplier shall submit to the Division Chief a Certified Test Report representing each lot in accordance with AASHTO PP 71. The Certified Test Report shall include test results for each specified requirement for the grade delivered and shall also indicate the density at 60ºF. Additionally, once a month one split sample for each emulsified asphalt grade shall be submitted.

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c. Basis of Approval

i. Each shipment of emulsified asphalt delivered to the project site shall be accompanied with the corresponding SDS and Certified Test Report listing Saybolt viscosity, residue by evaporation, penetration of residue, and weight per gallon at 60°F.

ii. Anionic emulsified asphalts shall conform to the requirements of AASHTO M-140(M). Materials used for tack coat shall not be diluted and meet grade RS-1 or RS-1H. When ambient temperatures are 80˚F and rising, grade SS-1 or SS-lH may be substituted if permitted by the Engineer.

iii. Cationic emulsified asphalt shall conform to the requirements of AASHTO M-208. 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 permitted by the Engineer.

6. 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.

7. 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

8. Joint Seal Material:

a. 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 ASTM D 6690 – Type 2.

9. Recycled Asphalt Shingles (RAS)

a. Requirements: RAS shall consist of processed asphalt roofing shingles from post-consumer asphalt shingles or from manufactured shingle waste. The RAS material under consideration for use in bituminous concrete mixtures must be certified as being asbestos free and shall be entirely free of whole, intact nails. The RAS material shall meet the requirements of AASHTO MP 23.

The producer shall test the RAS material to determine the asphalt content and the gradation of the RAS material. The producer shall take necessary action to prevent contamination of RAS stockpiles.

10. Plant Requirements:

a. Mixing Plant and Machinery: The mixing plant used in the preparation of the bituminous concrete shall comply with AASHTO M 156/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 delivery 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, and 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, *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. Curb Mix:

a. Requirements: When curb mix is specified, the Contractor shall develop a bituminous concrete mix design that includes a JMF consisting of target values for gradation, binder content and air voids as shown in Table M.04.02-1. The Contractor may use RAP in 5% increments up to a maximum of 30% provided a new JMF is accepted by the Engineer.

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 must be accepted by the Engineer, and the Contractor must demonstrate the ability to meet the accepted JMF. Additionally, the fraction of material retained between any two consecutive sieves shall not be less than 4%.

The Contractor shall test the 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. 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.

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.

TABLE M.04.02 – 1:
Master Ranges for Curb Mix Mixtures

Notes: (a) Compaction Parameter 50gyration N_{des}. (b) The percent passing the #200 sieve shall not exceed the percentage of bituminous asphalt binder determined by AASHTO T 164 or AASHTO T 308.		
Mix	Curb Mix	Production Tolerances from JMF target
Grade of PG Binder content %	PG 64S-22 6.5 - 9.0	0.4
Sieve Size		
# 200	3.0 – 8.0 (b)	2.0
# 50	10 - 30	4
# 30	20 - 40	5
# 8	40 - 70	6
# 4	65 - 87	7
¼"		
3/8 "	95 - 100	8
½ "	100	8
¾"		8
1"		
2"		
Additionally, the fraction of material retained between any two consecutive sieves shall not be less than 4%		
Mixture Temperature		
Binder	325°F maximum	
Aggregate	280-350° F	
Mixtures	265-325° F	
Mixture Properties		
VOIDS %	0 – 4.0 (a)	

2. 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 and AASHTO R 35. 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 and the specific gravity data.

2. Extracted aggregates from RAP aggregate, when applicable, consensus properties for each type & level, as specified in Table M.04.02-3 and the specific gravity data.

3. 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.

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. 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 as shown in Tables M.04.02-2 thru Table M.04.02-5. 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. The JMF shall be accompanied by a blending chart and supporting test results in accordance with AASHTO M 323 Appendix X1, or by test results that show the combined binder (recovered binder from the RAP, virgin binder at the mix design proportions, warm mix asphalt additive and any other modifier if used) meets the requirements of the specified binder grade.
- Two representative samples of RAP shall be obtained. Each sample shall be split and one split sample shall be tested for binder content in accordance with AASHTO T 164 and the other in accordance AASHTO T 308.

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

iii. Superpave Mixtures with RAS: Use of RAS may be allowed solely in HMA S1 mixtures with the following conditions:

- RAS amounts up to 3% may be used.
- RAS total binder replacement up to 15% may be used with no binder grade modification.
- RAS total binder replacement 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. The JMF shall be accompanied by a blending chart and supporting test results in accordance to AASHTO M 323 appendix X1 or by test results that show the combined binder (recovered binder from the RAP, virgin binder at the mix design proportions, warm mix asphalt additive and any other modifier if used) meets the requirements of the specified binder grade.
- Superpave Mixtures with RAS shall meet AASHTO PP 78 design considerations. The RAS asphalt binder availability factor (F) used in AASHTO PP 78 Equation 2 shall be 0.85.

iv. Superpave Mixtures with CRCG: In addition to the requirements in M.04.02 – 2 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.

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:

i. Gradation, consensus properties and specific gravities of the aggregate, RAP, and RAS.
ii. Average asphalt content of the RAP and RAS by AASHTO T 164.
iii. Source of RAP and RAS and percentage to be used.
iv. Warm mix Technology and manufacturer's recommended additive rate and tolerances.
v. TSR test report, and, if applicable, anti-strip manufacturer and recommended dosage rate.
vi. Mixing and compaction temperature ranges for the mix with and without the warm-mix technology incorporated.
vii. JMF ignition oven correction factor by AASHTO T 308.

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 and AASHTO M 323.

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.

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 as "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 in AASHTO R 35. (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)		CONTROL POINTS(3)		CONTROL POINTS(3)		CONTROL POINTS(3)	
inches	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	-	-	-	-
#8	32	67	32	67	28	58	19	45
#16	-	-	-	-	-	-	-	-
#30	-	-	-	-	-	-	-	-
#50	-	-	-	-	-	-	-	-
#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 – 350°F		280 – 350°F		280 – 350°F		280 – 350°F	
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 and 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 and elongated particles of materials retained on the #4 sieve, determined at 5:1 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 and 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. Standard Quality Control Plan (QCP) for Production:

The QCP for production 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. As a minimum, the following quality characteristics shall be included in the control charts: percent passing #4 sieve, percent passing #200 sieve, binder content, air voids, Gmm and VMA. 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 the first day of each month.

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.

The Contractor shall submit complete production testing records to the Engineer within 24 hours in a manner acceptable to the Engineer.

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:

i. General:

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 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 in accordance with the Department's QA Program for Materials. Labeled Acceptance test specimens shall be retained at the production facilities and may be disposed of with the approval of the Engineer. All Quality Control specimens shall be clearly labeled and separated from the Acceptance specimens.

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, during, and until completion of 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.

ii. Curb Mix Acceptance Sampling and Testing Procedures:

Curb Mixes shall be tested by the Contractor at a frequency of one test per every 250 tons of cumulative production, regardless of the day of production.

When these mix designs are specified, the following acceptance procedures and AASHTO test methods shall be used:

TABLE M.04.03 – 2: Curb Mix Acceptance Test Procedures

Protocol	Reference	Description
1	**AASHTO T 30(M)**	Mechanical Analysis of Extracted Aggregate
2	**AASHTO T 168**	Sampling of Bituminous Concrete
3	**AASHTO T 308**	Binder content by Ignition Oven method (adjusted for aggregate correction factor)
4	**AASHTO T 209(M)**	Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
5	**AASHTO T 312**	Superpave Gyratory molds compacted to N_{des}
6	**AASHTO T 329**	Moisture Content of Hot-Mix Asphalt (HMA) by Oven Method

a. Determination of Off-Test Status:

i. The test results of AASHTO T 308 and T 30(M) will be used to determine if the mixture is within the tolerances shown in Table M.04.02-1. Curb Mixtures are considered “off test" 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 mixture. If the mix is “off test”, the Contractor must take immediate actions to correct the deficiency and a new acceptance sample shall be tested on the same day or the following day of production.

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” status.

iii. The Engineer may cease supply from the plant when test results from three consecutive samples are not within the JMF tolerances or the test results from two consecutive samples not within the master range indicated in Table M.04.02-1 regardless of production date.

b. JMF Changes

i. If a test indicates that the bitumen content or gradation are outside the tolerances, the Contractor may make a single JMF change 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.

ii. 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.

iii. Superpave Mix Acceptance Sampling and Testing Procedures:

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 Engineer may request a second acceptance test within the first sub lot. One acceptance test shall always be performed in the last sub-lot based on actual tons of material produced.

The number of sub lots/acceptance tests is based on the total 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 Engineer may direct that additional acceptance samples be obtained to represent materials actually being delivered to the project.

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).

TABLE M.04.03 – 1:
Superpave 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

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	Sampling of bituminous concrete
2	AASHTO R 47	Reducing samples to testing size
3	AASHTO T 308	Binder content by Ignition Oven method (adjusted for aggregate correction factor)
4	AASHTO T 30	Gradation of extracted aggregate for bituminous concrete mixture
5	AASHTO T 312	(1)Superpave Gyratory molds compacted to N_{des}
6	AASHTO T 166	(2)Bulk specific gravity of bituminous concrete
7	AASHTO R 35	(2)Air voids, VMA
8	AASHTO T 209(M)	Maximum specific gravity of bituminous concrete (average of two tests)
9	AASHTO T 329	Moisture content of Production bituminous concrete

Notes: **(1)** One set equals two six-inch molds. Molds to be compacted to Nmax for PPTs and to Ndes for production testing. The first sublot of the year will be compacted to N_{max}
(2) Average value of one set of six-inch molds.

If the average corrected Pb content differs by 0.3% or more from the average bituminous concrete facility production delivery 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 aggregate correction factor.

The test specimen must be ready to be placed in an approved ignition furnace for testing in accordance with AASHTO T 308 within thirty minutes of being obtained from the hauling vehicle and the test shall start immediately after.

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, technical datasheet and SDS 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. Determination of Off-Test Status:

i. 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.04.03-4 and the computed binder content (Pb) established by AASHTO T308 or as documented on the vehicle delivery ticket is below the minimum binder content stated in sub article M.04.02-5. 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 any combination of VMA or Gmm, regardless of date of production.

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:

1. The binder content (Pb) is below the requirements of Table M.04.02-5 on the ignition oven test result after two (2) consecutive tests, regardless of the date of production.

2. The air voids (VA) is outside the requirements of Table M.04.03-4 after three (3) 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. A revised JMF submittal shall include the date and name of the Engineer that allowed it.

JMF changes 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 the form provided by the Engineer.
iv. A revised JMF submittal shall include the date and name of the Engineer that allowed it.

No change will be made on any aggregate or RAP consensus property or specific gravity unless the test is performed at an AASHTO Materials Reference Laboratory (AMRL) by NETTCP Certified Technicians.

A JMF change shall be submitted every time the plant target RAP and/or bin percentage deviates by more than 5% and/or the plant target binder content deviates by more than 0.15% from the active JMF.

TABLE M.04.03– 4: Superpave Master Range for Bituminous Concrete Mixture Production

Notes: (1) 300°F minimum after October 15. (2) Minimum Pb as specified in Table M.04.02-5 (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)		From JMF Targets (4)
inches	Min(%)	Max(%)	Min(%)	Max(%)	Min(%)	Max(%)	Min(%)	Max(%)	±Tol
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– 5:
JMF Tolerances for Application of Positive Adjustments

Notes: (1) Only for S1 mixes.
(2) Only for S0.5 and S1 mixes.

Sieve	Tolerances From JMF Targets
inches	±Tol
3/4	9 (1)
1/2	9 (1)
3/8	9 (2)
#4	8
#8	7
#16	6
#200	3
Pb	0.4

TABLE M.04.03– 6:
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.04.03-7:
Modifications to Standard AASHTO and ASTM Test Specifications and Procedures

AASHTO Standard Specification	
Reference	**Modification**
M 140	Emulsified Asphalt grade RS-1H shall meet all the requirements of the emulsified asphalt grade RS-1 except for the penetration requirement of the residue that will change from 100 to 200 penetration units (0.1 mm) to 40 to 90 penetration units (0.1 mm).
AASHTO Standard Method of Test	
Reference	**Modification**
T 30	Section 7.2 thru 7.4 Samples are not routinely washed for production testing
T 168	Samples are taken at one point in the pile. 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	Section 7.2 The average of two bowls is used proportionally in order to satisfy minimum mass requirements. 8.3 Omit Pycnometer method.
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 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 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. 7. All AASHTO M 320 references shall be replaced with AASHTO M 332. 8. Each year, in April and September, the supplier shall submit test results for two BBR testing at two different temperatures in accordance with AASHTO R 29. Suppliers shall provide AASHTO M 332 testing results and split samples at a minimum of once per lot.

ON-THE-JOB TRAINING (OJT) WORKFORCE DEVELOPMENT PILOT:

Description

To provide construction industry related job opportunities to minorities, women and economically disadvantaged individuals; and to increase the likelihood of a diverse and inclusive workforce on Connecticut Department of Transportation (ConnDOT) projects.

All contractors (existing and newcomers) will be automatically placed in the Workforce Development Pilot. Standard OJT requirements typically associated with individual projects will no longer be applied at the project level for new projects. Instead, these requirements will be applicable on an annual basis for each contractor performing work on ConnDOT projects.

The OJT Workforce Development Pilot will allow a contractor to train employees on Federal, State and privately funded projects located in Connecticut. However, contractors should give priority to training employees on ConnDOT Federal-Aid funded projects.

Funding

The Department will establish an OJT fund annually from which contractors may bill the Department directly for eligible trainee hours. The funds for payment of trainee hours on federal-aid projects will be allocated from the ½ of 1% provided for OJT funding, and will be based on hours trained, not to exceed a maximum of $25,000.00 per year; per contractor.

Minorities and Women

Developing, training and upgrading of minorities, women and economically disadvantaged individuals toward journeyperson level status is the primary objective of this special training provision. Accordingly, the Contractor shall make every effort to enroll minority, women and economically disadvantaged individuals as trainees to the extent that such persons are available within a reasonable area of recruitment. This training commitment is not intended, and shall not be used, to discriminate against any applicant for training whether a member of a minority group or not.

Assigning Training Goals

The Department, through the OJT Program Coordinator, will assign training goals for a calendar year based on the contractor's past two year's activities and the contractor's anticipated upcoming year's activity with the Department. At the beginning of each year, all contractors eligible will be contacted by the Department to determine the number of trainees that will be assigned for the upcoming calendar year. At that time, the Contractor shall enter into an agreement with the Department to provide a self-imposed on-the-job training program for the calendar year. This agreement will include a specific number of annual training goals agreed to by both parties. The number of training assignments may range from one (1) to six (6) per

contractor per calendar year. Each January, a summary of the trainees required and the OJT Workforce Development Pilot package will be sent to participating contractors. The number of trainees assigned to each contractor in the summary will increase proportionately not to exceed 6, as shown in the following table. This package will also be provided to contractors as they become newly eligible for the OJT Workforce Development Pilot throughout the remainder of the year. Projects awarded after September 30 will be included in the following year's Program.

The dollar thresholds for training assignments are as follows:

$4.5 – 8 million=	1 trainee
$ 9 – 15 million=	2 trainees
$16 – 23 million=	3 trainees
$24 – 30 million=	4 trainees
$31 – 40 million=	5 trainees
$41 – and above=	6 trainees

Training Classifications

Preference shall be given to providing training in the following skilled work classifications. However, the classifications established are not all-inclusive:

Equipment Operators	Electricians
Laborers	Painters
Carpenters	Iron / Reinforcing Steel Workers
Concrete Finishers	Mechanics
Pipe Layers	Welders

The Department has on file common training classifications and their respective training requirements; that may be used by the contractors. Contractors shall submit new classifications for specific job functions that their employees are performing. The Department will review and recommend for acceptance the new classifications proposed by contractors, if applicable. New classifications shall meet the following requirements:

Proposed training classifications are reasonable and realistic based on the job skill classification needs, and the number of training hours specified in the training classification is consistent with common practices and provides enough time for the trainee to obtain journeyman level status.

Where feasible, 25% percent of apprentices or trainees in each occupation shall be in their first year of apprenticeship or training. The number of trainees shall be distributed among the work classifications on the basis of the contractor's needs and the availability of journeymen in the various classifications within a reasonable area of recruitment.

No employee shall be employed as a trainee in any classification in which they have successfully completed a training course leading to journeyman level status or in which they have been employed as a journeyman.

Records and Reports

The Contractor shall maintain enrollment in the program and submit all required reports documenting company compliance under these contract requirements. These documents and any other information shall be submitted to the OJT Program Coordinator as requested.

Upon the trainee's completion and graduation from the program, the Contractor shall provide each trainee with a certification Certificate showing the type and length of training satisfactorily completed.

Trainee Interviews

In order to determine the continued effectiveness of the OJT Program in Connecticut, the department will periodically conduct personal interviews with current trainees and may survey recent graduates of the program. This enables the OJT Program Coordinator to modify and improve the program as necessary. Trainee interviews are generally conducted at the job site to ensure that the trainees' work and training is consistent with the approved training program.

Trainee Wages

Contractors shall compensate trainees on a graduating pay scale based upon a percentage of the prevailing minimum journeyman wages (Davis-Bacon Act). Minimum pay shall be as follows:

60 percent	of the journeyman wage for the first half of the training period
75 percent	of the journeyman wage for the third quarter of the training period
90 percent	of the journeyman wage for the last quarter of the training period

In no case, will the trainee be paid less than the prevailing rate for general laborer as shown in the contract wage decision (must be approved by the Department of Labor).

Achieving or Failing to Meet Training Goals

The Contractor will be credited for each trainee currently enrolled or who becomes enrolled in the approved training program and providing they receive the required training under the specific training program. Trainees will be allowed to be transferred between projects if required by the Contractor's schedule and workload. The OJT Program Coordinator must be notified of transfers within five (5) days of the transfer or reassignments by e-mail (Phylisha.Coles@ct.gov).

Where a contractor does not or cannot achieve its annual training goal with female or minority trainees, they must produce adequate Good Faith Efforts documentation. Good Faith Efforts are those designed to achieve equal opportunity through positive, aggressive, and continuous result-oriented measures. 23 CFR § 230.409(g) (4). Contractors should request minorities and females from unions when minorities and females are under-represented in the contractor's workforce.

Whenever a contractor requests ConnDOT approval of someone other than a minority or female, the contractor must submit documented evidence of its Good Faith Efforts to fill that position with a minority or female. When a non-minority male is accepted, a contractor must continue to attempt to meet its remaining annual training goals with females and minorities.

Where a contractor has neither attained its goal nor submitted adequate Good Faith Efforts documentation, ConnDOT will issue a letter of non-compliance. Within thirty (30) days of receiving the letter of non-compliance, the contractor must submit a written Corrective Action Plan (CAP) outlining the steps that it will take to remedy the non-compliance. The CAP must be approved by ConnDOT. Failure to comply with the CAP may result in your firm being found non-responsive for future projects.

Measurement and Payment

Optional reimbursement will be made to the contractor for providing the required training under this special provision on ConnDOT Federal-Aid funded projects only.

Contractor will be reimbursed at $0.80 for each hour of training given to an employee in accordance with an approved training or apprenticeship program. This reimbursement will be made even though the Contractor receives additional training program funds from other sources, provided such other source does not specifically prohibit the contractor from receiving other reimbursement.

Reimbursement for training is made annually or upon the trainees completion and not on a monthly basis. No payment shall be made to the Contractor if either the failure to provide the required training, or the failure to hire the trainee as a journeyperson, is caused by the Contractor.

Program reimbursements will be made directly to the prime contractor on an annual basis. To request reimbursement, prime contractors must complete the Voucher for OJT Workforce Development Pilot Hourly Reimbursement for each trainee in the OJT Program. This form is included in the OJT Workforce Development Pilot package and is available on the Department's web site at:

www.ct.gov/dot

The completed form must be submitted to the Office of Contract Compliance for approval. The form is due on the 15th day of January for each trainee currently enrolled and for hours worked on ConnDOT Federal-Aid funded projects only.

SMALL CONTRACTOR AND SMALL CONTRACTOR MINORITY BUSINESS ENTERPRISES

(SET-ASIDE)

March, 2001

NOTE: Certain of the requirements and procedures stated in this "Special Provision" are applicable prior to the execution of the Contract.

I. GENERAL

A. The Contractor shall cooperate with the Connecticut Department of Transportation (CONNDOT) in implementing the required contract obligations concerning "Small Contractor" and "Small Contractor Minority Business Enterprise" use on this Contract in accordance with Section 4a-60g of the Connecticut General Statutes as revised. References, throughout this "Special Provision", to "Small Contractors" are also implied references to "Small Contractor Minority Business Enterprises" as both relate to Section IIA of these provisions. The Contractor shall also cooperate with CONNDOT in reviewing the Contractor's activities relating to this provision. This "Special Provision" is in addition to all other equal opportunity employment requirements of this Contract.

B. For the purpose of this "Special Provision", the "Small Contractor(s)" and "Minority Business Enterprise(s)" named to satisfy the set-aside requirement must be certified by the Department of Administrative Services, Business Connections/ Set-Aside Unit [(860) 713-5236 www.das.state.ct.us/busopp.htm] as a "Small Contractor" and "Minority Business Enterprises" as defined by Section 4a-60g Subsections (1) and (3) of the Connecticut General Statutes as revised and is subject to approval by CONNDOT to do the work for which it is nominated pursuant to the criteria stipulated in Section IIC-3.

C. Contractors who allow work which they have designated for "Small Contractor" participation in the pre-award submission required under Section IIC to be performed by other than the approved "Small Contractor" organization and prior to concurrence by CONNDOT, will not be paid for the value of the work performed by organizations other than the "Small Contractor" designated.

D. If the Contractor is unable to achieve the specified contract goals for "Small Contractor" participation, the Contractor shall submit written documentation to CONNDOT's Manager of Construction Operations indicating his/her good faith

efforts to satisfy goal requirements. Documentation is to include but not be limited to the following:

1. A detailed statement of the efforts made to select additional subcontract opportunities for work to be performed by each "Small Contractor" 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 contracts with each "Small Contractor", including the names, addresses, dates and telephone numbers of each "Small Contractor" contacted, and a description of the information provided to each "Small Contractor" regarding the scope of services and anticipated time schedule of items proposed to be subcontracted and the nature of response from firms contacted.

3. For each "Small Contractor" that placed a subcontract quotation which the Contractor considered not to be acceptable, provide a detailed statement of the reasons for this conclusion.

4. Documents to support contacts made with CONNDOT requesting assistance in satisfying the contract specified or adjusted "Small Contractor" dollar requirements.

5. Document other special efforts undertaken by the Contractor to meet the defined goal.

E. Failure of the Contractor to have at least the specified dollar amount of this contract performed by "Small Contractor" as required in Section IIA of this "Special Provision" will result in the reduction in contract payment to the Contractor by an amount equivalent to that determined by subtracting from the specific dollar amount required in Section IIA, the dollar payments for the work actually performed by each "Small Contractor". The deficiency in "Small Contractor" achievement, will therefore, be deducted from the final contract payment. However, in instances where the Contractor can adequately document or substantiate its good faith efforts made to meet the specified or adjusted dollar amount to the satisfaction of CONNDOT, no reduction in payments will be imposed.

F. All records must be retained for a period of three (3) years following completion of the contract and shall be available at reasonable times and places for inspection by authorized representatives of CONNDOT.

G. Nothing contained herein, is intended to relieve any contractor or subcontractor or material supplier or manufacturer from compliance with all applicable Federal and State legislation or provisions concerning equal employment opportunity,

affirmative action, nondiscrimination and related subjects during the term of this Contract.

II. SPECIFIC REQUIREMENTS

In order to increase the participation of "Small Contractors", CONNDOT requires the following:

A. Not less than _____ (%) percent of the **final** value of this Contract shall be subcontracted to and performed by, and/or supplied by, manufactured by and paid to "Small Contractors" and/or "Small Contractors Minority Business Enterprises".

If the above percentage is zero (0%) AND an asterisk (*) has been entered in the adjacent brackets [ ], this Contract is 100% solely set-aside for participation by "Small Contractors" and/or "Small Contractors Minority Business Enterprises".

B. The Contractor shall assure that each "Small Contractor" will have an equitable opportunity to compete under this "Special Provision", particularly by arranging solicitations, time for the preparation of Quotes, Scope of Work, and Delivery Schedules so as to facilitate the participation of each "Small Contractor".

C. The Contractor shall provide to CONNDOT's Manager of Contracts within Seven (7) days after the bid opening the following items:

1. An affidavit (Exhibit I) completed by each named "Small Contractor" subcontractor listing a description of the work and indicating the dollar amount of all contract(s) and/or subcontract(s) that have been awarded to him/her for the current State Fiscal Year (July 1 - June 30) does not exceed the Fiscal Year limit of $10,000,000.00.

2. A certification of work to be subcontracted (Exhibit II) signed by both the Contractor and the "Small Contractor" listing the work items and the dollar value of the items that the nominated "Small Contractor" is to perform on the project to achieve the minimum percentage indicated in Section IIA above.

3. A certification of past experience (Exhibit III) indicating the scope of work the nominated "Small Contractor" has performed on all projects, public and private, for the past two (2) years.

4. In instances where a change from the originally approved named "Small Contractor" (see Section IB) is proposed, the Contractor is required to

submit, in a reasonable and expeditious manner, a revised submission, comprised of the documentation required in Section IIC, Paragraphs 1, 2 and 3 and Section E together with documentation to substantiate and justify the change, (i.e., documentation to provide a basis for the change) to CONNDOT's Manager of Construction Operations for its review and approval prior to the implementation of the change. The Contractor must demonstrate that the originally named "Small Contractor" is unable to perform in conformity to specifications, or unwilling to perform, or is in default of its contract, or is overextended on other jobs. The Contractor's ability to negotiate a more advantageous contract with another "Small Contractor" is not a valid basis for change. Documentation shall include a letter of release from the originally named "Small Contractor" indicating the reason(s) for the release.

D. After the Contractor signs the Contract, the Contractor will be required to meet with CONNDOT's Manager of Construction Operations or his/her designee to review the following:

1. What is expected with respect to the "Small Contractor" set aside requirements.

2. Failure to comply with and meet the requirement can and will result in monetary deductions from payment.

3. Each quarter after the start of the "Small Contractor" the Contractor shall submit a report to CONNDOT's Manager of Construction Operations indicating the work done by, and the dollars paid to each "Small Contractor" to date.

4. What is required when a request to sublet to a "Small Contractor" is submitted.

E. The Contractor shall submit to CONNDOT's Manager of Construction Operations all requests for subcontractor approvals on standard forms provided by the Department.

If the request for approval is for a "Small Contractor" subcontractor for the purpose of meeting the contract required "Small Contractor" percentage stipulated in Section IIA, a copy of the legal contract between the Contractor and the "Small Contractor" subcontractor must also be submitted at the same time. Any subsequent amendments or modifications of the contract between the Contractor and the "Small Contractor" subcontractor must also be submitted to CONNDOT's Manager of Construction Operations with an explanation of the change(s). The contract must show items of work to be performed, unit prices and, if a partial item, the work involved by both parties.

In addition, the following documents are to be attached:

(1) A statement explaining any method or arrangement for renting equipment. If rental is from a Contractor, a copy of Rental Agreement must be submitted.

(2) A statement addressing any special arrangements for manpower.

(3) A statement addressing who will purchase material.

F. Contractors subcontracting with a "Small Contractor" to perform work or services as required by this "Special Provision" shall not terminate such firms without advising CONNDOT, in writing, and providing adequate documentation to substantiate the reasons for termination if the designated "Small Contractor" firm has not started or completed the work or the services for which it has been contracted to perform.

G. Material Suppliers or Manufacturers

If the Contractor elects to utilize a "Small Contractor" supplier or manufacturer to satisfy a portion or all of the specified dollar requirements, the Contractor must provide the Department with:

1. An executed Affidavit Small Contractor (Set-Aside) Connecticut Department of Transportation Affidavit Supplier or Manufacturer (sample attached), and

2. Substantiation of payments made to the supplier or manufacturer for materials used on the project.

Brokers and packagers shall not be regarded as material Suppliers or manufacturer.

H. Non-Manufacturing or Non-Supplier "Small Contractor" Credit

Contractors may count towards its "Small Contractor" goals the following expenditures with "Small Contractor" firms that are not manufacturers or suppliers:

1. 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, material or supplies necessary for the performance of the contract provided that the fee or commission is determined by the Department of

Transportation to be reasonable and consistent with fees customarily allowed for similar services.

2. The fees charged for delivery of materials and supplies required on a job site (but not the cost of the materials and supplies themselves) when the hauler, trucker, or delivery service is not also the manufacturer of or a regular dealer in the materials and supplies, provided that the fee is determined by the Department of Transportation to be reasonable and not excessive as compared with fees customarily allowed for similar services.

3. The fees or commissions charged for providing any bonds or insurance specifically required for the performance of the Contract, provided that the fee or commission is determined by the Department of Transportation to be reasonable and not excessive as compared with fees customarily allowed for similar services.

III. BROKERING

For the purpose of this "Special Provision", a "Broker" is one who acts as an agent for others in negotiating contracts, purchases, sales, etc., in return for a fee or commission. Brokering of work by a "Small Contractor" is not allowed and is a contract violation.

IV. PRE-AWARD WAIVERS:

If the Contractor's submission of the "Small Contractor" listing, as required by Section IIC indicates that it is unable, by subcontracting to obtain commitments which at least equal the amount required by Section IIA, it may request, in writing, a waiver of up to 50% of the amount required by Section IIA. To obtain such a waiver, the Contractor must submit a completed "Application for Waiver of Small Contractor Minority Business Enterprise Goals" to CONNDOT's Manager of Contracts which must also contain the following documentation:

1. Information described in Section ID.

2. For each "Small Contractor" contacted but unavailable, a statement from each "Small Contractor" confirming its unavailability.

Upon receipt of the submission requesting a waiver, the CONNDOT's Manager of Contracts shall submit the documentation to the Director of the Office of Contract Compliance who shall review it for completeness. After completion of the Director of Contract Compliance's review, she/he should write a narrative of his/her findings of the application for a waiver, which is to include his/her recommendation. The Director of Contract Compliance shall submit the written narrative to the Chairperson of the DBE

Screening Committee at least five (5) working days before the scheduled meeting. The Contractor shall be invited to attend the meeting and present his/her position. The DBE Screening Committee shall render a decision on the waiver request within five (5) working days after the meeting. The DBE Screening Committee's decision shall be final. Waiver applications are available from the CONNDOT Manager of Contracts.

EXHIBIT I Mar. 01

SMALL CONTRACTOR/*MINORITY BUSINESS ENTERPRISE
(* Delete if not Applicable)
SET-ASIDE PROGRAM
(QUALIFICATION AFFIDAVIT)

PROJECT(s) _____
(INCLUDING TOWN & DESCRIPTION)

STATE OF _____CONNECTICUT_____

COUNTY OF_____

I_____,ACTING IN BEHALF
NAME OF PARTY SIGNING AFFIDAVIT
OF_____,DO HEREBY CERTIFY
PERSON FIRM OR ORGANIZATION
AND AFFIRM THAT THE INFORMATION SET FORTH BELOW IS TRUE AND ACCURATE TO THE BEST OF MY KNOWLEDGE. AS OF THIS DATE_____THE LIST OF SMALL CONTRACTOR SET-ASIDE PROGRAM - CONTRACTS AND/OR SUBCONTRACTS AWARDED DURING THE CURRENT FISCAL YEAR (JULY 1 - JUNE 30) 20_____ IS AS FOLLOWS:

Col. 1 TOWN AND PROJECT NUMBER	Col. 2 STATE AGENCY WHICH AWARDED CONTRACT	Col. 3 CONTRACT AMOUNT AWARDED UNDER THIS PROGRAM	Col. 4 AMOUNT OF WORK SUBCONTRACTED FROM OTHER FIRMS UNDER THIS PROGRAM	Col. 5 TOTAL AMOUNT OF ALL WORK UNDER THIS PROGRAM Col. 3 Plus Col. 4
	TOTALS	$	$	$

_____
NAME OF PERSON, FIRM OR ORGANIZATION

(FIRM SEAL)

_____
SIGNATURE & TITLE OF OFFICIAL

SWORN TO AND SUBSCRIBED BEFORE ME BY_____

WHO IS PERSONALLY KNOWN TO ME, THIS_____DAY OF_____, 20_____

_____
(NOTARY PUBLIC)

MY COMMISSION EXPIRES_____SEAL

PLEASE NOTE THAT ALL THE WORK AWARDED OR SUBCONTRACTED TO YOUR FIRM UNDER THE SET-ASIDE PROGRAM IN A FISCAL YEAR (JULY 1-JUNE 30) INCLUDING THIS PROJECT, CANNOT BE MORE THAN $10,000,000.00

Mar.01

EXHIBIT II

CERTIFICATION OF WORK TO BE SUBCONTRACTED
NOMINATED SMALL CONTRACTOR/*MINORITY BUSINESS ENTERPRISE

* Delete if not applicable

DEPARTMENT OF TRANSPORTATION
CONTRACT DIVISION
2800 BERLIN TURNPIKE
NEWINGTON, CT 06111

PLEASE INCLUDE A COPY OF CERTIFICATION LETTER

CONTRACTOR_____

ADDRESS_____

TOWN_____PROJECT NO._____

DESCRIPTION OF PROJECT_____

_____

CONTRACT BID AMOUNT $_____

DATE_____

Listed below is the Nominated Small Contractor/Minority Business Enterprise for the above project and the requested data:

Name, Address & Tel No. of the Nominated Firm	ITEM(s)NUMBER(s) and Description of the Item(s) to be performed by and paid to the Subcontractor	Quantities (indicate if partial)	Prime's Bid Amount For Item	Dollar Amount Subcontracted	Small Business Set-Aside Dollar Requirement

Signed By _____
Small Contractor/*Minority Business Enterprise
(Subcontractor)

Signed By_____
Contractor

Title_____

Mar.01

EXHIBIT III

CERTIFICATION
PAST CONSTRUCTION EXPERIENCE

SMALL CONTRACTOR / * MINORITY BUSINESS ENTERPRISES

* Delete if not applicable

PLEASE LIST ALL CONSTRUCTION PROJECTS YOUR ORGANIZATION HAS WORKED ON IN THE PAST TWO FISCAL YEARS

PROJECT LOCATION NUMBER AND DESCRIPTION APPLICABLE	CONTRACT AMOUNT	IF WORK PERFORMED AS PRIME GIVE OWNERS NAME IF WORK PERFORMED AS SUBCONTRACTOR GIVE CONTRACTORS NAME	START DATE	ACTUAL OR ESTIMATED COMPLETION DATE	NAME AND PHONE OF OWNER OR PRIME CONTRACTOR AS

SIGNED BY: _____

SMALL BUSINESS CONTRACTOR
*MINORITY BUSINESS ENTERPRISES

D.O.T. PROJECT NO. _____

* Delete if not applicable

MARCH, 2001

SMALL CONTRACTOR/SMALL CONTRACTOR MINORITY BUSINESS ENTERPRISE (MBE) (SET-ASIDE) CONNECTICUT DEPARTMENT OF TRANSPORTATION AFFIDAVIT – SUPPLIER OR MANUFACTURER

This affidavit must be completed by the State Contractor's designated Small Contractor/ Small Contractor Minority Business Enterprise (MBE), notarized and attached to the contractor's request to utilize a Small Contractor/Small Contractor Minority Business Enterprise (MBE) supplier or manufacturer as a credit towards its Small Contractor/Small Contractor Minority Business Enterprise (MBE) contract requirement; failure to do so will result in not receiving credit towards the contract Small Contractor/Small Contractor Minority Business Enterprise (MBE) requirement.

State Project No. _____
Federal Aid Project No. _____
Description of Project _____

I, _____, acting in behalf of _____
(Name of person signing Affidavit) (Small Contractor/Small Contractor MBE contractor person,
_____ of which I am the_____ affirm that _____
firm, association or certify and corporation) (Title of Person) (Small
_____is a certified Small Contractor/Small
Contractor/Small Contractor MBE person, firm, association or corporation)
Contractor Minority Business Enterprise, as defined by Section 4a-60g of the Connecticut General Statutes, as revised.

I further certify and affirm that _____
(Small Contractor/Small Contractor MBE person, firm, association or corporation)
will assume the actual and contractual responsibility for the provision of the materials and/or supplies sought by _____. If a manufacturer, I produce goods from raw
(State Contractor)
materials or substantially alter them before resale, or if a supplier, I perform a commercially useful function in the supply process.

I understand that false statements made herein are punishable at Law (Sec. 53a-157, CGS, as revised).

_____
(Name of Small Contractor/Small Contractor MBE person, firm, association or corporation)

_____
(Signature and Title of Official making the Affidavit)

Subscribed and sworn to before me, the _____ day of _____ 200____.

_____
Notary Public (Commissioner of the Superior Court)

My Commission Expires _____

CERTIFICATE OF CORPORATION

I, _____, certify that I am the _____ (Official) 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)

(Corporate Seal)

ITEM #0062680A - TACTILE WARNING STRIP

Description: This item shall include furnishing and installing Tactile Warning Strip in the locations and to the dimensions and details shown on the plans or as ordered by the Engineer. Work under this item shall also include saw-cutting and milling of the concrete platform for installation of the tactile warning strip, as shown on the plans.

Materials: The Tactile Warning Strip shall be a prefabricated detectable warning surface tile chosen from the Department's Qualified Products Lists. The tile shall conform to the dimensions shown on the plans and have a solid homogeneous color throughout in compliance with MNR Standards or approved equal.

Construction Methods: The Tactile Warning Strip shall be installed according to the plans and all Manufacturers requirements for environmental conditions, site preparations, installation procedures, curing procedures, and material compatibility.

The detectable warning strip shall be installed 4" from the edge of concrete platform along the full length of the platform as shown on the plans.

The Contractor is responsible for removing any material spatters or debris and repairing any damage to the existing platforms arising from the installation of the tile.

Method of Measurement: The Tactile Warning Strip shall be measured for payment by the number of linear feet of tactile warning strip installed and accepted in the finished structure.

Basis of Payment: Installation of the tactile warning strip shall be paid for at the contract unit price per linear foot of "Tactile Warning Strip" complete in place. This price shall include all saw cutting concrete, cleaning, adhesive, drilling holes for fasteners, fasteners, materials, equipment, tools and labor incidental thereto.

Pay Item	Pay Unit
Tactile Warning Strip	L.F.

ITEM #0063521A – RAIL FACILITY UPGRADE (SITE NO.1)

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. Refer to "Notice to Contractor – Rail Facility Upgrade (Site No. 1)" for a listing of the CSI-formatted Specifications that apply to each MLSI

Construction Methods:

All methods of construction shall conform to the requirements as stipulated in the CSI-formatted Specifications that make up this MLSI. Refer to "Notice to Contractor – Rail Facility Upgrade (Site No. 1)" for a listing of the CSI-formatted Specifications that apply to this MLSI.

Method of Measurement:

This item will be paid for at the contract lump sum price for "Rail Facility Upgrade (Site No. X)" complete.

Basis of Payment:

This item will be paid for at the contract lump sum price for "Rail Facility Upgrade (Site No. X)", which price shall include all administrative and procedural requirements, material, equipment, labor, and work incidental thereto.

Pay Item	Pay Unit
Rail Facility Upgrade (Site No. 1)	L.S.

ITEM #0090028A - CATENARY POLE FOUNDATION, TYPE A

ITEM #0104051A - POLE FOUNDATION, TYPE B

ITEM #0104055A - POLE FOUNDATION, TYPE F

ITEM #0104056A - POLE FOUNDATION, TYPE R

ITEM #0702078A - DRILLED SHAFT ROCK EXCAVATION (3' DIA)

ITEM #0702860A - DRILLED SHAFT ROCK EXCAVATION (3.5' DIA)

ITEM #0702086A - DRILLED SHAFT ROCK EXCAVATION (4.5' DIA)

Description: Work under these items includes furnishing all labor, material, and equipment for the excavation for, construction of, and installation of, foundations for catenary structures. Work under this section also includes the painting of foundations.

Work under this section includes hand digging of exploratory test pits.

Work includes rock excavation, as required, for foundation installation.

Materials: Form 816 Section 12.02 - Overhead Sign Support Foundation shall apply, except as noted hereafter.

Concrete shall be Form 816 class "F". Air entrainment or retarding admixture shall only be used with the approval of the Engineer.

Reinforcing steel shall be Grade 60 as specified in Form 816, Section M.06.01. The minimum cover shall be as called for in the plans. Reinforcing steel shall be epoxy coated.

Steel casings used in connection with pole foundations Type A, B, and F (and RA, RB and RF with rock socket), shall have a material and wall thickness adequate for the shell to withstand the earth pressure taking into consideration the surcharge from a passing train. (See construction methods for load and influence line).

Anchor bolts shall conform to ASTM A1554 Grade 105 and supplementary requirement S6, nuts shall conform to ASTM A563. All surfaces shall be galvanized in conformance with Form 816, Section M.06.03.

Grout shall be of non-shrink type and shall be according to Form 816, Section M.03.01.12.

Ground wire shall be as specified in GROUNDING AND BONDING SYSTEMS.

Rock Anchor assemblies shall be of the hollow core prestressable type.

Polymer coating, as specified under the concrete repair items.

Submittals and Tests: Form 816, Section 6.01.03.22 (b) is amended by the requirement that the Contractor shall provide, cure and have tested concrete cylinders representing each separate batch of concrete or as frequently as determined by the Engineer. Seven and 28-day compressive test results are required. The tests shall be performed, at no cost to the State, by a testing laboratory acceptable to the Engineer and the results shall be submitted to the Engineer within 7 days of the tests. The Contractor shall, at his own expense, remove and replace any concrete that does not meet the specified compressive strength.

Mill certificates for reinforcing steel.
Shop drawings for reinforcing steel in accordance with Form 816, Article 6.03.1.
Shop drawings for rock anchorage.
Proposed concrete mix.
Certified concrete cylinder test results.
Procedure for installing foundations, including methods of shoring and field welding of sections.
Procedure for rock anchor installation.
Procedure for rock anchor proof testing and performance/creep testing per AASHTO
Manufacturer’s product description, catalog data, material specifications and detail drawings for adhesive anchor bolts.

Construction Methods: All applicable portions of Form 816 Section 12.02.03 shall apply except as noted hereafter.

The installation of Pole Foundations Type A, B, and F may be with or without casing left in place dependent on the stability of the soil and proximity of a railroad track. When a casing is left in place, it shall be installed in such a manner that there will be no voids between the earth and the casing. Any void shall be filled with concrete. If the casing is elected to be removed, it must be done so after the concrete has been poured.

The caisson shell shall be installed so that it, during installation, does not foul an active track, signal and communication or fiber optic cables or energized feeders. This may require the installation of shell in increments of length and field welding and/or the temporary raising of cable messengers and cables.

The Contractor may drop the concrete for Pole Foundations to their entire depth subject to the Engineers approval and provided that care is taken to prevent the concrete from hitting the reinforcing steel.

Pole Foundations of Type A, B, and F shall be installed to the depth indicated on the plans. Should sound rock be encountered before design depth is reached, and at a depth more than 5 ft below the ground surface, then the foundations shall be extended into the sound rock as shown for Foundation Types A, B and F with Rock Socket, as shown on the plans. Excavation depth into sound rock shall be as directed by the Engineer but not less than 5 feet or as otherwise indicated on the plans.

Should sound rock be encountered less than 5 ft below the ground surface, then Foundation Types A, B and F shall be installed as Foundation Types RA, RB and RF with Rock Anchors.

Prior to excavation, whether by machine or hand, the contractor shall install sedimentation control fence, as applicable.

The Contractor shall ascertain that there are no buried cables or duct banks, water lines, sewers or other utilities prior to excavating by the use of metal detectors or by hand digging exploratory test pits 4 feet deep and the same width as the foundation or as directed by the Engineer.

The Contractor shall demolish any buried foundations that may be encountered when excavating for foundations.

Foundation excavation for caisson foundations shall be carried out so that the stability of the railroad embankment is not endangered, taking into account the effect of passing trains. The live load influence line is defined as a line originating at the bottom edge of tie and extending downward at a slope of 1 (vertical) on 2 (horizontal). Open excavations must be designed to withstand, in addition to all common loads such as soil pressure and hydrostatic pressure, a railroad live load of Cooper E-80 or other loading magnitudes as may be directed by the Engineer.

The spoil material from excavation shall be disposed of on or off-site in a manner as directed by the Engineer.

The contractor shall reroute or restore ditching at new structures where they otherwise would impede the established drainage course.

Backfill shall be placed in accordance with Form 816 Section 2.03.03.7.

Should ground water be encountered, the Engineer may require a tremmie seal of one-foot minimum depth to be placed prior to reinforcing steel and the balance of the concrete. The surface of the tremmie concrete shall be dry and cleaned to sound concrete before concrete placement is resumed. Disposal of ground water may require “Handling Contaminated Ground Water” described in another Section.

The void between the top of the foundation and the underside of the base plate shall be completely filled with grout after the anchor bolt nuts have been tightened and the structure loaded. The grout shall be mixed and placed in accordance with the manufacturers recommendations.

Rock anchors shall be installed and grouted into place in accordance with the manufacturer's recommendations.

All structures shall be grounded through their foundations as shown on the plans.

Blasting will not be permitted except with the Engineers approval and the obtaining of proper state and local permits, as per Form 816 Section 1.07.08.

Open excavations and caissons shall be covered at the end of each shift.

Construction Tolerances

The along the track tolerance for placing foundations is 12".

The maximum deviation from plumb shall be not more than 1%.

The tolerances for placement of anchor bolts for single pole structures shall be:

Horizontally in the direction of the track ±6"

Horizontally perpendicular to the track -0" + 1"

Vertically ± 1/2"

The tolerances for placement of anchor bolts for a portal structure shall be:

Between north and south foundations ± 1"

Opposing portal structure anchor bolts must be within 1" of a perpendicular line across the tracks.

Horizontally in the direction of the track between multiple foundations for the same structure: 1/8"

Method of Measurement: CATENARY POLE FOUNDATION TYPE A, POLE FOUNDATION TYPE B, and POLE FOUNDATION TYPE F shall be measured for payment based on EACH foundations installed and accepted, regardless of the depth of the foundation and shall include all materials, tools, equipment and labor necessary to complete the foundations in conformity with the requirements of the plans or as ordered by the Engineer. There will be no separate measurement for auguring, earth excavation or its protection, disposal of excavated material, demolition of underground foundations or man-made obstructions, backfilling, ditching or grading, dewatering, form work, steel casings, regular or tremmie concrete, grouting, reinforcing steel, anchor bolts, ground wire but the work shall be included in the measurement of each foundation. Any excavation beyond the dimensions shown on the plans shall be filled with concrete at the Contractor's expense. Rock excavation shall be measured separately under the item DRILLED SHAFT ROCK EXCAVATION (3’ DIA), (3.5’ DIA) or (4.5’ DIA), as applicable.

DRILLED SHAFT ROCK EXCAVATION (3’ DIA), (3.5’ DIA) and (4.5’ DIA) is applicable to Type A, B, and F foundations. When rock is encountered 5 ft or more below ground surface, DRILLED SHAFT ROCK EXCAVATION shall be measured for payment based on the vertical distance of rock excavated within the specified diameter of the foundation and between top of existing ledge rock and bottom of the foundation excavation.

Foundation Types RA, RB and RF with Rock Anchors, as shown on the plans shall be measured by EACH pole foundation installed and accepted under the item POLE FOUNDATION, TYPE R, regardless of the size and depth of the foundation, based on the number of separate foundations installed and accepted. There shall be no separate or additional payment for auguring, earth excavation, back filling, ditching, or grading, concrete, grouting, reinforcing steel, anchor bolts, rock anchors or ground wire but the cost thereof shall be included in the unit price for the foundations. Rock Excavation shall be measured separately under the item STRUCTURE EXCAVATION ROCK (COMPLETE).

Rock for all foundation types is defined as (1) ledge rock (2) boulders exceeding one cubic yard in accordance with Form 816, Section 02.02.03.

Basis for Payment:
Pole Foundation Type A shall be paid by EACH pole foundation installed and accepted under the item POLE FOUNDATION, TYPE A and shall include all materials, tools, equipment and

labor necessary to complete the foundations in conformity with the requirements of the plans or as ordered by the Engineer.

Pole Foundations Type F, Fa and Fb, shall be paid by EACH pole foundation installed and accepted under the item POLE FOUNDATION, TYPE F and shall include all materials, tools, equipment and labor necessary to complete the foundations in conformity with the requirements of the plans or as ordered by the Engineer.

Pole Foundation Type Ba shall be paid by EACH pole foundation installed and accepted under the item POLE FOUNDATION, TYPE B and shall include all materials, tools, equipment and labor necessary to complete the foundations in conformity with the requirements of the plans or as ordered by the Engineer.

Foundation Types RA, RB and RF with Rock Anchors, as shown on the plans shall be paid by EACH pole foundation installed and accepted under the item POLE FOUNDATION, TYPE R, regardless of the size and depth of the foundation, based on the number of separate foundations installed and shall include all materials, tools, equipment and labor necessary to complete the foundations in conformity with the requirements of the plans or as ordered by the Engineer.
There shall be no separate or additional payment for auguring, earth excavation, back filling, ditching, or grading, concrete, grouting, reinforcing steel, anchor bolts, rock anchors or ground wire but the cost thereof shall be included in the unit price for the foundations. Rock Excavation shall be paid for separately under the item STRUCTURE EXCAVATION ROCK (COMPLETE).

Foundation Types A, B and F with Rock Socket, as indicated on the plans, shall be paid by EACH pole foundation installed and accepted under the item CATENARY POLE FOUNDATION TYPE A, POLE FOUNDATION TYPE B AND POLE FOUNDATION TYPE F, respectfully and shall include all materials, tools, equipment and labor necessary to complete the foundations in conformity with the requirements of the plans or as ordered by the Engineer.
Rock excavation shall be paid for separately under the item DRILLED SHAFT ROCK EXCAVATION (3’ DIA), (3.5’ DIA) or (4.5’ DIA), as applicable.

Disposal of excavated contaminated material off-site shall be paid for separately under other pay items.

There shall be no separate payment for handling, transporting and/or disposal of reusable spoils from foundation excavations, but the cost thereof shall be included in the unit price for EACH foundation installed and accepted.

There shall be no separate payment for exploratory test pits, but the cost thereof shall be included in the unit price for EACH foundation.

DRILLED SHAFT ROCK EXCAVATION (3’ DIA), (3.5’ DIA) and (4.5’ DIA) is applicable to Type A, B, and F foundations. When rock is encountered 5 ft or more below ground surface, DRILLED SHAFT ROCK EXCAVATION shall be paid by the number of Lineal Feet removed and shall include all materials, tools, equipment and labor necessary to complete the excavation for payment based on the vertical distance of rock excavated within the specified diameter of the foundation and between top of existing ledge rock and bottom of the foundation excavation.

Rock excavation applicable to Foundation Type RA, RB and RF with Rock Anchors shall be paid by the Cubic Yard under the item STRUCTURE ECAVATION ROCK (COMPLETE).

All survey required for construction of new foundations and ground anchors, including locating new foundations and anchors, top of rail and high rail references, grades and anchor bolt orientation shall be covered under CONSTRUCTION STAKING.

The temporary removal & restoration, guying or supporting of overhead obstructions, including but not limited to, railroad signal and feeder wire, track jumpers, communication cables, fiber optic cable or guy wires, shall not be paid for separately, but the cost thereof shall be included in the pay item(s).

Installation of sedimentation control fence shall be paid for by the linear foot and covered under the item SEDIMENTATION CONTROL SYSTEM.

There will be no separate payment for restoration or rerouting of existing drainage ditching disturbed due to at new structures, but the cost thereof shall be included in the pay item(s).

Basis for Payment: This work will be paid for at the contract unit or lump sum prices for the following pay items which prices shall include all transportation, materials, equipment, tools and labor incidental thereto.

Pay Item	**Pay Unit**
CATENARY POLE FOUNDATION TYPE A	EA
POLE FOUNDATION, TYPE B	EA
POLE FOUNDATION, TYPE C	EA
POLE FOUNDATION, TYPE F	EA
POLE FOUNDATION, TYPE R	EA
STRUCTURE EXCAVATION ROCK (COMPLETE)	CY
DRILLED SHAFT ROCK EXCAVATION (3’ DIA)	LF
DRILLED SHAFT ROCK EXCAVATION (3.5’ DIA)	LF
DRILLED SHAFT ROCK EXCAVATION (4.5’ DIA)	LF

ITEM #0090033A - CATENARY GUY ROCK ANCHOR

ITEM #0096064A - CATENARY GUY ANCHORS IN SOIL

Description: Work under this item consists of the supply and installation of anchors for down guys as shown on the plans and specified herein.

Work under this section includes hand digging of exploratory test pits.

Materials: Concrete shall be as specified for FOUNDATIONS.

Structural steel shall be as specified for STRUCTURAL STEEL or called for on the plans.

Rock anchorage assemblies shall be of the hollow core prestressable type.

Submittals: Shop drawings of structural steel and reinforcing steel.

Proposed Rock Anchors

Procedures for rock anchor installation.

Construction Methods:
The construction methods specified for Pole Foundations shall apply to Catenary Guy Anchors in soil.

The Contractor shall ascertain that there are no buried cables or duct banks, water lines, sewers or other utilities prior to excavating by the use of metal detectors or by hand digging exploratory test pits 4 feet deep and the same width as the foundation or as directed by the Engineer.

The Contractor shall demolish any buried foundations that may be encountered when excavating for foundations.

Catenary Guy Anchors shall be installed in line with the conductor to be terminated unless otherwise notified by the Engineer.

Catenary Guy Rock Anchors (GRA) shall be grouted in place in accordance with the manufacturer's recommendations.

The spoil material from excavation shall be disposed of on or off-site as directed by the Engineer.

Backfill shall be placed in accordance with Form 816 Section 2.03.03.7.

Placing of concrete shall be as specified for FOUNDATIONS.

Construction Tolerances: Catenary Guy anchors shall be within the following tolerances unless specified otherwise on the plans:

a. Along the track ± 12" of dimension given on the plans.

b. Across the track ± 3" but not within 9 ft. from centerline of track.

c. The top of GA-1 shall be within ± 1" of the required level shown on the plans.

d. Plumb: The maximum deviation from plumb shall not be more than 1% for concrete anchors.

e. The catenary guy rock anchor shall be in line with the down guy within 5 degrees

Method of Measurement: The work will be measured for payment by the actual number of Catenary Guy Anchors (GA-1 or GRA) installed. There will be no separate payment for earth excavation, concrete, structural steel, backfilling, concrete anchors, guy guards, guy stub PVC pipe, but the cost thereof shall be included in the unit price for down guys and anchors.

For Catenary Guy Anchors in Soil, rock excavation will be paid for under the item DRILLED SHAFT ROCK EXCAVATION (3.5’ DIA)

Disposal of excavated material off-site will be paid under other pay items.

Basis for Payment: This work will be paid for at the contract unit price for the following pay items which price shall include all transportation, materials, equipment, tools and labor incidental thereto.

Pay Item	**Pay Unit**
CATENARY GUY ANCHORS IN SOIL	EA
CATENARY GUY ROCK ANCHOR	EA

ITEM #0090037A - DOWN GUYS

Description: Work under this item consists of the supply and installation of galvanized steel wire, preforms, fittings and guy safety covers for down guys (guy assemblies), as well as for the installation of guy bracket assemblies, as shown on the plans and specified herein.

Applicable Standards: Pertinent provisions of the following listed and other relevant standards shall apply to the work of this Section, except as they may be modified herein:

Organi-zation	Number	Title
ASTM	A475	Zinc-Coated Steel Wire Strand

Materials: Guy Bracket Assemblies shall be as specified for STEEL (MISCELLANEOUS) or as called for on the plans.

The material used for stranded zinc-coated steel wire rope, shall be as specified for GALVANIZED STEEL WIRE, ALUMOWELD STRANDS AND WIRE ROPE.

Fittings shall be as specified in Section CATENARY FITTINGS AND HARDWARE.

The weight of coating shall not be less than that specified in A475 as applicable for the intended duty.

The Contractor shall provide certification that the galvanized steel wire has been designed, fabricated, and tested in compliance with the applicable provisions of the relevant standards.

Materials shall be protected against damage in ordinary handling and shipping. Each reel shall have a strong, weatherproof tag securely fastened to it showing the physical and mechanical properties as well as the steel type designation, ASTM designation and the name and mark of the manufacturer.

Submittals: Reports for each type of wire to be used containing the physical and mechanical properties of all components described in this Section shall be submitted. The conformance of components with these Specifications and the plans in the form of a manufacturer's certification shall be shown. Include the following as a minimum:

Size
Type
Material
Number of and diameter of individual wires
Overall diameter
Cross section area

Weight per foot
Rated breaking load

Submit catalog cuts for all crimp parts, tools and procedures.

The Contractor shall provide certification that the zinc-coated steel wire has been designed, fabricated, rated and tested in compliance with the applicable provisions of the standards referenced in these Specifications.

Shop drawings of miscellaneous steel.

Construction Methods: Zinc-coated steel wire rope shall be cut and installed using tools and methods specified by the manufacturer.

Down guys shall be installed before loading the structures. They shall be pulled taut, and secured in place with provisions for future adjustment as required to hold the structure in proper alignment after wires are pulled to correct tension. Catenary guy anchors in soil shall not be loaded until the concrete has reached a strength of 4000 psi.

Down guy attachments shall be installed as recommended by the manufacturer.

Down Guys anchored to the base of structures shall be installed before encasing the structure base in concrete.

The Contractor shall make final adjustments to the down guys as required to compensate for initial stretch.
Guy safety covers guards shall be installed as directed by the Engineer.

In certain locations there are signal cables, signal boxes and/or ladders attached to the structures. Should the Contractor have to temporarily relocate these in order to proceed with the installation of steel, the Contractor must obtain prior permission from the Railroad to do so.

The wire and wire rope shall be cut and installed using tools and methods specified by the manufacturer. Nicopress sleeves and hydraulic tools shall be used for crimping as required.

Splicing of the galvanized steel wire shall not be permitted.

Overgrown vegetation shall be selectively removed in order to provide a minimum five foot clear zone around the installed down guy and attachments.

Method of Measurement: The work will be measured for payment by the number of Down Guys (guy assemblies) installed, regardless of their length, including guy bracket assemblies. There will be no separate payment for excavation, concrete, steel, guy safety covers, or selective vegetative clearing, but the cost thereof shall be included in the unit prices for Down Guys.

Procurement and installation of guy attachment(s) to poles, such as guy bracket assemblies and swivel bracket assemblies shall be included in the item for DOWN GUYS.

The temporary removal and restoration, if any, of a member of the structure, including truss to post knee brace, or signal cables, signal cases, ladders, platforms or other impediment attached to the structure, in order to facilitate the installation of down guy assemblies shall not be paid for separately, but the cost thereof shall be included in the item DOWN GUYS.

Basis for Payment: This work will be paid for at the contract unit price for the following pay items which price shall include all transportation, materials, equipment, tools and labor incidental thereto:

Pay Item	**Pay Unit**
DOWN GUYS	EA

ITEM #0090042A - CATENARY SYSTEMS

Description: Work under this item consists of the supply and installation of the fixed-termination (FT) catenary system in Stamford Yard, specifically for Tracks 6, 8, 10, 12, lower lead and car wash tracks.

The catenary system is broadly defined as those conductors, and related items, forming the overhead power distribution system, and comprise the catenary messenger and contact wires, hangers, feeder bus, sectioning devices, and ground connections, together with their related supports and insulation. The Contractor shall supply an inspection vehicle with driver for inspection.

Work shall include the installation of transitional cross-overs between new catenary and existing catenary, as required due to construction staging.

Work shall include the design and installation of temporary fixed-termination catenary overlaps and cross-overs required due to construction staging.

The Contractor shall be responsible for coordinating the catenary system installation with the Railroad and the requirements set forth in the Special Provisions, obtaining necessary outages for conducting work, and turning the work over to the Railroad for its use as specified.

This Section covers the manufacture, supply and installation of the catenary assemblies. The work includes but may not be limited to the following:

> Messenger support assemblies, Cantilever assemblies, Tail wire support assemblies, Contact wire registration assemblies, Pull-off assemblies, Dead end assemblies, Cross span assemblies, Feeder and jumper assemblies, Midspan insulation assemblies, Span wire insulation assemblies, Across track feeder assemblies.

The Contractor shall supply, and install all applicable assemblies for the catenary system as per the plans. The assemblies shall be formed out of the Railroad's standard components as far as possible. Any departure shall require Engineer's prior approval.

This Specification covers the manufacture and supply of ferrous and non-ferrous metal catenary material, hardware and fittings. The work includes but may not be limited to the following:

> Hanger and hanger assembly fittings, Cross contact assembly fittings, Clevis-tongue fittings, Clevis-clevis fittings, Parallel wire clamps, Nuts, bolts, washers, keys and cotter pins, Shackles, Links and eyebolts, Messenger, contact and span, wire terminations and turnbuckles, Double clevis end fittings, Thimbles, Wire sleeves, Messenger suspension clamps and span wire supports, Span wire clamps, Wire connectors, Full tension

compression joint fittings, Strain clamps, Wire knuckles, Anti-torsion pipe hanger, Wire splices.

For tension tests, a minimum of three test bars shall be poured from each lot of metal.

For chemical analysis each lot of castings shall be analyzed for conformance with the chemical composition specified in the referenced ASTM Standards.

A lot shall consist of all castings produced from a furnace melt.

The work of this Section covers the manufacture, and supply of various types of insulators for the catenary, feeders, traction power and signal power systems, as shown on the plans and specified herein. Catenary insulators shall be incorporated into support, registration, termination and in-span assemblies as shown on the plans.

This Specification covers the supply and installation of uninsulated wires as shown on the plans. This work shall include, but may not be limited to, the following:

Catenary Messenger Wire, Contact Wire, Catenary Jumper Wire, Traction Feeder and Tap Wires, Signal Power Wires, Ground Wire, Cross Span Wires, Pull-Off Wire and Steady Wire.

The Contractor shall supply and install all applicable bare wires for the overhead catenary system in accordance with the requirements specified on the plans.

Applicable Standards: Pertinent provisions of the following latest standards shall apply to the work of this Section, except as they may be modified herein, and are hereby made a part of this Specification to the extent required.

Organi-zation	Number	Title
ANSI	C2	National Electrical Safety Code
ANSI	C29.1	Test Methods for Electrical Power Insulators Including Addenda C291a and C29.2a
ANSI	C29.2	Wet Process Porcelain Insulators (Suspension Type)
ANSI	C29.7	Wet Process Porcelain Insulators (High-Voltage Line-Post Type), Including Supplement C29.7a
ANSI	C29.8	Wet Process Porcelain Insulators (Apparatus, Cap and Pin Type)

Organi-zation	Number	Title
ANSI	C76.1	Code for Outdoor Apparatus Bushings, Requirements and Test
ANSI	Z55.1	Gray Finishes for Industrial Apparatus and Equipment
ASTM	A27	Mild to Medium-Strength Carbon-Steel Castings
ASTM	A36	Steel Plates, Shapes and Bars, Structural Steel
ASTM	A47	Malleable Iron Castings
ASTM	A123	Zinc Coatings on Products Fabricated From Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strips
ASTM	A150	Aluminum Bronze Rod, Bar and Shapes
ASTM	A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM	A167	Stainless and Heat-Resisting Steel
ASTM	A276	Stainless and Heat Resisting Steel Bars and Shapes
ASTM	A368	Stainless and Heat Resisting Steel Wire Strand
ASTM	A484	General Requirements for Stainless and Heat-Resisting Wrought Steel Products
ASTM	A492	Stainless and Heat Resisting Steel Rope Wire
ASTM	A518	Corrosion-Resistant High Silicon Cast Iron
ASTM	A530	General Requirements for Specialized Carbon and Alloy Steel Pipe
ASTM	A536	Ductile Iron Castings
ASTM	A555	General Requirements for Stainless and Heat-Resisting Steel Wire
ASTM	A580	Stainless and Heat Resisting Wire

Organi-zation	Number	Title
ASTM	A588	High-Strength, Low Alloy Structural Steel
ASTM	A668	Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM	A711	Carbon and Alloy Steel Blooms, Billets, and Slabs for Forgings
ASTM	A747	Steel Castings, Stainless, Precipitation Hardening
ASTM	B1	Hard-Drawn Copper Wire
ASTM	B3	Soft or Annealed Copper Wire
ASTM	B8	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM	B9	Bronze Trolley Wire
ASTM	B30	Specification for Copper-Base Alloys in Ingot Form
ASTM	B148	Aluminum-Bronze Sand Castings
ASTM	B173	Rope-Lay-Stranded Copper Conductors Having Concentric-Stranded Members, for Electrical Conductors
ASTM	B193	Test Method for Resistivity of Electrical Conductor Materials
ASTM	B228	Concentric-Lay-Stranded Copper-Clad Steel Conductors
ASTM	B229	Concentric-Lay-Stranded Copper and Copper-Clad Steel Composite Conductors
ASTM	B248	General Requirements for Wrought Copper and Copper-Alloy Plate, Sheet, Strips and Rolled Bar
ASTM	B249	General Requirements for Wrought Copper and Copper-Alloy Rod, Bar and Shapes

Organi-zation	Number	Title
ASTM	B258	Standard Nominal Diameters of Cross-Sectional Areas of AWG Sizes of Solid Round Wires Used as Electrical Conductors
ASTM	B584	Copper-Alloy Sand Castings for General Applications
ASTM	C150	Portland Cement
ASTM	C151	Test Method for Autoclave Expansion of Portland Cement
ASTM	D116	Vitrified Ceramic Materials for Electrical Applications, Testing
ASTM	F1154	Specification for Turnbuckles, Swaged, Welded, Forged
NFPA	70	National Electrical Code
US FED	RRC271	Chain and Attachments, Welded and Weldless
NEMA	HV-1	Insulators, High-Voltage

If other types of materials are proposed, the Contractor shall, along with the product description, include the relevant standards and information on that material in his submittal to the Engineer for approval.

Submittals: Submittals shall be in accordance with Section 1.05, Control of the Work and the Notice to Contractor - Submittals.

A complete description of the methods and procedures for new and temporary construction shall be submitted for review by the Engineer prior to starting the work. The description shall indicate the following as a minimum:

Proposed stringing methods, including special precautions, if any.

Proposed temporary arrangements for transitional cross-overs, sectioning, equipment lowering and installation of new pull-off assemblies.

The Contractor shall prepare and submit working drawings detailing the construction methods and materials to be used for the installation of the catenary overlaps between the existing

mainline catenary system and the new fixed-termination catenary system. Working drawings shall include the design, methods and materials to be used for the installation of temporary fixed-termination catenary overlaps at all locations.

Acceptance measurements shall be submitted upon completion of installation of individual tension lengths of catenary and at the completion of each work stage when catenary is to be placed back in service.

Catenary Assemblies

Certification: Furnish a certification verifying that all material included in the assemblies has been manufactured, inspected and tested in accordance with the referenced standards and these Specifications and conforms to the Railroad's standards.

Test Reports: Furnish copies of reports of all factory tests including quality assurance checks, required by these Specifications and all relevant standards. The Engineer reserves the right to check and inspect the manufacture, testing and quality control procedures at any time.

Manufacturer's Data: Furnish complete assembly and component drawings indicating working loads and factor of safety in each application. Components, small part steel or assembly drawings shall be prepared using Microstation. Submit catalog cuts for all crimp parts, tools and procedures for all assemblies. Submit working loads and factor of safety of components in each application. Shop drawings that do not include the working loads and factor of safety data shall be summarily rejected.

Catenary Fittings and Hardware

Plans: The Contractor shall submit shop/working drawings and material specifications for all components for approval prior to ordering or fabrication showing details and dimensions, and giving designations of the materials comprising the various components/ subcomponents together with technical, mechanical, electrical characteristics and material specifications as appropriate. Component, small part steel, or assembly drawings shall be prepared using Microstation. Submit catalog cuts for all crimp parts, tools and procedures for all assemblies. Submit working loads and factor of safety of components in each application. Shop drawings that do not include the working loads and factor of safety data shall be summarily rejected.

Insulators

Manufacturer's certification shall be provided showing compliance with the applicable requirements of the referenced standards, these Specifications and the plans.

Shop Drawings: Shop Drawings shall be submitted prior to fabrication. Component drawings shall be prepared using AutoCAD 14. Included, as a minimum, shall be:

Electrical:

Creepage length (inches)
Insulation level (impulse withstand test voltage, kV)
DC withstand voltage (kV)
Maximum working voltage (kV)

Mechanical:

Attachment centers or overall length (inches)
Shed diameters (inches)
Core diameters (inches)
Breakdown of weights, insulator and fittings (pounds)
Tensile withstand load (pounds)
Cantilever withstand load (inch-pounds)
Recommended maximum working tensile load (inch-pounds)
Material/procurement specifications (including end caps and touch-up insulator sealants)
Manufacturer's design mechanical and electrical safety factors

Working drawings of hardware and components

Listing and description of components and hardware

List of values of BIL, ultimate tensile strength, ultimate torsional strength, weight (including weight of components) and electrical characteristics.

Certification of compliance for the following:

Steel analysis
Hot-dip galvanizing
Adhesive materials
Insulator materials
In service record of proposed insulators
Certified quality control procedures used in the manufacturing process

Storage and handling instructions.

Maintenance manuals.

Stainless Steel Wire Rope and Rod

Certification: Furnish certification verifying that the stainless steel wire rope, and rod have been designed, manufactured, inspected and tested in accordance with the referenced standards and these Specifications.

Test Reports: Furnish copies of reports of all factory tests as required by these Specifications and referenced standards.

Manufacturer's Data: Furnish complete manufacturer's data, relevant drawings and material/procurement specifications.

Uninsulated Wires

The Contractor shall submit product data and relevant drawings for approval prior to wire manufacture. Included as a minimum shall be:

Physical Characteristics and Parameters

- Size
- Type and stranding class
- Material
- Number of and diameter of individual wires
- Overall diameter
- Cross section area
- Weight per foot
- Rated breaking load.

Electrical Characteristics

- Rated current carrying size (AWG/kcmil)
- Resistance per unit length.

The Contractor shall furnish certification from the manufacturer verifying that the wires have been designed, manufactured, inspected and tested in accordance with applicable portions of the referenced standards, these Specifications, and the plans.

The Contractor shall provide certified copies of manufacturer's test reports for the specific wires furnished, which shall include but not limited to the following:

- Initial and Final Modulus of Elasticity (E)
- Coefficient of Thermal Expansion (CTE)
- Yield stress
- Hardness values
- Contact wire joint strength test.

Materials: All parts shall conform with or be interchangeable with the Railroad's standard components.

Catenary Assemblies

The Contractor shall manufacture, supply, and install all applicable assemblies for the catenary system as per the plans. The assemblies shall be formed out of the Railroad's standard components as far as possible. Any departure shall require Engineer's prior approval.

Catenary Assemblies includes but may not be limited to the following:

Messenger support assemblies
Cantilever assemblies
Tail wire support assemblies
Contact wire registration assemblies
Pull-off assemblies
Dead end assemblies
Cross span assemblies
Feeder and jumper assemblies
Midspan insulation assemblies
Span wire insulation assemblies
Across track feeder assemblies.

All assemblies, components and materials shall be protected against damage, during handling and shipping, storage and installation.

Store material to permit easy access for inspection and identification. Protect steel members and packaged materials from corrosion and deterioration.

All packaged components and/or assemblies shall have a waterproof tag securely fastened to the package showing the assembly or component name, number, or identification code.

Packaging and/or packing methods of all assemblies or components shall be approved by the Engineer.

All materials used in the components or the assemblies shall be of sufficient strength and durability to withstand the loads as shown on the plans, with the addition of a factor of safety of 2.5. Any substitution of materials shall be submitted to the Engineer for approval.

Structural Steel: Material for structural steel shall comply with ASTM A36 or A588. A36 material must be galvanized in accordance with ASTM A123. Fabricator to provide adequate vent holes to all enclosed areas prior to galvanizing.

Stainless Steel: Stainless steel material shall conform to ASTM A484.

Copper: All copper components shall conform to ASTM B248 or B249.

Copper-alloys for fittings and components shall conform to ASTM B584 and B248.

Aluminum components shall conform to ASTM A150.

All cotter pins shall be made out of stainless steel.

Pulley wheels for messenger supports shall be 8" minimum diameter with groove design for the messenger wire. These pulley wheels shall not be used for conductor stringing purposes. They will be manufactured from material conforming to ASTM B-30 alloy C95500 and ASTM B148, alloy C95500 and shall have the following physical composition and properties.

Copper 88 percent, Tin 2.5 percent, Lead 2 percent, Zinc 6.5 percent, Nickel 1 percent

Tensile Strength (psi)	37000
Yield Strength (psi)	14000
Elongation (percent in 2")	39
Reduction of Area (percent)	31
Brinell Hardness (10mm Ball 500 kg load)	55
Specific Gravity	8.8
Weight/Cu. in (lbs)	0.318
Pattern maker's shrinkage	3/16 (in /ft)
Melting Point (degrees F)	1860
Pouring Temperature (degrees F)	2150-2350
Machinability	75 percent free cutting brass

Pulley wheels shall be free to rotate without rubbing against the insulator or end-cap. They shall be fitted with needle or roller bearings to promote maintenance free non-seizing operation.

Jumpers and feeders shall be sized as shown on the plans. Jumpers shall be flexible wire rope or braid Class H; shaped and supported to reduce possible failure due to fatigue induced by differential uplift of the conductors. Jumper and feeder clamps shall be bronze and sized to suit the electrical capacity of the jumper and shall be installed per the manufacturer's recommendations.

Compression-type dead-ends shall be used only where suitable bolted or wedge type fittings are unavailable.

Catenary Fittings and Hardware

The identification mark of the manufacturer or foundry and the pattern numbers assigned by the supplier shall be cast into all castings. Marks and numbers shall be readable size, and in such a position that they will not affect the electrical or mechanical performance.

Fittings and hardware shall be packed in accordance with the best commercial practice, adequate to ensure acceptance and safe delivery.
All shipping boxes, bags, or crates shall be properly marked showing the contents of each. If different materials are packaged in a box, bag or crate all items of kind should be boxed, bagged or crated and properly marked or tagged prior to placement in the shipping vessel.

Catenary fittings and hardware shall be packaged in a manner to allow stacking and outdoor storage until installation with no harmful effects.
Material for hardware and fittings shall comply with the applicable referenced standards. Substitutions will be considered and approved if the requirements of the Contract Documents are satisfied. The Contractor shall be responsible for form and fit of all catenary components and hardware, as shown on the plans.

The material/components shall be lightweight and reliable to ensure a 30 year life period. They shall be of proven designs, which shall have been used on railroad catenary systems.

The Contractor shall furnish all labor, tools, equipment, apparatus and facilities as required to assemble catenary fittings/hardware and perform installation work as required.

Structural Steel: Material for structural steel shall comply with ASTM A36 or A588. A36 material must be galvanized in accordance with ASTM A123.

Alloy Steel: 5/8", 3/4", and 7/8" shackles shall comply with the performance and dimensional requirements of US Federal Specification RR-C-271.
3/4" x 6" turnbuckles shall be Type 1 Grade 1 per ASTM F-1145, Class D, G or H.

Forged Steel: Materials for forged steel shall comply with ASTM A711 or A668. All fittings and components shall be hot-dip galvanized in accordance with ASTM A153.

Malleable Iron: Fittings or components made of malleable iron shall be grade 32510 or better and shall conform to ASTM A47. All components and fittings shall be galvanized in accordance with ASTM A153.

Ductile Iron: Fittings or components requiring high yield strength shall be of ductile iron, grade 60.40.18 or better and shall conform to ASTM A536. All fittings and components shall be galvanized in accordance with ASTM A153.

Stainless Steel: Stainless Steel hardware shall conform to ASTM A747.

Non-Ferrous Metals: Copper-alloys for fittings and components shall conform with ASTM B30, B584 and B148.

Copper: All copper components shall conform to ASTM B248 or B249.

All cotter pins shall be made of stainless steel.

The designated metals shall be produced by an approved method that will meet the requirements of these Specifications and the plans.

Castings shall be of uniform quality and shall be made in such a manner that the material of the casting conforms to the chemical and mechanical properties prescribed in the referenced ASTM Standards.

The castings shall be free of adhering sand, voids, cracks, surface porosity and non-uniform dimensions.

The Contractor shall be responsible for the dimensional accuracy of all fittings and hardware.

Repairs shall be permitted only to the extent allowed by the referenced ASTM Standards. If welding or repair of a greater magnitude is required, the Contractor shall obtain the Engineer's approval prior to processing.

Insulators

All parts shall conform with, or be interchangeable with the Railroad's standard components.

The Contractor shall ensure that all materials furnished are suitably packaged, stored and protected from damage and exposure.

The Contractor shall handle and otherwise use the insulators in accordance with the manufacturer's instructions, so as to ensure that the products are not damaged or misused prior to or during installation.

Any damage to the insulators shall be the Contractor's responsibility, and replacements shall be accomplished by the Contractor in accordance with the manufacturer's instructions.

The insulators shall have a minimum in-service life expectancy of 30 years under normal operating conditions.

The insulators shall be unconditionally guaranteed by the manufacturer and/or supplier to be free from defects for a period not less than five years

The suspension, termination and rod insulators shall be of non-ceramic type. The pin and post insulators shall be made of the best commercial-grade wet-process porcelain.

The entire surface of the porcelain insulators that will be exposed after assembly shall be glazed in No. 70 light gray color as specified in ANSI Z55.1.

The surface shall be free of imperfections. Pieces with imperfections in the glaze repaired by re-coating and refiring, as well as those pieces repaired by re-touching with paint, will be rejected.

Cement used for assembling porcelain to metal shall meet or exceed the requirements of ASTM C150 and C151.

The non-ceramic insulator shall be a unit consisting of a rod; weather sheds as required, and end fittings. The rod shall be made of glass fiber or reinforced polymer (silicon, rubber, teflon, or cycloalipathic resin), with its fibers running longitudinally through the rod length. The rod may be attached to the end fittings or hardware by a compression sleeve, wedge or adhesive. If adhesive is used, the adhesive shall encapsulate the rod in the end-fitting cavity and shall form a compressive wedge upon loading. Weather sheds shall, for the expected life of the insulator, protect the rod from the elements and insure the necessary leakage distance.
The non-ceramic insulator shall be constructed so as to be a lightweight, compact unit with high-impact strength. Weather sheds shall be "self-cleaning" and weather resistant to reduce the possibility of ice bridging between sheds. They shall be of a material that is vandal resistant in so far as being shatterproof, thereby reducing vandalism damage.

All non-ceramic material shall have a smooth, void-free finish. All adhesive coatings shall be sealed to the fittings to protect them against the ingress of moisture.

The design shall be such that stress due to temperature variation, and mechanical extension/contraction in any part of the insulator under load and normal handling, shall not lead to deterioration. The materials used shall not cause degradation by chemical interactions.

The end fittings attached to the insulator's fiberglass rod shall ensure exact alignment with the rod and correct assembly with respect to each other to avoid torsional stress when the insulator is installed.

The insulators shall be so designed that no sparking or arcing shall occur on the surface of the insulator when energized at the maximum design voltage under clean and dry conditions.

The insulators shall be designed to suit the various assembly arrangements, as shown on the plans.

The metal parts of the insulators shall be made of malleable iron, Grade 35018, to conform to ASTM A47, or open-hearth or electric furnace steel. All ferrous metal parts shall be galvanized in accordance with ASTM A153. Insulator fittings shall provide for connections as shown on the plans.

To protect the galvanizing from harmful chemical action of the cement, the hardware, which is in contact with cement, shall be coated with a bituminous paint, or the hardware shall be protected as recommended by the insulator manufacturer for use with his materials.
Insulators shall be tested in accordance with ANSI C29.1.

The mechanical strength of insulators shall meet or exceed the strength indicated on the plans.

Insulators for various uses shall have ratings not lower than the classes indicated on the plans.
Types and electrical classes and minimum mechanical characteristics for insulators shall conform to the plans. The overall length of the insulators shall conform to the plans for standardization.

The Engineer reserves the right to witness the manufacture, testing and packing of all insulators. The manufacturer will notify the Engineer not less than ten days in advance of manufacturing and testing operations.
Each insulator shall bear the manufacturer's name, mark number, and year of manufacture, clearly and permanently imprinted, without affecting the appearance or the function of the item. The insulators shall be supplied complete with hardware, etc. as indicated on the plans.

The insulators shall be designed for the class of insulation specified on the plans for specific operating and environmental conditions. The insulators shall have the following classifications with their corresponding characteristics:

Classification	Insulation Class (kV)	Creepage Distance (inches)	Impulse Wet Flashover (kV)	Withstand (kV)
Catenary*	25	24	60	150

* Catenary insulators shall include all strut, cantilever, suspension and pin types.

Stainless Steel Wire Rope and Rod

The wire rope shall be shipped on reels suitable for the weight carried.

The rod shall be shipped on reels suitable for the weight carried or in straight lengths, securely bundled. Rods shipped on reels shall be straightened prior to use.

All material shall be protected against damage during handling and shipping. Each reel or bundle shall have a strong, weatherproof tag securely fastened showing the physical and mechanical properties as well as type designation, ASTM designation and the name and mark of the manufacturer, the total length and weight of the wire rope, strand or rod on each reel or bundle.

High corrosion resistant austenitic grade stainless steel compatible with component items shall be used.

The component items shall be designed to carry maximum working loads with a factor of safety of 2.5 minimum based on yield stress.

Stainless steel wire rope shall be extra flexible and manufactured, and tested and in conformance with requirements of ASTM A368, A492, A555, and A580

Stainless steel wire strands shall be manufactured and tested in conformance with requirements of ASTM A368, A555, and A580.

Stainless steel rod shall be round and manufactured and tested in conformance with requirements of ASTM A276.

Uninsulated Wires

Uninsulated wires include, but may not be limited to the following:

Catenary Messenger Wire

Contact Wire
Catenary Jumper Wire
Traction Feeder and Tap Wires
Ground Wire
Cross Span Wires, Pull-Off Wire and Steady Wire.

The Contractor shall supply and install all applicable bare wires for the overhead catenary system in accordance with the requirements specified on the plans.

Conductor materials shall be of a composition, quality and purity such that the finished product shall have the physical, mechanical, electrical properties, characteristics and parameters conforming to this Specification and the plans.

The wires shall be unconditionally guaranteed by the manufacturer and/or supplier to be free from defects for a period not less than five years.

The Engineer reserves the right to witness the manufacture, testing and packing of all wires. The manufacturer shall notify the Engineer not less than ten days in advance of manufacturing and testing operations.

All wires shall be subject to factory quality control tests as required in the applicable standards. Tests shall be performed on each reel prior to shipment. A certified copy of the test report for each reel shall be submitted to the Engineer prior to shipment. A copy of the test report shall be packed with each reel.

Grooved contact wire supplied in accordance with ASTM B9 shall be subject to the twist test in addition to other required tests. The twist test shall be performed as specified for round wire, except that six twists shall be required. Contact wire not meeting this test will be rejected.

All wires shall be shipped on wooden reels, suitable for the weight of the wires and shall be protected from damage. The diameter of the drum shall be sufficiently large so as to avoid difficulty with waves or kinks when the wire is strung. The grooved contact wire shall be wound on the reel in such manner that the vertical axis of cross section shall be parallel to the axis of the reel. Any permanent twisting or rotation of the grooved contact wire shall be cause for rejection of the reel at the manufacturer’s or Contractor's expense.

Each reel shall consist of one continuous, unspliced wire; and shall have the required length of wire so that no splices are required in the tension sections as installed unless approved by the Engineer.

Contact wire shall be permanently identified at intervals of 300' along its length on the surface of the top lobe, showing the manufacturer's mark, material, size, and year of manufacture.

Each reel shall have a strong, weatherproof tag or marker securely fastened to it, showing the size and type of wire as well as the ASTM designation, name and mark of the manufacturer, total reel length, reel weight and manufacturer's special instructions.

A stripe in any contrasting color approximately 1" wide shall be painted across the outermost layer on each reel. Any visible wire shift at this line, upon receipt at the job site, will be treated as indicating a relative wire movement during shipment, and is cause for reel rejection.

Joints in contact wire shall be marked with paint or dye prior to wire drawing. The marks shall be readily distinguishable after the wire drawing process. Such joints shall meet the breaking strength requirements of the trolley wire.

Any damage to the wires shall be the Contractor's responsibility, and all repairs and replacements of the damaged wires shall be at the Contractor's expense.

Factory fused trolley splices in a wire run shall have their locations from the nearest structure recorded by the Contractor and provided to the Engineer and MNR with the as-built plans.

Construction Methods: Proper clearances shall be maintained through the construction stages to ensure that the final installation adheres to OSHA, NESC and MNRR rules for climbing space, clearances to communications cables, trailing wires, termination strands, and adjacent energized circuits. A climbable structure is defined as any structure or pole, including catenary portal columns, that can be climbed to access signal feeders, power feeders or other equipment supported above.

Insulators:

All insulators shall be cleaned before installation. Only clean rags, free from any abrasive material shall be used for cleaning insulators. Wire brushes shall not be used for cleaning any parts, metal or otherwise. In the completed line, all insulator assemblies and hardware shall be clean, bright and free from nicks, chips or other mars.

Cantilevered insulators of messenger support assemblies shall be level after loading.

Fittings & Hardware:

Installation requirements for fittings and hardware shall be in accordance with the manufacturer's recommendations and as shown on the plans.

All fittings and hardware used for catenary assemblies shall be selected and made such that they can be reused after removal.

All fittings and hardware shall be designed with maximum interchangeability and standardization for easy interface with the other components of the catenary system.

All fittings and hardware shall be designed to provide a homogenous catenary hardware and assembly arrangement.

Components and assemblies shall be designed such that all fastenings and adjustments are accomplished with the same dimensional standards or tools.

Where knuckles are used, their selection shall require that they are not displaced in the along track direction by more than 5 degrees.

Hanger types and locations, size, length and spacing shall be as indicated on the plans and tabulations to be provided by the Engineer based on the field data to be furnished by the Contractor. The loops of hangers shall be free to rise on messenger saddles without binding.

Hangers shall be formed before installation by use of jigs and tools approved by the Engineer. Hanger identification labels shall be removed before the catenary is commissioned. The hangers required for an individual span shall be called a hanger set assembly.

Messenger wire saddles shall retain the hanger loops irrespective of saddle orientation by means of extended lobes, as shown on the plans. Messenger wire saddles for hangers shall be insulated from the messenger wire by means of insulating neoprene sleeves not less than one-tenth of an inch thick.

All pole-line hardware shall be installed as shown and as recommended by the manufacturer. Bolts and nuts shall be properly tightened in accordance with the manufacturer's recommendations. All bolts shall be of sufficient length for a full thread beyond the nut and/or lock nut, but shall not protrude beyond the nut and/or lock nut more than 1/2", excluding foundation bolts. Bolt ends shall not be cut off. Where lock nuts are not used, lock washers shall be provided.

Hardware shall be installed using tools and methods specified by the manufacturer and approved by the Engineer.
Hardware shall be inspected for cleanliness and damage. Any item that does not fit, creates scraping of galvanizing during installation, or is found defective shall be rejected.

Cotter pins shall be installed with the open end toward the ground.

Suspension-link type messenger supports shall be installed within 600 feet of mid-point anchors.

Connectors:

Current-carrying connectors, shall be as shown on the plans and shall be installed in accordance with the manufacturer's recommendations. Connectors for copper or bronze wire shall be copper or bronze or a combination of copper and bronze.

Where possible, the connectors shall be factory-loaded with a corrosion inhibitor, which is made for the specific purpose. Wire surfaces, which are in contact with conducting surfaces of the connector shall be thoroughly wire brushed and an inhibitor applied. Where connectors are not factory-loaded, the same inhibitor shall be applied in the field to the connector.

Corrosion inhibitors shall be stable over a wide temperature range, adhere to cold metal surfaces, be water-repellent, weather resistant and inert to copper, aluminum, zinc, tin, cadmium, steel and neoprene rubber. Grit-bearing inhibitors shall be used except for flat lugs, sliding surfaces or where not recommended by the connector manufacturer. Grit shall be compatible with the connector and wire metal.

One typical full-tension test of each type of splice for each type of conductor shall be fabricated independent of the catenary and shall be tested by an independent testing laboratory approved by the Engineer or by another means acceptable to the State. The tensile strength and electrical conductivity of full-tension line splices shall be at least equal to the values specified in NEMA Standard CC3 for Class 1, full-tension connectors. Copper and bronze line splices shall conform to the specified standard of 95 percent tensile strength and 100 percent conductivity (minimum).

Contact wire splices shall be permitted only with the approval of the Engineer. When permitted, contact wire splices shall be designed to avoid the formation of “Hard Spots” in the catenary system. Maximum separation of spliced trolley wires shall be 1/32 of an inch.

Conductors:

For each length of conductor installed, a record shall be kept of the reel number from which the conductor was used. Partly used reels shall be recorded as such.

All conductors shall be handled in accordance with good overhead line practice and the manufacturer's recommendations.

Conductors shall normally be ordered with several lengths of conductors on one reel to satisfy several anchor-to-anchor runs. They shall be supplied in one (1) length. As each anchor-to-anchor length is removed, the length remaining on the reel shall be recomputed and properly recorded both on the reel and on substantiating documentation.

Care must be taken with reels so as not to jeopardize the stringing operation. Damaged reels shall be set aside for repair before use.

Installation of Drop Tubes:

Drop tubes shall be installed to be vertical after loading by the equipment. The bottom end of all drop tubes shall be installed so as not to intrude into pantograph clearance envelope (with contact wire in the uplifted position) as per the plans.

Stainless Steel Wire Rope and Rod:

Installation of wire rope, rod, and strands shall be as shown on the plans and in accordance with manufacturer's recommendations. Nicopress sleeves and hydraulic tools shall be used for crimping as required.

Torque Values:

The following table shows torque values for Dossert equipment. If a different company is used, then the contractor shall develop a similar table giving manufacturer-recommended torque values.

TABLE OF TORQUE VALUES FOR USE WITH CATENARY SUPPORTING STEEL ATTACHMENT BOLTS, CATENARY ASSEMBLIES, SUB ASSEMBLIES, HARDWARE, FITTINGS AND OTHER COMPONENTS

HEX HEAD BOLTS	TORQUE VALUE
3/8" DIAMETER	20 - 22 FT. LBS.
1/2" DIAMETER	40 - 42 FT. LBS.
5/8" DIAMETER	70 – 72 FT. LBS
3/4" DIAMETER	

CROSBY WIRE ROPE CLIPS	TORQUE VALUE
ROPE SIZE 3/8" DIAMETER	45 FT. LBS.
ROPE SIZE 1/2" DIAMETER	65 FT. LBS.
ROPE SIZE 5/8" DIAMETER	95 FT. LBS.

SPECIAL ITEMS	TORQUE VALUE
DOSSERT STRAIN CLAMP	
SECL50 (MESSENGER WIRE D.E.)	70 - 72 FT. LBS.
1/2" DIAMETER HIGH STRENGTH STEEL "U" BOLTS	

DOSSERT HOLLOW BOLT USED WITH CONTACT WIRE CLAMPS AND JUMPER CLAMPS 5/8" DIAMETER BRONZE	52 - 55 FT. LBS.

Installation of Catenaries:

Catenaries shall not be erected without the catenary guy anchor assemblies being in place, ready to receive loads.

Care shall be taken to prevent kinks in the wires and cables. The Engineer reserves the right to reject any contact wire in its entirety if it is judged that any kink will jeopardize current-collection performance. Bird caging of stranded wire shall be cause for rejection.

Tensions in all conductors shall be as given in temperature-tension charts, +/- 5 percent.

Splicing of conductors is not acceptable in any in-running contact wire (one which is in contact with the pantograph) except where called for on the staging plans or unless approved by the Engineer. When permitted, contact wire splices shall be designed to avoid the formation of "Hard Spots" in the catenary system. Maximum separation of spliced trolley wires shall be 1/32 of an inch.

Splicing of messenger wires is not acceptable except where called for on the staging plans or unless otherwise approved by the Engineer.

No splice will be permitted within five feet of a support clamp.

Any damage to the conductors shall be reported, in writing, to the Engineer. Remedial action must be approved by the Engineer and will be performed as directed.

The Contractor shall provide any temporary anchors and down guys required to facilitate system installation and construction staging at the Contractor's expense.

After installation of support and registration assemblies and stringing of conductors, adjustment may be required to the stagger, heel setting, contact wire height to be within the specified design tolerances.

Messenger wire heights shown on the plans are nominal values. Additional adjustment to the messenger wire heights may be necessary to achieve proper trolley wire heights.

Conductor interfaces of all clamps for feeder jumpers, full feeding jumpers, tap wires, equalizing jumpers and in-span jumpers shall be coated with conductive grease.

The Contractor shall review and note all field changes from the design, and submit these changes together with his recommendations to the Engineer for approval.

Span wire registration assemblies of pull-offs and steady spans shall be adjusted such that the heels of steady arms are clear of the pantograph clearance envelope under operating ice load conditions.

The slack end of the steady span shall have a normal tension of 500 lbs.

Wire sizes, location of turnbuckles; insulators, suspension assemblies, and hangers for the catenary shall be installed in accordance with the plans or as directed by the Engineer.

Field adjustments of hangers, contact and messenger wire heights shall be performed by the Contractor.

Stagger, wire heights, and heel setting of the steady arm shall be in accordance with the plans or as directed by the Engineer.

Installation of Catenary Assemblies not covered elsewhere:

Insulators for pull-off assemblies are shown on the plans centered between tracks. With track centers at 12 feet, the insulators for pull-off and cross span assemblies cannot always be exactly centered between the adjacent tracks. In these instances, the insulator should be installed as close as possible to the pull-of assembly. In all other instances, the insulator should be installed centered between adjacent tracks.

In-span insulating assemblies for wires crossing over the catenary are to be installed centered between adjacent tracks for maximum electrical clearance.

Registration, dead-end and pull-off assemblies should be constructed with maintenance and replacement tasks in mind. Span insulators shall be installed bearing in mind maintenance clearances and lateral adjustments.

Prior to the installation of in-span insulators, torsion shall be removed from stranded wire by use of a temporary swivel device, suitable for this purpose, installed at the insulator location.

All supporting devices including steady arms, messenger supports, cross span and steady wire or wire pull-off registration assemblies shall be installed as shown on the plans.

The design and installation of contact wire registrations including steady arms shall be such that pantographs shall clear steady arms by a minimum of 1 1/2" for the full range of pantograph uplift and sway.

All connections, bolts, and nuts shall be properly tightened in accordance with the manufacturer's recommendations.

All items shall be inspected for fit, damaged coating or bent/kinked members. Any piece found to be defective shall be rejected and a replacement shall be installed at the Contractor's expense.

Support and registration assemblies shall be installed as shown on the plans and in accordance with the manufacturer's instructions. The Contractor shall take field measurements, immediately prior to assembly fabrication, to determine the as-built reach from the elevated track centerline to face-of-pole at either contact wire height or messenger wire height. Due allowance shall be made, during fabrication, for dead load deflection of the pole, as applicable.

The wire heights and stagger given on the plans are related to the track high rail level and the elevated track centerline.

For stability during stringing, the support assemblies shall be temporarily restrained to prevent collapse due to swinging. The details of the restraint shall be submitted to the Engineer for approval.

Cotter pins and nuts on each assembly shall be located on the same side of the structure to assure uniformity along the line.

Assemblies fitted with pins, cotters, bolts and nuts shall be oriented where possible in such a manner as to lock these components together by gravity if the pins or nuts should become detached under service conditions.

Components employing a hinge or swivel shall be greased with an approved grease before assembly of the rubbing surfaces.

Contractor shall make all final adjustments on loaded wire runs as per plans (i.e., staggers and messenger deflections).

Preparation for Stringing Messenger Wire:

Roller-bearing sheaves of the closed type shall be used at all support points for stringing of the messenger wire. Sheaves shall be of sufficient size to accommodate the conductor without damage.

Stringing of the messenger shall start from an anchor location. After the initial termination is made, the conductor shall be pulled from the reel and lifted into the sheaves at each support. Sufficient tension must be maintained in the conductor during stringing to prevent the conductor from touching the ground or track between support points.

When the second anchor location is reached, the messenger conductor shall be pretensioned above the specified design tension by 10,200 lbs.

This pretensioning is to be held for 15 minutes. At the end of 15 minutes, the wire is to be re-tensioned to the original pretensioning value and held for another 15 minutes. At the end of the second 15-minute period, the wire is again to be re-tensioned up to the original pretensioning value and held for another 15 minutes. This is to continue until no more than 100 lbs. of tension is lost in a 15-minute period.

Erection tensions shall be governed by tables furnished for the purpose, based on the equivalent span for the tension length and temperature of the conductor.

The conductors shall be lowered temporarily at catenary structures adjacent to overhead obstructions, when there is a possibility of interference. Satisfactory clearance to the track and/or cross streets at grade crossings shall be maintained at all times.

Adjusting Messenger Wire Stringing Tension:

Final adjustment to the specified stringing tension shall be made progressively, working any slack from the first anchor location toward the second anchor location at the other end of the run.

The tension shall be adjusted so that it will be within five (5) percent, plus or minus, of the erection tension derived from the tables.

When the proper tension has been obtained, the messenger wire will be transferred to the messenger suspension clamp.

Dynamometer or similar device shall be used for measuring wire tension.

Installing Hangers:

The Engineer will provide the Contractor with hangar types, locations, size, lengths and spacing based on actual span lengths to be provided by the Contractor. The Contractor shall provide the Engineer with span lengths for all tracks in a span whenever hanger lengths are requested. The Contractor shall be responsible for any changes required in the hanger lengths for final catenary adjustments for proper current collection by the pantograph and for any adjustments for obtaining required clearances.

Hangers shall be manufactured to a tolerance of +/-1/4" in length.

The along track position of each hanger shall be within +/- 6" of the design position.

All hangars shall be installed plumb.

The loops of hangers shall be free to rise on messenger saddles without binding.

Hangers shall be formed before installation by use of jigs and tools approved by the Engineer. Hanger identification labels shall be removed before the catenary is commissioned. The hangers required for an individual span shall be called a hanger set assembly.

Messenger wire saddles shall retain the hanger loops irrespective of saddle orientation by means of extended lobes, as shown on the plans. Messenger wire saddles for hangers shall be insulated

from the messenger wire by means of insulating neoprene sleeves not less than one-tenth of an inch thick.

Preparation for Stringing and Tensioning of Contact Wire:

Stringing of the contact wire shall start from an anchor location. After initial termination is made, the conductor shall be pulled from the reel and lifted into temporary wire loops attached to the ends of the hangers. "Figure Eight" loops made of annealed No. 9 iron wire, or other approved loops, may be used. In any case, the trolley wire shall not be restrained from longitudinal movement during tensioning.

Contact wire shall be held in proper lateral position, in relation to the centerline of track, using temporary rollers to prevent kinking. Sufficient tension must be maintained in the conductor during stringing to never allow the conductor to touch the ground between supports.

Contact wire shall be tensioned in accordance with the tensions shown on the plans for the appropriate equivalent span and temperature.

The contact wire shall be pretensioned above the specified design tension by 7,000 lbs.

This pretensioning is to be held for 15 minutes. At the end of 15 minutes, the wire is to be re-tensioned to the original pretensioning value and held for another 15 minutes. At the end of the second 15 minute period, the wire is again to be re-tensioned up to the original pretensioning value and held for another 15 minutes. This is to continue until no more than 100 lbs. of tension is lost in a 15 minute period.

Dynamometer or similar device shall be used for measuring wire tension.

Tension Conditions:

Conductor temperatures shall be measured by thermometer. The bulb of the thermometer shall be in intimate contact with the conductor and shall be taped to the conductor to prevent drafts around the bulb. The thermometer shall be read after five minutes of contact.

A record of temperature and the tension recorded at both ends of the tension sections shall be kept for all catenaries.

Attaching Hanger Clips and Registration Arms:

As the hanger clips are fastened and steady arms attached, any twist in the contact wire shall be removed by working from one anchor to the other.

As far as practicable, bolts shall be installed in the various clips so that the nuts will be on the same side giving a uniform appearance. On curves, the nuts shall be placed on the inside of the curve to provide the best clearance to the pantograph.

Saddles for loop-type hangers shall clamp the messenger tightly. The loops shall have a loose fit around the saddle, permitting free rise and fall without binding.

Wire pull-offs shall be installed in locations designated on the plans.

Installation of Wire Cross Assemblies:

Cross-contact assemblies shall be fitted at all in-running contact wire crossings as shown on the plans.

Installation of Transitional Overlaps:

Permanent transitional overlaps between the existing hanging beam catenary system and the new fixed-tensioned catenary system shall be provided as per the plans. These shall be adjusted to provide a smooth transition for the vehicle pantographs.

Temporary transitional overlaps shall be provided between the existing hanging beam catenary system and the new fixed-tensioned catenary system as per the Contractor’s submitted and approved plan.

Work for the installation of catenary transitions shall include re-profiling and lowering of the existing hanging beam system, installation of permanent and temporary catenary deadends, installation of permanent and temporary down guys, re-profiling and deadending of the 7/8 inch grounded messenger wires, re-positioning of the grounded messenger saddles, installation of permanent and temporary overlaps.

Ground anchors, as shown on the plans, for the new fixed-tensioned catenary system may be used for temporary back-guying purposes.

Installation of Overlaps:

Insulated and uninsulated overlaps shall be provided between individual catenary tension sections as per the plans. These shall be adjusted to provide a smooth transition from one tension section to the next with good commutation for pantographs.

Installation of Section Insulators:

Section insulators shall be installed as recommended by the manufacturer. They shall be positioned in-span in accordance with the plans. Each unit shall be adjusted to maximize performance at the maximum speed of operation in both directions.

The method of installation shall cause no damage to the catenary wires. Any kinked contact wire shall be repaired or replaced at the Contractor's expense if the damage jeopardizes good current collection as determined by the Engineer.

Installation of Jumpers:

Jumpers shall be installed as shown on the plans.

Before fitting jumper clamps, the conductors shall be wire-brushed to ensure a good electrical connection beneath the jumper clamps and manufacturer recommended inhibitor applied.

Jumpers shall protrude through their clamps 1/2" and jumper ends shall be wrapped.

The configuration of jumpers shall make due allowance for the relative movement between catenaries for all temperatures.

Control of Scrap:

Scrap components shall be segregated from usable components, collected and removed daily.

Scrap components shall not be left alongside the track.

Scrap components shall become property of the Contractor and shall be removed from the project site.

Final Adjustments:

After tensioning has been completed, hangers and clips fastened, steady arms erected, and pull-offs installed, a check of the construction and adjustment to final position shall be made (i.e., staggers, heights at structure, and mid span).

Any hangers with improper fit shall be replaced with hangers of proper length.

Messenger wire heights shown on the plans are nominal values. Additional adjustment to the messenger wire heights after initial installation, may be necessary to achieve the proper trolley wire heights.

Height of contact wire and lateral position of wire shall be checked in accordance with the plans and adjusted where necessary and is to be measured normal to the track along the elevated centerline. Messenger wire heights shown on the plans are nominal. The final messenger wire heights shall be adjusted accordingly to achieve proper trolley wire height.

Where the normal height of contact wire is 21'-0" and above, a tolerance of +3", -0" from the height shown in the plans will be permitted.

The staggers of the contact wire shown in the plans are relative to the inclined centerline of track, which coincides, with the nominal centerline of the static pantograph.

Generally, on tangent track, the stagger of the contact wire will be alternately to the right or left of the centerline of pantograph at consecutive structures.

The lateral position of the contact wire on curved track will vary with the curvature and span length. The stagger at each support will be as shown in the plans.

The installation tolerance for contact wire stagger shall be +/- 1/2".

The messenger wire shall be installed vertically above the final contact wire stagger with an allowance of +/- 1/2" for system heights of 1'-6" or less, increasing to +/- 2" for system heights of 3'-0" or greater.

Measurement of the contact wire at structures:

The following measurements shall be made and recorded with the catenary in its final position:

Contact wire height above each track at each messenger support point.

Contact wire stagger relative to design superelevated track centerline at each registration point.

Track centerline to face of pole at rail level at each structure location, actual track superelevation and pole rake.

A complete set of the final height and stagger dimensions, as accepted, shall be available at the Final Inspection, and incorporated into the final as-built documents.

Clearance Check:

The Contractor shall make a clearance check, using a height and stagger gauge fitted with removable clearance ears. If fouling occurs at any point, it shall immediately be brought to the attention of the Engineer. The Contractor shall make any field corrections at no additional cost.

The clearance ears shall allow for 7" of uplift of the contact wire with an additional allowance of 3" for mechanical clearance. All parts of the system shall be outside this clearance envelope, with the exception of the steady arm. Any registration pipe drop bracket to which the steady arm is attached shall be outside the clearance envelope.

Pantograph Running Tests:

Prior to final acceptance, the Railroad will conduct pantograph tests on the catenary, using a vehicle with the pantograph in contact with the contact wire. These tests are to assure a smooth shock-free passage of the pantograph with no interruption to current collection especially at turnouts, section insulators and overlaps. Particular attention will be focused on wire takeover at overlaps, turnouts and crossovers, and lack of arcing at all locations. The Contractor shall be responsible for all adjustments required as a result of these tests.

Precautions in Handling Conductors:

Conductors shall be handled in such a manner that it will not be scratched, cut, or nicked with tools or clamps.

Conductors shall not lie upon, or be dragged across, sharp or rough surfaces.

Conductors shall not be annealed.

Sharp bends in the conductors shall not be permitted.

Conductors shall not be looped to form dead-ends of either a temporary nature or a permanent nature.

Conductors shall not be wrapped around poles or other anchorages.

Conductors shall not be marred with temporary wire or hook hangers.

Only approved parallel jaw clamps shall be used in tensioning all conductors. The grooves of the clamps must be free from burrs, fins, or any roughness, and the ends of the grooves must be flared (bell-shaped).

Vertical kinks in the contact wire shall be removed. A leather or copper-faced hammer shall be used, beating against a smooth flat surface. A 4" x 4" x 4' hardwood block is recommended.

Lateral kinks in the contact wire shall be removed if they affect the fit of any parts.

Inspection:

The Contractor shall provide a self-propelled, high rail, man lift platform inspection vehicle for final inspection of each completed catenary wire run. The inspection vehicle shall be capable of lifting four (4) people to trolley wire height and shall be supplied with a vehicle driver.

The Contractor shall provide all manpower, equipment, and grounding devices required to provide equal-potential grounding protection for inspection personnel on the high rail inspection vehicle. The protection shall be provided for the entire length of catenary wire run being inspected and shall be in conformance with all Metro-North rules, procedures, and regulations.

The high rail inspection vehicle will be made available for use by the Engineer and the Railroad Inspectors for final inspection of each completed catenary installation. The inspection vehicle shall also be made available for use for the re-inspection(s) of completed catenary installations when remedial work is required due to deficiencies found during the initial inspection.

All non-insulated, aerial wires, which are not jumpered or connected to catenary or feeder circuits, are to be grounded. This includes all temporary and permanently installed wires for pull

off assemblies, cross span assemblies, tail wire assemblies, and wires installed for other catenary construction purposes.

Method of Measurement: This work will be measured for payment by the actual number of linear feet of the complete catenary system furnished, installed and accepted.

Measurement for payment will be made from anchor to anchor as shown on the plans along the geometric centerline of each track which has a catenary system positioned above it, using actual track length, with no adjustment for additional lengths due to stagger offsets, sag or other material consuming configurations. At overlaps and crossovers the measurement of each section of the two catenary systems shall be made referenced to track centerline, with measurement terminating at the balance weight assembly or terminal pole, as the case may be.

Basis for Payment: This work will be paid for at the contract unit price per linear foot for CATENARY SYSTEMS which price shall include all transportation, materials, equipment, tools and labor incidental thereto:

There shall be no separate payment for the installation of temporary or permanent transitional overlaps and interface with existing catenary system, but the work shall be included in the pay item CATENARY SYSTEMS.

There shall be no separate payment for the relocation of the 7/8 inch grounded messenger wires and their messenger saddles for the installation of temporary or permanent transitional overlaps, but the work shall be included in the pay item CATENARY SYSTEMS.

There shall be no separate payment for final adjustments to achieve proper catenary wire heights, including adjustments to the messenger wire supports, but the work shall be included the pay item CATENARY SYSTEMS.

The furnishing, installation and acceptance of the catenary system shall include fabrication, supply, installation and adjustments of all wires and conductors, registration and termination/ anchor assemblies, cantilever assemblies and all in-span assemblies, pull-off assemblies, jumpers and their connections, hangers, all hardware and fittings and all else necessary (except disconnect switches, down guys, drop tubes and drop tube supports and section insulators which will be paid for under separate pay items) to form the complete functioning catenary system.

There shall be no separate payment for surveys to verify rail to structure dimensions, for temporary material, temporary guying, or temporary fittings or to provide high rail inspection vehicle, but the cost shall be included in the unit cost for CATENARY SYSTEMS.

There shall be no separate payment for removal of truss-to-post knee braces or platforms without signals to simplify drop tube installation but the cost thereof shall be included in the unit cost for CATENARY SYSTEMS. There will be no separate payment for relocation of C&S cables but the cost thereof shall be included in the unit cost for CATENARY SYSTEMS.

It may be necessary, from time to time, to add or to substitute assemblies called for on an erection diagram bill of material in order to meet the requirement that the Contractor provides a complete functioning catenary system. No separate payment will be made for such changes but the cost thereof shall be included in the unit price for CATENARY SYSTEMS.

No separate payment shall be made for the installation of temporary back guys, but the cost thereof shall be included in the item CATENARY SYSTEMS.

Pay Item	**Pay Unit**
CATENARY SYSTEMS	LF

ITEM #0090045A - AERIAL GROUND WIRE SYSTEMS

ITEM #0090073A - CABLE SUPPORT MESSENGER WIRE

Description: The Work under this Section consists of the procurement and installation of aerial ground wires and cable support messenger wire as shown on the plans. This work includes furnishing, installing, testing, and turn over to the Railroad, those conductors and related items which comprise these wire systems and includes all related components and accessories for a complete and functional system.

Work under this section includes the installation of all slack span ground wires to pull-off poles and overhead bridges and their related attachments to the bridges.

Catenary poles shall be bonded to the aerial ground wire and/or grounded as shown on the plans. All non-insulated, aerial wires, which are not jumpered or connected to catenary or feeder circuits, are to be grounded. This includes all temporary and permanently installed wires for pull off assemblies, cross span assemblies, tail wire assemblies, and wires installed for other catenary construction purposes. All wires and assemblies that are required to be grounded shall be grounded by approved ground wire connectors or clamps, and jumper wire.

Work in this section also includes the removal of lead based paint and corrosion at locations where new ground clamps are to be installed.

The Contractor shall be responsible for coordinating the installation with the requirements set forth in the Special Provisions, obtaining necessary Railroad power and track outages, as well as utility company outages for conducting work, and turning the work over to the Railroad for its use as specified.

The Contractor shall supply and install all applicable bare wires in accordance with the requirements specified on the plans.

Applicable Standards: Pertinent provisions of the most current revision of the following standards shall apply to the Work of this Section, except as they may be modified herein, and are hereby made a part of this Specification to the extent required.

Organi-zation	Number	Title
ANSI	C2	National Electrical Safety Code
NFPA	70	National Electrical Code

Organi-zation	Number	Title
NFPA	78	Lightning Protection Code
IEEE	81	Recommended Guide for Measuring Ground Resistance and Potential Gradients in the Earth
IEEE	142	Recommended Practice for Grounding of Industrial and Commercial Power Systems
UL	467	Grounding and Equipment
ASTM	A474	Aluminum-Coated Steel Wire Strand
ASTM	A475	Zinc-Coated Steel Wire Strand
ASTM	B8	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM	B1	Hard-Drawn Copper Wire
ASTM	B3	Soft or Annealed Copper Wire
ASTM	B173	Rope-Lay-Stranded Copper Conductors Having Concentric-Stranded Members, for Electrical Conductors
ASTM	B193	Test Method for Resistivity of Electrical Conductor Materials
ASTM	B228	Concentric-Lay-Stranded Copper-Clad Steel Conductors
ASTM	B229	Concentric-Lay-Stranded Copper and Copper-Clad Steel Composite Conductors
ASTM	B258	Standard Nominal Diameters of Cross-Sectional Areas of AWG Sizes of Solid Round Wires Used as Electrical Conductors
ASTM	A276	Stainless and Heat Resisting Steel Bars and Shapes
ASTM	A368	Stainless and Heat Resisting Steel Wire Strand
ASTM	A492	Stainless and Heat Resisting Steel Rope Wire

Organi-zation	Number	Title
ASTM	A555	General Requirements for Stainless and Heat Resisting Steel Wire
ASTM	A580	Stainless and Heat Resisting Wire

Submittals: The Contractor shall select and develop a full arrangement of components, and demonstrate by means of engineering calculations that all selected components are capable of meeting the design criteria for safety and operational requirements as stated in the specifications and plans.

The Contractor shall prepare and submit a complete detailed design package of layout, allocation, component shop, assembly, and sub-assembly drawings, which is based on design shown on the plans. All drawings for load carrying components must identify the component's load capacity. Fabrication of components shall not proceed until the shop drawings have been reviewed and approved by the Engineer.

The Contractor shall submit product data and relevant drawings for approval prior to wire manufacture. Included as a minimum shall be:

Physical Characteristics and Parameters

Size
Type and stranding class
Material
Number of and diameter of individual wires
Overall diameter
Cross section area
Weight per foot
Rated breaking load.

Electrical Characteristics

Rated current carrying size (AWG/kcmil)
Resistance per unit length.

The Contractor shall furnish certification from the manufacturer verifying that the wires have been designed, manufactured, inspected and tested in accordance with applicable portions of the referenced standards, these Specifications, and the plans.

The Contractor shall provide certified copies of manufacturer's test reports for the specific wires furnished, which shall include but not limited to the following:

Initial and Final Modulus of Elasticity (E)
Coefficient of Thermal Expansion (CTE)
Yield stress
Hardness values
Contact wire joint strength test.

Materials: Conductor materials shall be of a composition, quality and purity such that the finished product shall have the physical, mechanical, electrical properties, characteristics and parameters conforming to this Specification and the plans.

The wires shall be unconditionally guaranteed by the manufacturer and/or supplier to be free from defects for a period not less than five years.

The Engineer reserves the right to witness the manufacture, testing and packing of all wires. The manufacturer shall notify the Engineer not less than ten days in advance of manufacturing and testing operations.

All wires shall be subject to factory quality control tests as required in the applicable standards. Tests shall be performed on each reel prior to shipment. A certified copy of the test report for each reel shall be submitted to the Engineer prior to shipment. A copy of the test report shall be packed with each reel.

All wires shall be shipped on wooden reels, suitable for the weight of the wires and shall be protected from damage. The diameter of the drum shall be sufficiently large so as to avoid difficulty with waves or kinks when the wire is strung.

Each reel shall consist of one continuous, unspliced wire; and shall have the required length of wire so that no splices are required in the tension sections as installed unless approved by the Engineer.

Each reel shall have a strong, weatherproof tag or marker securely fastened to it, showing the size and type of wire as well as the ASTM designation, name and mark of the manufacturer, total reel length, reel weight and manufacturer's special instructions.

A stripe in any contrasting color approximately 1" wide shall be painted across the outermost layer on each reel. Any visible wire shift at this line, upon receipt at the job site, will be treated as indicating a relative wire movement during shipment, and is cause for reel rejection.

Any damage to the wires shall be the Contractor's responsibility, and all repairs and replacements of the damaged wires shall be at the Contractor's expense.

All components shall conform to or be interchangeable with the Railroad’s standard components.

Conductors for grounding and bonding shall be ASTM B8, Class B stranded annealed copper, and sized as indicated on the plans.

Connectors and Clamps: Bolts, washers and stop nuts shall be a high copper alloy, such as Everdur, Durium, Duronze or silicone bronze. Ferrous hardware will not be acceptable. Buried ground connections shall be exothermic welded.

Ground rods shall be copper, or copper-clad steel, not less than 3/4 inch in diameter, and in ten-foot lengths, threaded at one or both ends as required for extension.

Ground wire imbedded in foundations and aerial ground wire shall be 4/0 AWG HD stranded copper conductor.

The wire rope shall be shipped on reels suitable for the weight carried.

The rod shall be shipped on reels suitable for the weight carried or in straight lengths, securely bundled. Rods shipped on reels shall be straightened prior to use

All material shall be protected against damage during handling and shipping. Each reel or bundle shall have a strong, weatherproof tag securely fastened showing the physical and mechanical properties as well as type designation, ASTM designation and the name and mark of the manufacturer, the total length and weight of the wire rope, strand or rod on each reel or bundle.

High corrosion resistant austenitic grade stainless steel compatible with component items shall be used.

The component items shall be designed to carry maximum working loads with a factor of safety of 2.5 minimum based on yield stress.

Stainless steel wire rope shall be extra flexible and manufactured, and tested and in conformance with requirements of ASTM A368, A492, A555 and A580.

Stainless steel wire strands shall be manufactured and tested in conformance with requirements of ASTM A368, A555, and A580.

Stainless steel rod shall be round and manufactured and tested and in conformance with requirements of ASTM A276.

Zinc-coated stranded wire shall be manufactured and tested in accordance with ASTM A475. The aluminum-coated stranded wire shall be manufactured and tested in accordance with ASTM A474.

Physical properties of the stranded wire shall conform to ASTM A474 or A475 as applicable.

The material used for stranded steel wire and preforms shall conform to ASTM A474 or A475 as applicable.

The weight of coating shall not be less than that specified in ASTM A474 or A475 as applicable for the intended duty.

The Contractor shall provide certification that the galvanized steel wire, wire rope and alumoweld strands have been designed, fabricated, and tested in compliance with the applicable provisions of the relevant standards.

Construction Methods: The installation of the aerial ground wire and their attachment assemblies will occur in the vicinity of electrical energized facilities. De-energizing of the Railroad's and the utility company's electric lines will be required to perform the work. The Contractor shall perform the work in accordance with the following:

1. During construction of the new aerial ground wire and track jumper wire, all equipment and persons will at all times, remain at least 20 feet clear of the utility's existing 115 kV overhead transmission lines, installed on catenary or pole structures along the railroad's mainline right-of-way. When approach closer that the specified distance is required, the Contractor will request in writing, with six months advance notice, the de-energizing of the utility lines or equipment. De-energizing of the utility power line is contingent on power demand and economic dispatch and shall be coordinated with the utility. The Contractor will assume any risk involved in the reasonable denial of a request to de-energize the utility's transmission line and the last minute cancellation of an approved request to de-energize the transmission lines. If so ordered by the Engineer, the Contractor will immediately cease all activity in the areas where the utility's transmission lines are to be re-energized.

2. The Contractor and the utility company must cooperate fully in order to avoid damage to the conductors, and to insure that no delays will occur in the progress of the work. Therefore, the Contractor shall furnish the utility with a schedule for this work, which is to include starting and completion dates and, shall notify the UI and CL&P Company six months in advance of the commencement of construction work.

All paint debris shall be caught and/or vacuumed and disposed of as specified in DISPOSAL OF LEAD DEBRIS. Specifically the Contractor shall comply with the requirements of the OSHA Standard for Lead in Construction and any other applicable Federal and State laws and adhere to LEAD COMPLIANCE FOR MISCELLANEOUS EXTERIOR TASKS specification.

Insulators

All insulators shall be cleaned. Only clean rags, free from any abrasive material shall be used for cleaning insulators. Wire brushes shall not be used for cleaning any insulator parts, metal or otherwise. In the completed line, all insulator assemblies and hardware shall be clean, bright and free from nicks, chips or other marks.

Hardware

All pole-line hardware shall be installed as shown on the plans and as recommended by the manufacturer. Bolts and nuts shall be properly tightened in accordance with the manufacturer's recommendations. All bolts shall be of sufficient length for a full thread beyond the nut and/or locknut, but shall not protrude beyond the nut and/or locknut more than 1/2", excluding foundation bolts. Bolt ends shall not be cut off. Where locknuts are not used, lock washers shall be provided.

Hardware shall be installed using tools and methods specified by the manufacturer and approved by the Engineer.

Hardware shall be inspected for cleanliness and damage. Any item that does not fit, scrapes other galvanized parts during installation, or is defective shall be rejected. Replacement shall be at the Contractor's expense.

Cotter pins, when used, shall be installed with the open end toward the ground.

Connectors

Current-carrying connectors, shall be as shown on the plans and shall be installed in accordance with the manufacturer's recommendations. Connectors for copper or bronze wire shall be copper or bronze. Connectors for bi-metallic connections shall be tin-plated.

Bolts in bolt-type connectors shall be lubricated as recommended by the manufacturer, and torqued, using a calibrated torque wrench.

Where practicable and available, connectors shall be factory-supplied with a corrosion inhibitor.

Wire surfaces, which are in contact with conducting surfaces of the connector, shall be thoroughly wire brushed and shall be coated with an inhibitor. When connectors are not factory-supplied with a corrosion inhibitor, the inhibitor shall be applied to the connector in the field.

Corrosion inhibitors shall be stable over a wide temperature range, adhere to cold metal surfaces, be water-repellent, be weather resistant, and be inert to copper, aluminum, zinc, tin, cadmium, steel and neoprene rubber. Grit-bearing inhibitors shall generally be used except on flat lugs, sliding surfaces or where not recommended by the connector manufacturer. Grit shall be compatible with the connector and the wire metal.

One typical full-tension splice for each type of conductor shall be fabricated and tested by an independent testing laboratory. The laboratory shall be approved by the Engineer prior to testing. This requirement may be waived if test documentation for similar splices is provided and found to be acceptable by the Engineer. The tensile strength and electrical conductivity of full-tension line splices shall be at least equal to the values specified in NEMA Standard CC3 for

Class 1, full-tension connectors. Copper and bronze line splices shall conform to the specified standard of 95 percent tensile strength and 100 percent conductivity (minimum).

Conductors

For each length of conductor installed, a record shall be kept of the reel number from which the conductor was used. Partly used reels shall be recorded as such.

All conductors shall be handled in accordance with good overhead line practices and the manufacturer's recommendations.

Care must be taken with reels so as not to adversely influence the stringing operation. Damaged reels shall be set aside for repair before use.

Aerial Ground Wire, and Messenger Wire Installation

Wire shall not be erected without the guy anchor assemblies being in place, ready to receive loads.

The methods of erecting the aerial ground wire and cable support messengers shall be subject to approval by the Engineer.

Care shall be taken to prevent kinks in the wires. Bird caging of stranded wire shall be cause for rejection.

Erection tensions in all conductors shall be as shown on the plans with tolerance of plus/minus five percent.

Wire splices are not allowed without prior approval of the Engineer. No splice will be permitted within five feet of a support clamp.

Any damage to the wires shall be reported, in writing, to the Engineer. Remedial action must be approved by the Engineer and will be performed as directed at the Contractor's expense.

At his own expense, the Contractor shall provide any temporary anchors and down guys required to facilitate overhead wire installation or construction staging.

Roller-bearing sheaves of the closed type shall be used at all support points for stringing of jumper wire, aerial ground wire and cable support messenger wire. Sheaves shall be of sufficient size to accommodate the conductor without damage and mounted so as not to introduce bending forces on the pin insulator.

Stringing of wires shall start at an anchor location. After the initial termination is made, the wire shall be pulled from the reel and lifted into the sheaves at each support. Sufficient tension must

be maintained in the wire during stringing to ensure that it does not touch the ground or track between support points.

When the second anchor location is reached, the wire shall be tensioned above the specified erection tension by 200 lbs. This tension shall be held for approximately five minutes and then slackened to the specified erection tension before the dead-end assembly is attached.

Erection tensions shall be governed by the plans, based on the equivalent span for the tension length and temperature of the conductor.

When there is a possibility of interference at structures adjacent to overhead obstructions, wires may be lowered with approval of the Engineer.

During stringing of new wires, proper vertical and horizontal electrical clearances must be maintained from existing wires and structures.

Final adjustment of aerial ground wire and cable support messenger wire to the specified stringing tension shall be made progressively, by working any slack from the first anchor location toward the second anchor location at the other end of the run.

The tension shall be adjusted so that it will be within plus/minus five percent of the erection tension as shown on the plans.

When the proper tension has been obtained, the conductor shall be tightened to its permanent position on the supporting devices.

Temperatures of tensioned wires shall be measured by using a thermometer. The bulb of the thermometer shall be in intimate contact with the wire and shall be closely taped to the wire to prevent drafts around the bulb. The thermometer shall be read after 15 minutes of contact.

Wire temperature and wire tension shall be recorded at both ends of the tension sections. These records shall be kept for all conductors.

Bolts shall be installed in the various clips so that the nuts will be on the same side thereby providing a uniform appearance.

Jumpers shall be installed as shown on the plans.

Before fitting jumper clamps, conductors shall be wire-brushed to ensure a good electrical connection between the jumper clamp and the conductor. The manufacturer's recommended inhibitor shall also be applied.

Jumpers shall protrude through their clamps ½" and jumper ends shall be wrapped.

The configuration of jumpers shall allow for relative movement between wires at all temperatures.

The support messenger for aerial cables shall meet ANSI C2 (NESC) requirements for clearance above ground and are subject to the approval of the Engineer.

Scrap components shall be segregated from usable components, collected, and removed daily. Scrap components shall not be left along side the track.

Before installing the ground clamp on existing structures, the steel shall be cleaned of rust and lead paint to sound metal. Conductive grease shall be applied as necessary.

In locations where 2/0 aerial ground is slack-spanned from one pole to an adjacent pole, the 2/0 ground wire shall be connected directly to the 4/0, by continuing the 2/0 ground wire vertically along the pole to the attachment point of the 4/0 ground.

Aerial ground wire shall be connected to overhead bridge ground loops in at least two locations.

The work shall be arranged in such a manner that each part of the grounding system which is laid below finished grade shall be completed and inspected before backfilling is done. All precautions shall be taken to assure that no damage is done to the grounding and bonding conductors or connections during backfilling, compacting and concreting operations. Testing for ground resistance shall be performed in accordance with the requirements of this Specification before any finish surfacing is laid above the grounding and bonding conductors.

Any shortfall in the existing ground conductors, when connected to the new structures, shall be dealt with by splicing additional ground wire.

Bond all non-energized connections to structures so that there are no neutral or floating components (i.e., strap across any pin or clevis connection).

Field-testing shall be thorough, continuing throughout the installation, and fully documented, with the following as a minimum and as applicable:

Ground rods shall be driven vertically to the depth of ten feet. Rod points shall be provided with a steel alloy cone and the driven end provided with removable driving stud. Ground rods shall be separated from adjacent buried metallic structure or pipe by a minimum of two feet.

Electrical resistance tests shall be made during installation to verify continuity of the grounding system.

Measure, record, and report the ground resistance at each location, while disconnected from the MNR ground grid, where grounding system is installed. The required ground resistance is five ohms or less. Corrective measures shall be taken by the Contractor to achieve the specified ground resistance.

Resistance-to-earth tests shall be witnessed by the Engineer and written results of these tests shall be submitted to the Engineer for evaluation.

Installation of wire rope, rod, and strands shall be as shown on the plans and in accordance with manufacturer's recommendations. Nicopress sleeves and hydraulic tools shall be used for crimping as required.

Method of Measurement: The Work of this Section will be measured for payment based on actual linear foot of each type of completed wire system furnished, installed and accepted.

Measurement will be made from wire termination to wire termination as shown on the plans.

No separate payment will be made for turnbuckles, shackles, strain clamp connectors and associated components. The cost thereof shall be included under the respective pay items.

No separate payment will be made for ground wire attachments to structures, including angle clips, but the cost thereof shall be included under the pay item for AERIAL GROUND WIRE SYSTEMS.

No separate payment will be made for ground wire attachments to overhead bridges, but the cost thereof shall be included under the pay item for AERIAL GROUND WIRE SYSTEMS.

No separate payment will be made for connections to be installed from 4/0 ground wire to 2/0 ground wire or between aerial ground wire and their connections to ground rods, foundations or ground mats, but the cost thereof shall be included under the pay item for AERIAL GROUND WIRE SYSTEMS.

Ground rods, where specified, and their connections to the aerial ground wires will not be paid for separately but their cost shall be covered as a part of the price for AERIAL GROUND WIRE SYSTEMS.

Payment for the procurement and installation of bracket assemblies for cable support messenger wire shall be covered under the item STEEL (MISCELLANEOUS).

Payment for removal of existing wire will be paid under other sections.

No separate or additional measurement and payment will be made for temporary material, temporary guying, and temporary fittings.

There shall be no separate payment for the removal of corrosion and lead paint to sound metal, but the cost thereof shall be included in the items of this section.

It may be necessary, from time to time, to add or to substitute assemblies called for on an erection diagram bill of material in order to meet the requirements that the Contractor provides a

complete functioning system. No separate payment will be made for such changes but the cost thereof shall be included in the unit prices for installation.

Basis for Payment: This work will be paid for at the contract unit prices for the following pay items including all transportation, materials, equipment, tools and labor incidental thereto:

Pay Item	**Pay Unit**
AERIAL GROUND WIRE SYSTEMS	LF
CABLE SUPPORT MESSENGER WIRE	LF

ITEM #0090046A - STAGGER / HEIGHT GAUGE

Description: This item includes the supply of stagger/height gauges and associated attachment as gauges as specified herein. This work shall include the following:

Contact wire height and stagger gauge, either mirror or laser.

Four fiberglass measuring sticks.

The Contractor shall deliver one set of new gauges to the Engineer prior to the beginning of Stage 1 and the remaining three sets prior to the start of catenary removal in Stage 2.

The gauges shall be supplied with a manufacturer's spare parts list, and necessary replacement components to allow the continuous use of the equipment, considering reasonable wear and tear.

Submittals: The Contractor shall obtain and submit a Certificate of Performance from a certified testing laboratory, which attests to the accuracy and performance of the gauges, as required hereafter.

The Contractor shall submit shop drawings, or catalog cuts, detailing all gauge components and dimensions for approval prior to fabrication.

Manufacturer's catalog cut for fiberglass measuring sticks (Hastings Fiberglass or equivalent)

The stagger/height gauges and associated items shall be guaranteed to be free from manufacturing defects for a minimum of 3 years, from date of delivery to the Engineer.

Materials:

Gauge:	Non-metal, non-conductive, rigid and lightweight of a fiberglass, phonemic or reinforced plastic material. If metal, provide insulating base to prevent shunting.

Construction Materials: The stagger gauge, marked in inches, 18" minimum on each side of the pantograph centerline, shall be used to measure the distance (stagger) between the contact wire and the super-elevated pantograph centerline at contact wire height.

The height gauge shall be adjustable, marked in feet and inches for all heights between 15' and 25' and capable of measuring the contact and messenger wire heights above the rail level.

The stagger/height gauge shall be of sufficient strength to withstand normal handling and shall be usable under 15 MPH wind conditions without deflection, buckling or permanent

deformation. All scales and working parts shall remain operate when exposed to adverse weather conditions, including ambient temperature extremes and precipitation.

Necessary components of the stagger/height gauge shall be adjustable to permit fast and easy calibration.

The stagger/height gauge construction shall be such that injury to an operator from electrocution cannot occur by providing reliable 25 kV to ground isolation. The stagger/height gauge base shall electrically isolate the two track rails so as not to allow signal or traction power circuits to be conducted.

The gauge shall be easily handled by one operator, be portable and weigh a maximum of 60 lbs.

All measuring scales for stagger and height shall be readable from a ground level.

The gauge design shall incorporate replaceable components and parts, which are fabricated and assembled for use on an electrified railroad.

All surfaces shall be maintained clean and free of all foreign matter, and all parts shall be in good condition when is use for the duration of the Contractors work in accordance with the gauge manufacturers instructions.

The stagger gauge shall be field calibrated by the Contractor at the start of every day it is utilized, and shall be adjusted in accordance with the gauge manufacturer's instructions.

Under no circumstances shall the gauge be used if of out calibration, damaged or in an inoperable condition.

The gauge shall be cleaned frequently, as recommended by the manufacturers, to ensure it retains the 25 kV insulation properties, even if it is used for unenergized wires.

Method of Measurement: The lump sum price is for four (4) stagger/height gauges with associated equipment and spare parts supplied to the Engineer. The lump sum price also includes 4 fiberglass measuring sticks supplied to the Engineer.

Basis for Payment: This work will be paid for a lump sum price which price will include all transportation, materials, equipment, tools and labor incidental thereto:

Pay Item	**Pay Unit**
STAGGER / HEIGHT GAUGE	LS

ITEM #0096050A - AUTO-TENSIONED CATENARY

Description: The work under this Section consists of the supply and installation of the auto-tensioned catenary system in accordance with the plans. The catenary system is broadly defined as those conductors, and related items, forming the overhead power distribution system, and comprise the catenary messenger and contact wires, hangers, feeder bus, sectioning devices, tensioning systems (including balance weight assemblies), and ground connections, together with their related supports and insulation. The Contractor shall supply an inspection vehicle with driver for inspection.

Work shall include modifying the existing cross-overs and/or installation of transitional cross-overs between new catenary and existing catenary, as required due to construction staging.

Work shall include survey verification of the top of rail to bottom of truss dimensions at each bridge and catenary structure and each track.

The Contractor shall be responsible for coordinating the catenary system installation with the Railroad and the requirements set forth in the Special Provisions, obtaining necessary outages for conducting work and turning the work over to the Railroad for its use as specified.

This Section covers the manufacture, supply and installation of the catenary assemblies. The work includes but may not be limited to the following: Messenger support assemblies, Cantilever assemblies, Tail wire support assemblies, Contact wire registration assemblies, Pull-off assemblies, Dead end assemblies, Cross span assemblies, Feeder and jumper assemblies, Midspan insulation assemblies, Span wire insulation assemblies, Across track feeder assemblies.

The Contractor shall manufacture, supply, and install all applicable assemblies for the catenary system as per the plans. The assemblies shall be formed out of the Railroad's standard components as far as possible. Any departure shall require Engineer's prior approval.

This Specification covers the manufacture and supply of ferrous and non-ferrous metal catenary material, hardware and fittings. The work includes but may not be limited to the following: Hanger and hanger assembly fittings, Cross contact assembly fittings, Clevis-tongue fittings, Clevis-clevis fittings, Parallel wire clamps, Nuts, bolts, washers, keys and cotter pins, Shackles, Links and eyebolts, Messenger, contact and span, wire terminations and turnbuckles, Double clevis end fittings, Thimbles, Wire sleeves, Messenger suspension clamps and span wire supports, Span wire clamps, Wire connectors, Full tension compression joint fittings, Strain clamps, Wire knuckles, Anti-torsion pipe hanger, Wire splices.

For tension tests, a minimum of three test bars shall be poured from each lot of metal.

For chemical analysis each lot of castings shall be analyzed for conformance with the chemical composition specified in the referenced ASTM Standards.

A lot shall consist of all castings produced from a furnace melt.

The work of this Section covers the manufacture, and supply of various types of insulators for the catenary, feeders, traction power and signal power systems, as shown on the plans and specified herein. Catenary insulators shall be incorporated into support, registration, termination and in-span assemblies as shown on the plans.

This Specification covers the supply and installation of uninsulated wires as shown on the plans. This work shall include, but may not be limited to, the following: Catenary Messenger Wire, Contact Wire, Catenary Jumper Wire, Traction Feeder and Tap Wires, Signal Power Wires, Ground Wire, Cross Span Wires, Pull-Off Wire and Steady Wire.

The Contractor shall supply and install all applicable bare wires for the overhead catenary system in accordance with the requirements specified on the plans.

Applicable Standards: Pertinent provisions of the following latest standards shall apply to the work of this Section, except as they may be modified herein, and are hereby made a part of this Specification to the extent required.

Organi-zation	Number	Title
ANSI	C2	National Electrical Safety Code
ANSI	C29.1	Test Methods for Electrical Power Insulators Including Addenda C29.1a and C29.2a
ANSI	C29.2	Wet Process Porcelain Insulators (Suspension Type)
ANSI	C29.7	Wet Process Porcelain Insulators (High-Voltage Line-Post Type), Including Supplement C29.7a
ANSI	C29.8	Wet Process Porcelain Insulators (Apparatus, Cap and Pin Type)
ANSI	C76.1	Code for Outdoor Apparatus Bushings, Requirements and Test
ANSI	Z55.1	Gray Finishes for Industrial Apparatus and Equipment
NFPA	70	National Electrical Code
ASTM	A27	Mild to Medium-Strength Carbon Steel Castings

ASTM	A36	Structural Steel
ASTM	A47	Malleable Iron Castings
ASTM	A123	Zinc Coating on Products Fabricated from Rolled, Pressed, and Forged Steel-Shaped Plates, Bars and Strip
ASTM	A150	Aluminum Bronze Rod, Bar and Shapes
ASTM	A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM	A167	Stainless and Heat-Resisting Chromium Nickel Steel Plate and Strip
ASTM	A307	Carbon Steel Externally - and Internally-Threaded Standard Fasteners
ASTM	A386	Zinc Coating (Hot-Dip) on Assembled Steel Products
ASTM	A484	General Requirements for Stainless and Heat-Resisting Wrought Steel Products
ASTM	A518	Corrosion-Resistant High-Silicon Cast Iron
ASTM	A530	General Requirements for Specialized Carbon and Alloy Steel Pipe
ASTM	A536	Ductile Iron Castings
ASTM	A588	High-Strength, Low Alloy Structural Steel
ASTM	A668	Steel Forgings, Carbon, and Alloy for General Industrial Use
ASTM	A711	Carbon and Alloy Steel Blooms, Billets, and Slabs for Forging
ASTM	A747	Steel Castings, Stainless, Precipitation Hardening
ASTM	B1	Hard-Drawn Copper Wire
ASTM	B3	Soft or Annealed Copper Wire

ASTM	B8	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM	B9	Bronze Trolley Wire
ASTM	B26	Specification for Aluminum-Alloy Sand Castings
ASTM	B30	Specification for Copper-Base Alloys in Ingot Form
ASTM	B148	Aluminum-Bronze Sand Castings
ASTM	B173	Rope-Lay-Stranded Copper Conductors Having Concentric-Stranded Members, for Electrical Conductors
ASTM	B179	Aluminum Alloys in Ingot Form for Sand Castings, Permanent Mold Castings and Die Castings
ASTM	B193	Test Method for Resistivity of Electrical Conductor Materials
ASTM	B228	Concentric-Lay-Stranded Copper-Clad Steel Conductors
ASTM	B229	Concentric-Lay-Stranded Copper and Copper-Clad Steel Composite Conductors
ASTM	B248	General Requirements for Wrought Copper and Copper-Alloy Plate, Sheet, Strips and Rolled Bar
ASTM	B249	General Requirements for Wrought Copper and Copper-Alloy Rod, Bar and Shapes
ASTM	B258	Standard Nominal Diameters of Cross-Sectional Areas of AWG Sizes of Solid Round Wires Used as Electrical Conductors
ASTM	B584	Copper-Alloy Sand Castings for General Applications
ASTM	B686	Specification for Aluminum Alloy Castings - High Strength
ASTM	C150	Portland Cement

ASTM	C151	Test Method for Autoclave Expansion of Portland Cement
ASTM	D116	Vitrified Ceramic Materials for Electrical Applications, Testing
ASTM	F1154	Specification for Turnbuckles, Swaged, Welded, Forged
US FED	RRC271	Chain and Attachments, Welded and Weldless
NEMA	HV-1	Insulators, High-Voltage

If other types of materials are proposed, the Contractor shall, along with the product description, include the relevant standards and information on that material in his submittal to the Engineer for approval.

Submittals: A complete description of the methods and procedures for new and temporary construction shall be submitted for review by the Engineer prior to starting the work. The description shall indicate the following as a minimum:

Proposed stringing methods, including special precautions, if any.

Proposed method and equipment for removal of torsion in catenary tail wires.

Proposed temporary arrangements for transitional cross-overs, sectioning, equipment lowering and installation of new pull-off assemblies.

The Contractor shall submit survey verification of the top of rail to bottom of truss dimensions at each bridge and catenary structure and each track. Submittal shall include any discrepancies between existing conditions and what is depicted on the plan sheets.

The Contractor shall prepare and submit working drawings detailing the construction methods and materials to be used for the installation of the temporary catenary transitional cross-overs between the existing hanging beam catenary system and new auto-tensioned catenary system. Working drawings shall include the design, methods and materials to be used for the installation of temporary fixed-tension/auto-tension catenary cross-overs at all locations.

Acceptance measurements shall be submitted upon completion of installation of individual tension lengths of catenary and at the completion of each work stage when catenary is to be placed back in service.

<u>Submittals - Balance Weight Anchor Assembly:</u>

The Contractor shall furnish the following; a complete set of assembly, components, and shop/working drawings giving dimensions and weights, and related design calculations, working loads and factor of safety for each component and assembly. Component, small part steel or assembly drawings shall be prepared using AutoCAD 2007 or later.

Installation, Operation and Maintenance Instructions which shall include:

Center to center dimensions of pulley wheels at the normal temperature and their variations for other temperatures.

'STOP' setting dimension for various half tension lengths based on a minimum conductor temperature of 15 degrees F, normal conductor temperature of 70 degrees F, and maximum conductor temperature of 135 degrees F.

Precautions/adjustments to prevent balance weight from chafing on adjacent components.

Recommended procedure for assembling the balance weight assembly including safety precautions to minimize risk to work staff during handling and installation.

List of special tools and associated catalog cuts, required for assembly and installation of a single unit. Submit procedures for using special tools as applicable.

The supplier's certificate of compliance shall accompany each shipment. As a minimum, it shall contain the following:

Product name.
Drawing number and revision or date.
Serial numbers (if required).
Quantity.
Purchase order number.
List of specifications to which the product was produced.
Supplier's name and address.
Signature and title of recognized quality assurance authority.
Test reports shall be submitted to the Engineer for approval.

Catenary Assemblies:

Certification: Furnish a certification verifying that all material included in the assemblies has been manufactured, inspected and tested in accordance with the referenced standards and these Specifications and conforms to the Railroad’s standards

Test Reports: Furnish copies of reports of all factory tests including quality assurance checks, required by these Specifications and all relevant standards. The Engineer reserves the right to check and inspect the manufacture, testing and quality control procedures at any time.

Manufacturer's Data: Furnish complete assembly and component drawings indicating working loads and factor of safety in each application. Components, small part steel or assembly drawings shall be prepared using AutoCAD 14. Submit catalog cuts for all crimp parts, tools and procedures for all assemblies. Submit working loads and factor of safety of components in each application. Shop drawings that do not include the working loads and factor of safety data shall be summarily rejected.

Plans: The Contractor shall submit shop/working drawings and material specifications for all components for approval prior to ordering or fabrication showing details and dimensions, and giving designations of the materials comprising the various components/ subcomponents together with technical, mechanical, electrical characteristics and material specifications as appropriate.

Submittals - Insulators:

Shop Drawings: Shop Drawings shall be submitted prior to fabrication. Component drawings shall be prepared using AutoCAD 14. Included, as a minimum, shall be:

Electrical:

Creepage length (inches)
Insulation level (impulse withstand test voltage, kV)
DC withstand voltage (kV)
Maximum working voltage (kV)

Mechanical:

Attachment centers or overall length (inches)

Shed diameters (inches)
Core diameters (inches)
Breakdown of weights, insulator and fittings (pounds)
Tensile withstand load (pounds)
Cantilever withstand load (inch-pounds)
Recommended maximum working tensile load (inch-pounds)
Material/procurement specifications (including end caps and touch-up insulator sealants)
Manufacturer's design mechanical and electrical safety factors
Working drawings of hardware and components
Listing and description of components and hardware
List of values of BIL, ultimate tensile strength, ultimate torsional strength, weight (including weight of components) and electrical characteristics.

Certification of compliance for the following:

Steel analysis
Hot-dip galvanizing
Adhesive materials
Insulator materials
In service record of proposed insulators
Certified quality control procedures used in the manufacturing process

Storage and handling instructions.

Maintenance manuals.

Submittals - Uninsulated Wires:

The Contractor shall submit product data and relevant drawings for approval prior to wire manufacture. Included as a minimum shall be:

Physical Characteristics and Parameters

Size
Type and stranding class
Material
Number of and diameter of individual wires
Overall diameter
Cross section area
Weight per foot
Rated breaking load.

Electrical Characteristics

Rated current carrying size (AWG/kcmil)
Resistance per unit length.

The Contractor shall furnish certification from the manufacturer verifying that the wires have been designed, manufactured, inspected and tested in accordance with applicable portions of the referenced standards, these Specifications, and the plans.

The Contractor shall provide certified copies of manufacturer's test reports for the specific wires furnished, which shall include but not limited to the following:

Initial and Final Modulus of Elasticity (E)
Coefficient of Thermal Expansion (CTE)
Yield stress
Hardness values
Contact wire joint strength test.

Materials: All parts shall conform with, or be interchangeable with the Railroad's standard components.

Materials - Balance Weight Anchor Assembly:

Catenary balance weight anchor assemblies shall be packaged in a manner to allow stacking and outdoor storage until installation with no harmful effects.

The assembly shall maintain constant tension in the conductors notwithstanding changes in ambient, solar or current heating temperatures. Changes in the lengths of conductors shall be compensated for by an equivalent change in stroke length of the unit. Temperature stop devices shall be furnished and installed such that movement of the weights due to OCS behavior under conditions below 15 degrees F and above 135 degrees F is eliminated.

The balance weight anchor assembly shall operate at a nominal pulley ratio of approximately 3:1 as per the plans.

The balance weight assembly shall have pulleys with self-lubricating bearings. The bearings shall be sealed to prevent the ingress of moisture or other contaminants, or the loss of lubricant.

The balance weight assembly shall operate freely under all climatic conditions within the limits specified and shall function freely when a weight differential of plus/minus 25 lbs. is applied to the balance weight stack.

The assembly shall incorporate a safety feature to prevent the weights falling to the ground in the event of a failure of the tensioned wires. It shall also have provisions for continuity to ground under electrical fault conditions.

Balance weights shall be steel plates as called for on the Standard Component drawings.

The flexible cable for specific use with balance weight pulley sheaves shall be suitable for such use as certified by the Contractor.

All external ferrous parts shall be stainless steel or hot-dip galvanized in accordance with Form 816, Section M.06.03. Any ferrous parts, which are not stainless steel or cannot be galvanized, shall be painted with an approved epoxy coating with color to match ANSI #61, light gray.

Materials - Catenary Assemblies:

All assemblies, components and materials shall be protected against damage, during handling and shipping, storage and installation.

Store material to permit easy access for inspection and identification. Protect steel members and packaged materials from corrosion and deterioration.

All packaged components and/or assemblies shall have a waterproof tag securely fastened to the package showing the assembly or component name, number, or identification code.

Packaging and/or packing methods of all assemblies or components shall be approved by the Engineer.

All materials used in the components or the assemblies shall be of sufficient strength and durability to withstand the loads as shown on the plans, with the addition of a factor of safety of 2.5. Any substitution of materials shall be submitted to the Engineer for approval.

Structural Steel: Material for structural steel shall comply with ASTM A36 or A588. A36 material must be galvanized in accordance with ASTM A123. Fabricator to provide adequate vent holes to all enclosed areas prior to galvanizing.

Stainless Steel: Stainless steel material shall conform to ASTM A484.

Copper-alloys for fittings and components shall conform to ASTM B584 and B248.

Aluminum components shall conform to ASTM A150.

All copper components shall conform to ASTM B248 or B249.

All cotter pins shall be made out of stainless steel.

Pulley wheels for messenger supports shall be 8" minimum diameter with groove design for the messenger wire. These pulley wheels shall not be used for conductor stringing purposes. They will be manufactured from material conforming to ASTM B-30 alloy C95500 and ASTM B148, alloy C95500 and shall have the following physical composition and properties.

Copper 88 percent, Tin 2.5 percent, Lead 2 percent, Zinc 6.5 percent, Nickel 1 percent	
Tensile Strength (psi)	37000
Yield Strength (psi)	14000
Elongation (percent in 2")	39
Reduction of Area (percent)	31
Brinell Hardness (10mm Ball 500 kg load)	55
Specific Gravity	8.8
Weight/Cu. in (lbs)	0.318
Pattern maker's shrinkage	3/16 (in /ft)
Melting Point (degrees F)	1860
Pouring Temperature (degrees F)	2150-2350
Machinability	75 percent free cutting brass

Pulley wheels shall be free to rotate without rubbing against the insulator or end-cap. They shall be fitted with needle or roller bearings to promote maintenance free non-seizing operation.

Jumpers and feeders shall be sized as shown on the plans. Jumpers shall be flexible wire rope or braid Class H; shaped and supported to reduce possible failure due to fatigue induced by differential uplift of the conductors. Jumper and feeder clamps shall be bronze and sized to suit the electrical capacity of the jumper and shall be installed per the manufacturer's recommendations.

Compression-type dead-ends shall be used only where suitable bolted or wedge type fittings are unavailable.

Materials - Catenary Fittings and Hardware:

The identification mark of the manufacturer or foundry and the pattern numbers assigned by the supplier shall be cast into all castings. Marks and numbers shall be readable size, and in such a position that they will not affect the electrical or mechanical performance.

Fittings and hardware shall be packed in accordance with the best commercial practice, adequate to ensure acceptance and safe delivery.

All shipping boxes, bags, or crates shall be properly marked showing the contents of each. If different materials are packaged in a box, bag or crate all items of kind should be boxed, bagged or crated and properly marked or tagged prior to placement in the shipping vessel.

Catenary fittings and hardware shall be packaged in a manner to allow stacking and outdoor storage until installation with no harmful effects.

Material for hardware and fittings shall comply with the applicable referenced standards. Substitutions will be considered and approved if the requirements of the Contract Documents are satisfied. The Contractor shall be responsible for form and fit of all catenary components and hardware, as shown on the plans.

The material/components shall be lightweight and reliable to ensure a 30 year life period. They shall be of proven designs, which shall have been used on railroad catenary systems.

The Contractor shall furnish all labor, tools, equipment, apparatus and facilities as required to assemble catenary fittings/hardware and perform installation work as required.

Alloy Steel: 5/8”, 3/4”, and 7/8” shackles shall comply with the performance and dimensional requirements of US Federal Specification RR-C-271.
3/4” x 6” turnbuckles shall be Type 1 Grade 1 per ASTM F-1145, Class D, G or H.

Forged Steel: Materials for forged steel shall comply with ASTM A711 or A668. All fittings and components shall be hot-dip galvanized in accordance with ASTM A153.

Malleable Iron: Fittings or components made of malleable iron shall be grade 32510 or better and shall conform to ASTM A47. All components and fittings shall be galvanized in accordance with ASTM A153.

Ductile Iron: Fittings or components requiring high yield strength shall be of ductile iron, grade 60.40.18 or better and shall conform to ASTM A536. All fittings and components shall be galvanized in accordance with ASTM A153.

Stainless Steel: Stainless Steel hardware shall conform to ASTM A747.

Non-Ferrous Metals: Copper-alloys for fittings and components shall conform with ASTM B30, B584 and B148.

Copper: All copper components shall conform to ASTM B248 or B249.

All cotter pins shall be made of stainless steel.

The designated metals shall be produced by an approved method that will meet the requirements of these Specifications and the plans.

Castings shall be of uniform quality and shall be made in such a manner that the material of the casting conforms to the chemical and mechanical properties prescribed in the referenced ASTM Standards.

The castings shall be free of adhering sand, voids, cracks, surface porosity and non-uniform dimensions.

The Contractor shall be responsible for the dimensional accuracy of all fittings and hardware.

Repairs shall be permitted only to the extent allowed by the referenced ASTM Standards. If welding or repair of a greater magnitude is required, the Contractor shall obtain the Engineer’s approval prior to processing.

Materials - Insulators:

The Contractor shall ensure that all materials furnished are suitably packaged, stored and protected from damage and exposure.

The Contractor shall handle and otherwise use the insulators in accordance with the manufacturer's instructions, so as to ensure that the products are not damaged or misused prior to or during installation.

Any damage to the insulators shall be the Contractor's responsibility, and replacements shall be accomplished by the Contractor in accordance with the manufacturer's instructions.

The insulators shall have a minimum in-service life expectancy of 30 years under normal operating conditions.

The insulators shall be unconditionally guaranteed by the manufacturer and/or supplier to be free from defects for a period not less than five years.

The suspension, termination and rod insulators shall be of non-ceramic type. The pin and post insulators shall be made of the best commercial-grade wet-process porcelain.

The entire surface of the porcelain insulators that will be exposed after assembly shall be glazed in No. 70 light gray color as specified in ANSI Z55.1.

The surface shall be free of imperfections. Pieces with imperfections in the glaze repaired by re-coating and refiring, as well as those pieces repaired by re-touching with paint, will be rejected.

Cement used for assembling porcelain to metal shall meet or exceed the requirements of ASTM C150 and C151.

The non-ceramic insulator shall be a unit consisting of a rod; weather sheds as required, and end fittings. The rod shall be made of glass fiber or reinforced polymer (silicon, rubber, teflon, or cycloalipathic resin), with its fibers running longitudinally through the rod length. The rod may be attached to the end fittings or hardware by a compression sleeve, wedge or adhesive. If adhesive is used, the adhesive shall encapsulate the rod in the end-fitting cavity and shall form a compressive wedge upon loading. Weather sheds shall, for the expected life of the insulator, protect the rod from the elements and insure the necessary leakage distance.

The non-ceramic insulator shall be constructed so as to be a lightweight, compact unit with high-impact strength. Weather sheds shall be "self-cleaning" and weather resistant to reduce the possibility of ice bridging between sheds. They shall be of a material that is vandal resistant in so far as being shatterproof, thereby reducing vandalism damage.

All non-ceramic material shall have a smooth, void-free finish. All adhesive coatings shall be sealed to the fittings to protect them against the ingress of moisture.

The design shall be such that stress due to temperature variation, and mechanical extension/contraction in any part of the insulator under load and normal handling, shall not lead to deterioration. The materials used shall not cause degradation by chemical interactions.

The end fittings attached to the insulator's fiberglass rod shall ensure exact alignment with the rod and correct assembly with respect to each other to avoid torsional stress when the insulator is installed.

The insulators shall be so designed that no sparking or arcing shall occur on the surface of the insulator when energized at the maximum design voltage under clean and dry conditions.

The insulators shall be designed to suit the various assembly arrangements, as shown on the plans.

The metal parts of the insulators shall be made of malleable iron, Grade 35018, to conform to ASTM A47, or open-hearth or electric furnace steel. All ferrous metal parts shall be galvanized in accordance with ASTM A153. Insulator fittings shall provide for connections as shown on the plans.

To protect the galvanizing from harmful chemical action of the cement, the hardware, which is in contact with cement, shall be coated with a bituminous paint, or the hardware shall be protected as recommended by the insulator manufacturer for use with his materials.

Insulators shall be tested in accordance with ANSI C29.1.

The mechanical strength of insulators shall meet or exceed the strength indicated on the plans.

Insulators for various uses shall have ratings not lower than the classes indicated on the plans.

Types and electrical classes and minimum mechanical characteristics for insulators shall conform to the plans. The overall length of the insulators shall conform to the plans for standardization.

The Engineer reserves the right to witness the manufacture, testing and packing of all insulators. The manufacturer will notify the Engineer not less than ten days in advance of manufacturing and testing operations.

Each insulator shall bear the manufacturer's name, mark number, and year of manufacture, clearly and permanently imprinted, without affecting the appearance or the function of the item. The insulators shall be supplied complete with hardware, etc. as indicated on the plans.

The insulators shall be designed for the class of insulation specified on the plans for specific operating and environmental conditions. The insulators shall have the following classifications with their corresponding characteristics:

Classification	Insulation Class (kV)	Creepage Distance (inches)	Impulse Wet Flashover (kV)	Impulse Withstand (kV)
Catenary*	25	24	60	150
Pin	34.5	21	80	200
Station-Post	34.5	37	80	200

* Catenary insulators shall include all strut, cantilever, suspension and pin types.

Materials - Uninsulated Wires:

Conductor materials shall be of a composition, quality and purity such that the finished product shall have the physical, mechanical, electrical properties, characteristics and parameters conforming to this Specification and the plans.

The wires shall be unconditionally guaranteed by the manufacturer and/or supplier to be free from defects for a period not less than five years.

The Engineer reserves the right to witness the manufacture, testing and packing of all wires. The manufacturer shall notify the Engineer not less than ten days in advance of manufacturing and testing operations.

All wires shall be subject to factory quality control tests as required in the applicable standards. Tests shall be performed on each reel prior to shipment. A certified copy of the test report for each reel shall be submitted to the Engineer prior to shipment. A copy of the test report shall be packed with each reel.

Grooved contact wire supplied in accordance with ASTM B9 shall be subject to the twist test in addition to other required tests. The twist test shall be performed as specified for round wire, except that six twists shall be required. Contact wire not meeting this test will be rejected.

All wires shall be shipped on wooden reels, suitable for the weight of the wires and shall be protected from damage. The diameter of the drum shall be sufficiently large so as to avoid difficulty with waves or kinks when the wire is strung. The grooved contact wire shall be wound on the reel in such manner that the vertical axis of cross section shall be parallel to the axis of the reel. Any permanent twisting or rotation of the grooved contact wire shall be cause for rejection of the reel at the manufacturer□s or Contractor's expense.

Each reel shall consist of one continuous, unspliced wire; and shall have the required length of wire so that no splices are required in the tension sections as installed unless approved by the Engineer.

Contact wire shall be permanently identified at intervals of 300' along its length on the surface of the top lobe, showing the manufacturer's mark, material, size, and year of manufacture.

Each reel shall have a strong, weatherproof tag or marker securely fastened to it, showing the size and type of wire as well as the ASTM designation, name and mark of the manufacturer, total reel length, reel weight and manufacturer's special instructions.

A stripe in any contrasting color approximately 1" wide shall be painted across the outermost layer on each reel. Any visible wire shift at this line, upon receipt at the job site, will be treated as indicating a relative wire movement during shipment, and is cause for reel rejection.

Joints in contact wire shall be marked with paint or dye prior to wire drawing. The marks shall be readily distinguishable after the wire drawing process. Such joints shall meet the breaking strength requirements of the trolley wire.

Any damage to the wires shall be the Contractor's responsibility, and all repairs and replacements of the damaged wires shall be at the Contractor's expense.

Factory fused trolley splices in a wire run shall have their locations from the nearest structure recorded by the Contractor and provided to the Engineer and MNR with the as-built plans.

Construction Methods: Proper clearances shall be maintained through the construction stages to ensure that the final installation adheres to OSHA, NESC and MNRR rules for climbing space, clearances to communications cables, trailing wires, termination strands, and adjacent energized circuits. A climbable structure is defined as any structure or pole, including catenary portal columns, that can be climbed to access signal feeders, power feeders or other equipment supported above.

Insulators:

All insulators shall be cleaned before installation. Only clean rags, free from any abrasive material shall be used for cleaning insulators. Wire brushes shall not be used for cleaning any parts, metal or otherwise. In the completed line, all insulator assemblies and hardware shall be clean, bright and free from nicks, chips or other mars.

Cantilevered insulators of messenger support assemblies shall be level after loading.

Hardware:

All pole-line hardware shall be installed as shown and as recommended by the manufacturer. Bolts and nuts shall be properly tightened in accordance with the manufacturer's recommendations. All bolts shall be of sufficient length for a full thread beyond the nut and/or lock nut, but shall not protrude beyond the nut and/or lock nut more than 1/2", excluding foundation bolts. Bolt ends shall not be cut off. Where lock nuts are not used, lock washers shall be provided.

Hardware shall be installed using tools and methods specified by the manufacturer and approved by the Engineer.

Hardware shall be inspected for cleanliness and damage. Any item that does not fit, creates scraping of galvanizing during installation, or is found defective shall be rejected.

Cotter pins shall be installed with the open end toward the ground.

Suspension-link type messenger supports shall be installed within 600 feet of mid-point anchors.

Connectors:

Current-carrying connectors, shall be as shown on the plans and shall be installed in accordance with the manufacturer's recommendations. Connectors for copper or bronze wire shall be copper or bronze or a combination of copper and bronze.

Where possible, the connectors shall be factory-loaded with a corrosion inhibitor, which is made for the specific purpose. Wire surfaces, which are in contact with conducting surfaces of the connector shall be thoroughly wire brushed and an inhibitor applied. Where connectors are not factory-loaded, the same inhibitor shall be applied in the field to the connector.

Corrosion inhibitors shall be stable over a wide temperature range, adhere to cold metal surfaces, be water-repellent, weather resistant and inert to copper, aluminum, zinc, tin, cadmium, steel and neoprene rubber. Grit-bearing inhibitors shall be used except for flat lugs, sliding surfaces or where not recommended by the connector manufacturer. Grit shall be compatible with the connector and wire metal.

One typical full-tension test of each type of splice for each type of conductor shall be fabricated independent of the catenary and shall be tested by an independent testing laboratory approved by the Engineer or by another means acceptable to the State. The tensile strength and electrical conductivity of full-tension line splices shall be at least equal to the values specified in NEMA Standard CC3 for Class 1, full-tension connectors. Copper and bronze line splices shall conform to the specified standard of 95 percent tensile strength and 100 percent conductivity (minimum).

Contact wire splices shall be permitted only with the approval of the Engineer. When permitted, contact wire splices shall be designed to avoid the formation of “Hard Spots” in the catenary system. Maximum separation of spliced trolley wires shall be 1/32 of an inch.

Conductors:

For each length of conductor installed, a record shall be kept of the reel number from which the conductor was used. Partly used reels shall be recorded as such.

All conductors shall be handled in accordance with good overhead line practice and the manufacturer's recommendations.

Conductors shall normally be ordered with several lengths of conductors on one reel to satisfy several anchor-to-anchor runs. They shall be supplied in one (1) length. As each anchor-to-anchor length is removed, the length remaining on the reel shall be recomputed and properly recorded both on the reel and on substantiating documentation.

Care must be taken with reels so as not to jeopardize the stringing operation. Damaged reels shall be set aside for repair before use.

Installation of Drop Tubes:

Drop tubes shall be installed to be vertical after loading by the equipment. The bottom end of all drop tubes shall be installed so as not to intrude into pantograph clearance envelope (with contact wire in the uplifted position) as per the plans.

Torque Values:

The following table shows torque values for Dossert equipment. If a different company is used, then the contractor shall develop a similar table giving manufacturer-recommended torque values.

TABLE OF TORQUE VALUES FOR USE WITH CATENARY SUPPORTING STEEL ATTACHMENT BOLTS, CATENARY ASSEMBLIES, SUB ASSEMBLIES, HARDWARE, FITTINGS AND OTHER COMPONENTS

HEX HEAD BOLTS	TORQUE VALUE
3/8" DIAMETER	20 - 22 FT. LBS.
1/2" DIAMETER	40 - 42 FT. LBS.
5/8” DIAMETER	70 – 72 FT. LBS
3/4" DIAMETER	

CROSBY WIRE ROPE CLIPS	TORQUE VALUE
ROPE SIZE 3/8" DIAMETER	45 FT. LBS.
ROPE SIZE 1/2" DIAMETER	65 FT. LBS.
ROPE SIZE 5/8" DIAMETER	95 FT. LBS.

SPECIAL ITEMS	TORQUE VALUE
DOSSERT STRAIN CLAMP SECL50 (MESSENGER WIRE D.E.) 1/2" DIAMETER HIGH STRENGTH STEEL “U” BOLTS	70 - 72 FT. LBS.
DOSSERT HOLLOW BOLT USED WITH CONTACT WIRE CLAMPS	52 - 55 FT. LBS.

AND JUMPER CLAMPS 5/8" DIAMETER BRONZE

Installation of Catenaries:

Catenaries shall not be erected without the catenary guy anchor assemblies being in place, ready to receive loads.

Care shall be taken to prevent kinks in the wires and cables. The Engineer reserves the right to reject any contact wire in its entirety if it is judged that any kink will jeopardize current-collection performance. Bird caging of stranded wire shall be cause for rejection.

Tensions in all conductors shall be as given in temperature-tension charts, +/- 5 percent.

Splicing of conductors is not acceptable in any in-running contact wire (one which is in contact with the pantograph) except where called for on the staging plans or unless approved by the Engineer. When permitted, contact wire splices shall be designed to avoid the formation of "Hard Spots" in the catenary system. Maximum separation of spliced trolley wires shall be 1/32 of an inch.

Splicing of messenger wires is not acceptable except where called for on the staging plans or unless otherwise approved by the Engineer.

No splice will be permitted within five feet of a support clamp or wheel.

Any damage to the conductors shall be reported, in writing, to the Engineer. Remedial action must be approved by the Engineer and will be performed as directed.

The Contractor shall provide any temporary anchors and down guys required to facilitate system installation and construction staging at the Contractor's expense.

After installation of support and registration assemblies and stringing of conductors, adjustment may be required to the stagger, heel setting, contact wire height to be within the specified design tolerances.

Messenger wire heights shown on the plans are nominal values. Additional adjustment to the messenger wire heights may be necessary to achieve proper trolley wire heights.

Conductor interfaces of all clamps for feeder jumpers, full feeding jumpers, tap wires, equalizing jumpers and in-span jumpers shall be coated with conductive grease. All jumpers shall allow for along track movement of catenary over the temperature range specified on the plans.

Jumpers in overlaps shall be of a length to allow full differential along track movement of the two catenary systems, without strain.

At midpoints, messenger wires shall be terminated using a “pistol” type dead end to each side of the mid-point structure. The tails of the messenger wires shall be clamped as per the plans.

Where the balance plate on the Balance Weight Assembly is at the elevation of an adjacent catenary, the balance plate should be located to assure electrical clearance to catenary hangers at all ambient temperatures.

Cross track feeders shall accommodate along track movement of the catenary without strain.

The Contractor shall review and note all field changes from the design, and submit these changes together with his recommendations to the Engineer for approval.

Span wire registration assemblies of pull-offs and steady spans shall be adjusted such that the heels of steady arms are clear of the pantograph clearance envelope under operating ice load conditions.

The slack end of the steady span shall have a normal tension of 500 lbs.

Wire sizes, location of turnbuckles; insulators, suspension assemblies, and hangers for the catenary shall be installed in accordance with the plans or as directed by the Engineer.

Field adjustments of hangers, contact and messenger wire heights shall be performed by the Contractor.

Stagger, wire heights, and heel setting of the steady arm shall be in accordance with the plans or as directed by the Engineer.

Installation of Catenary Assemblies not covered elsewhere:

Insulators for pull-off assemblies are shown on the plans centered between tracks. With track centers at 12 feet, the insulators for pull-off and cross span assemblies cannot always be exactly centered between the adjacent tracks. In these instances, the insulator should be installed as close as possible to the pull-of assembly. In all other instances, the insulator should be installed centered between adjacent tracks.

In-span insulating assemblies for wires crossing over the catenary are to be installed centered between adjacent tracks for maximum electrical clearance.

Registration, dead-end and pull-off assemblies should be constructed with maintenance and replacement tasks in mind. Span insulators shall be installed bearing in mind maintenance clearances and lateral adjustments.

Prior to the installation of in-span insulators, torsion shall be removed from stranded wire by use of a temporary swivel device, suitable for this purpose, installed at the insulator location.

All supporting devices including steady arms, messenger supports, cross span and steady wire or wire pull-off registration assemblies shall be installed as shown on the plans.

The design and installation of contact wire registrations including steady arms shall be such that pantographs shall clear steady arms by a minimum of 1 1/2" for the full range of pantograph uplift and sway.

All connections, bolts, and nuts shall be properly tightened in accordance with the manufacturer's recommendations.

All items shall be inspected for fit, damaged coating or bent/kinked members. Any piece found to be defective shall be rejected and a replacement shall be installed at the Contractor's expense.

Support and registration assemblies shall be installed as shown on the plans and in accordance with the manufacturer's instructions. The Contractor shall take field measurements, immediately prior to assembly fabrication, to determine the as-built reach from the elevated track centerline to face-of-pole at either contact wire height or messenger wire height. Due allowance shall be made, during fabrication, for dead load deflection of the pole, as applicable.

The wire heights and stagger given on the plans are related to the track high rail level and the elevated track centerline.

For stability during stringing, the support assemblies shall be temporarily restrained to prevent collapse due to swinging. The details of the restraint shall be submitted to the Engineer for approval.

Cotter pins and nuts on each assembly shall be located on the same side of the structure to assure uniformity along the line.

Assemblies fitted with pins, cotters, bolts and nuts shall be oriented where possible in such a manner as to lock these components together by gravity if the pins or nuts should become detached under service conditions.

Components employing a hinge or swivel shall be greased with an approved grease before assembly of the rubbing surfaces.

Contractor shall make all final adjustments on loaded wire runs as per plans (i.e., staggers and messenger deflections).

Erection of Balance Weight Anchor (BWA) Device:

The BWA device shall be installed as shown on the approved shop drawing and as recommended by the manufacturer.

It is suggested that the balance weights be positioned at the mean temperature (70 degrees F) position on the pole and locked during catenary installation so that vertical travel is prevented. Tensioning of the messenger and contact wires can then be effected in accordance with the erection tensions as shown on the plans. This method permits support assemblies and pull-offs to be set perpendicular to track for messenger suspension clamp tightening. It avoids the need to calculate along track offsets, resulting from temperature variation or cantilever setting and clamping, if the conductor tensioning is affected with the weights free to move.

Preparation for Stringing Messenger Wire:

Roller-bearing sheaves of the closed type shall be used at all support points for stringing of the messenger wire. Sheaves shall be of sufficient size to accommodate the conductor without damage.

Stringing of the messenger shall start from an anchor location. After the initial termination is made, the conductor shall be pulled from the reel and lifted into the sheaves at each support. Sufficient tension must be maintained in the conductor during stringing to prevent the conductor from touching the ground or track between support points.

When the second anchor location is reached, the messenger conductor shall be pretensioned above the specified design tension by 1,500 lbs. as follows:

For A.T. systems, use a pretensioning value of 9,000 lbs.

This pretensioning is to be held for 15 minutes. At the end of 15 minutes, the wire is to be re-tensioned to the original pretensioning value and held for another 15 minutes. At the end of the second 15-minute period, the wire is again to be re-tensioned up to the original pretensioning value and held for another 15 minutes. This is to continue until no more than 100 lbs. of tension is lost in a 15-minute period.

Erection tensions shall be governed by tables furnished for the purpose, based on the equivalent span for the tension length and temperature of the conductor.

The conductors shall be lowered temporarily at catenary structures adjacent to overhead obstructions, when there is a possibility of interference. Satisfactory clearance to the track and/or cross streets at grade crossings shall be maintained at all times.

Adjusting Messenger Wire Stringing Tension:

Final adjustment to the specified stringing tension shall be made progressively, working any slack from the first anchor location toward the second anchor location at the other end of the run.

The tension shall be adjusted so that it will be within five (5) percent, plus or minus, of the erection tension derived from the tables.

When the proper tension has been obtained, the messenger wire will be transferred to the messenger pulley wheel.

Dynamometer or similar device shall be used for measuring wire tension.

Installing Hangers:

The Engineer will provide the Contractor with hanger lengths based on actual span lengths to be provided by the Contractor. The Contractor shall provide the Engineer with span lengths for all tracks in a span whenever hanger lengths are requested. The Contractor shall be responsible for any changes required in the hanger lengths for final catenary adjustments for proper current collection by the pantograph and for any adjustments for obtaining required clearances.

Hangers shall be manufactured to a tolerance of +/-1/4" in length.

The along track position of each hanger shall be within +/- 6" of the design position.

All hangars shall be installed plumb.

Preparation for Stringing and Tensioning of Contact Wire:

Stringing of the contact wire shall start from an anchor location. After initial termination is made, the conductor shall be pulled from the reel and lifted into temporary wire loops attached to the ends of the hangers. "Figure Eight" loops made of annealed No. 9 iron wire, or other approved loops, may be used. In any case, the trolley wire shall not be restrained from longitudinal movement during tensioning.

Contact wire shall be held in proper lateral position, in relation to the centerline of track, using temporary rollers to prevent kinking. Sufficient tension must be maintained in the conductor during stringing to never allow the conductor to touch the ground between supports.

Contact wire shall be tensioned in accordance with the tensions shown on the plans for the appropriate equivalent span and temperature.

The contact wire shall be pretensioned above the specified design tension by 1,000 lbs. as follows:

For A.T. systems, use a pretensioning value of 6,000 lbs.

This pretensioning is to be held for 15 minutes. At the end of 15 minutes, the wire is to be re-tensioned to the original pretensioning value and held for another 15 minutes. At the end of the second 15 minute period, the wire is again to be re-tensioned up to the original pretensioning value and held for another 15 minutes. This is to continue until no more than 100 lbs. of tension is lost in a 15 minute period.

Dynamometer or similar device shall be used for measuring wire tension.

Tension Conditions:

Conductor temperatures shall be measured by thermometer. The bulb of the thermometer shall be in intimate contact with the conductor and shall be taped to the conductor to prevent drafts around the bulb. The thermometer shall be read after five minutes of contact. Conductor temperatures may also be read using an infrared digital thermometer.

A record of temperature and the tension recorded at both ends of the tension sections shall be kept for all catenaries.

Attaching Hanger Clips and Registration Arms:

As the hanger clips are fastened and steady arms attached, any twist in the contact wire shall be removed by working from one anchor to the other.

As far as practicable, bolts shall be installed in the various clips so that the nuts will be on the same side giving a uniform appearance. On curves, the nuts shall be placed on the inside of the curve to provide the best clearance to the pantograph.

Saddles for loop-type hangers shall clamp the messenger tightly. The loops shall have a loose fit around the saddle, permitting free rise and fall without binding.

Wire pull-offs shall be installed in locations designated on the plans.

Installation of Wire Cross Assemblies:

Cross-contact assemblies shall be fitted at all in-running contact wire crossings as shown on the plans.

Removal of Transitional Overlaps:

Permanent transitional overlaps between the existing hanging beam catenary system and the existing auto-tensioned catenary system shall be removed.

Temporary work may be required to remove the transitional overlaps in stages, including, but not limited to, temporary bridle wires, guy wires, aerial guy wires, re-profiling of the existing auto-tensioned catenary system.

Installation of Overlaps:

Insulated and uninsulated overlaps shall be provided between individual catenary tension sections as per the plans. These shall be adjusted to provide a smooth transition from one tension section to the next with good commutation for pantographs.

Installation of Transitional Cross-Overs:

Due to the staging, it may be necessary to install transitional cross-overs between the new auto-tensioned catenary system on one track and the existing hanging beam catenary system on an adjacent track. The contractor shall develop means and methods to ensure that the temporary configuration is installed within the installation tolerances noted elsewhere in this specification.

Installation of Section Insulators:

Section insulators shall be installed as recommended by the manufacturer. They shall be positioned in-span in accordance with the plans. Each unit shall be adjusted to maximize performance at the maximum speed of operation in both directions.

The method of installation shall cause no damage to the catenary wires. Any kinked contact wire shall be repaired or replaced at the Contractor's expense if the damage jeopardizes good current collection as determined by the Engineer.

Installation of Jumpers:

Jumpers shall be installed as shown on the plans.

Before fitting jumper clamps, the conductors shall be wire-brushed to ensure a good electrical connection beneath the jumper clamps and manufacturer recommended inhibitor applied.

Jumpers shall protrude through their clamps 1/2" and jumper ends shall be wrapped.

The configuration of jumpers shall make due allowance for the relative movement between catenaries for all temperatures.

Control of Scrap:

Scrap components shall be segregated from usable components, collected and removed daily.

Scrap components shall not be left alongside the track.

Scrap components shall become property of the Contractor and shall be removed from the project site.

Final Adjustments:

After tensioning has been completed and any temporary stops at the balance weight anchors removed, hangers and clips fastened, steady arms erected, and pull-offs installed, a check of the

construction and adjustment to final position shall be made (i.e., staggers, heights at structure, mid span, and weight carriage).

Construction at overhead bridges shall be checked for proper contact wire height, and for clearance from the messenger to the underside of the bridge.

Any hangers with improper fit shall be replaced with hangers of proper length.

Height of contact wire and lateral position of wire shall be checked in accordance with the plans and adjusted where necessary and is to be measured normal to the track along the elevated centerline. Messenger wire heights shown on the plans are nominal. The final messenger wire heights shall be adjusted accordingly to achieve proper trolley wire height.

Where the normal height of contact wire is 18'-0" and above, a tolerance of +3", -0" from the height shown in the plans will be permitted.

Where the wire is shown less than 18'-0" in order to clear overhead bridges, a tolerance of +1/2", -0", will be allowed.

Midspan heights for catenaries must be at the average of the support heights at the structures at each end of the span; +/- 1" for spans less than 100 ft., and +/- 2" for spans over 100 ft after all options shown on the plans have been attempted. For auto-tensioned catenaries the presag must be subtracted from the average height to determine the required midspan heights with the same tolerances as above.

The staggers of the contact wire shown in the plans are relative to the inclined centerline of track, which coincides, with the nominal centerline of the static pantograph.

Generally, on tangent track, the stagger of the contact wire will be alternately to the right or left of the centerline of pantograph at consecutive structures.

The lateral position of the contact wire on curved track will vary with the curvature and span length. The stagger at each support will be as shown in the plans.

The installation tolerance for contact wire stagger shall be +/- 1/2".

The messenger wire shall be installed vertically above the final contact wire stagger with an allowance of +/- 1/2" for system heights of 1'-6" or less, increasing to +/- 2" for system heights of 3'-0" or greater.

Measurement of the contact wire at structures and at midspan:

The following measurements shall be made and recorded with the catenary in its final position:

Contact wire height above each track at each messenger support point and at midspan.

Contact wire stagger relative to design superelevated track centerline at each registration point and at midspan.

Track centerline to face of pole at rail level at each structure location, actual track superelevation and pole rake.

A complete set of the final height and stagger dimensions, as accepted, shall be available at the Final Inspection, and incorporated into the final as-built documents.

Clearance Check:

The Contractor shall make a clearance check, using a height and stagger gauge fitted with removable clearance ears. If fouling occurs at any point, it shall immediately be brought to the attention of the Engineer. The Contractor shall make any field corrections at no additional cost.

The clearance ears shall allow for 7" of uplift of the contact wire with an additional allowance of 3" for mechanical clearance. All parts of the system shall be outside this clearance envelope, with the exception of the steady arm. Any registration pipe drop bracket to which the steady arm is attached shall be outside the clearance envelope.

Pantograph Running Tests:

Prior to final acceptance, the Railroad will conduct pantograph tests on the catenary, using a vehicle with the pantograph in contact with the contact wire. These tests are to assure a smooth shock-free passage of the pantograph with no interruption to current collection especially at turnouts, section insulators and overlaps. Particular attention will be focused on wire takeover at overlaps, turnouts and crossovers, and lack of arcing at all locations. The Contractor shall be responsible for all adjustments required as a result of these tests.

Precautions in Handling Conductors:

Conductors shall be handled in such a manner that it will not be scratched, cut, or nicked with tools or clamps.

Conductors shall not lie upon, or be dragged across, sharp or rough surfaces.

Conductors shall not be annealed.

Sharp bends in the conductors shall not be permitted.

Conductors shall not be looped to form dead-ends of either a temporary nature or a permanent nature.

Conductors shall not be wrapped around poles or other anchorages.

Conductors shall not be marred with temporary wire or hook hangers.

Only approved parallel jaw clamps shall be used in tensioning all conductors. The grooves of the clamps must be free from burrs, fins, or any roughness, and the ends of the grooves must be flared (bell-shaped).

Vertical kinks in the contact wire shall be removed. A leather or copper-faced hammer shall be used, beating against a smooth flat surface. A 4" x 4" x 4' hardwood block is recommended.

Lateral kinks in the contact wire shall be removed if they affect the fit of any parts.

Inspection:

The Contractor shall provide a self-propelled, high rail, man lift platform inspection vehicle for final inspection of each completed catenary wire run, as well as for inspection of any temporary catenary modifications, including in curves and temporary cross-over arrangements. The inspection vehicle shall be capable of lifting four (4) people to trolley wire height and shall be supplied with a vehicle driver.

The Contractor shall provide all manpower, equipment, and grounding devices required to provide equal-potential grounding protection for inspection personnel on the high rail inspection vehicle. The protection shall be provided for the entire length of catenary wire run being inspected and shall be in conformance with all Metro-North rules, procedures, and regulations.

The high rail inspection vehicle will be made available for use by the Engineer and the Railroad Inspectors for final inspection of each completed catenary installation. The inspection vehicle shall also be made available for use for the re-inspection(s) of completed catenary installations when remedial work is required due to deficiencies found during the initial inspection.

Balance Weight Anchor Assembly:

The assemblies shall be installed as shown on the plans and as specified.

Installation, adjustment and testing of the device shall be in conformance with the manufacturer's instruction manuals.

The assembly shall be inspected and tested to ensure that it satisfies the contract requirements including dimensional accuracy and compatibility with matching components.

Catenary Fittings and Hardware:

Installation requirements for fittings and hardware shall be in accordance with the manufacturer's recommendations and as shown on the plans.

All fittings and hardware used for catenary assemblies shall be selected and made such that they can be reused after removal.

All fittings and hardware shall be designed with maximum interchangeability and standardization for easy interface with the other components of the catenary system.

All fittings and hardware shall be designed to provide a homogenous catenary hardware and assembly arrangement.

Components and assemblies shall be designed such that all fastenings and adjustments are accomplished with the same dimensional standards or tools.

Where knuckles are used, their selection shall require that they are not displaced in the along track direction by more than 5 degrees.

Hanger types and locations, size, length and spacing shall be as indicated on the plans and tabulations to be provided by the Engineer based on the field data to be furnished by the Contractor. The loops of hangers shall be free to rise on messenger saddles without binding.

Hangers shall be formed before installation by use of jigs and tools approved by the Engineer. Hanger identification labels shall be removed before the catenary is commissioned. The hangers required for an individual span shall be called a hanger set assembly.

Messenger wire saddles shall retain the hanger loops irrespective of saddle orientation by means of extended lobes, as shown on the plans. Messenger wire saddles for hangers shall be insulated from the messenger wire by means of insulating neoprene sleeves not less than one-tenth of an inch thick.

Method of Measurement: The Work of this Section will be measured for payment based on linear foot of the complete catenary system furnished, installed and accepted.

Measurement for payment will be made from anchor to anchor as shown on the plans along the geometric centerline of each track which has a catenary system positioned above it, using actual track length, with no adjustment for additional lengths due to stagger offsets, sag or other material consuming configurations. At overlaps and crossovers the measurement of each section of the two catenary systems shall be made referenced to track centerline, with measurement terminating at the balance weight assembly or terminal pole, as the case may be.

There shall be no separate payment for the removal of transitional overlaps and interface with existing catenary system, but the work shall be included in the pay item AUTO-TENSIONED CATENARY.

There shall be no separate payment for the design, development of working drawings or for the installation and removal of transitional crossovers between new auto-tensioned catenary system

on one track and the fixed-tension hanging bean catenary system on the adjacent track, but the work shall be included in the pay item AUTO-TENSIONED CATENARY

There shall be no separate payment for the relocation of the 7/8 inch grounded messenger wires and their messenger saddles required during the removal of transitional overlaps, but the work shall be included in the pay item AUTO-TENSIONED CATENARY.

There shall be no separate payment for final adjustments to achieve proper catenary wire heights, including adjustments to the messenger wire supports, but the work shall be included the pay item AUTO-TENSIONED CATENARY.

The furnishing, installation and acceptance of the catenary system shall include fabrication, supply, installation and adjustments of all wires and conductors, registration and termination/ anchor assemblies, cantilever assemblies and all in-span assemblies, pull-off assemblies, jumpers and their connections, hangers, all hardware and fittings and all else necessary (except disconnect switches, down guys, drop tubes and drop tube supports and section insulators which will be paid for under separate pay items) to form the complete functioning catenary system.

Removal of interfering signals and signal access walkways will be paid for under REMOVAL OF SIGNAL HEAD INCLUDING DROP TUBES.

There shall be no separate payment for surveys to verify rail to truss dimensions, for temporary material, temporary guying, or temporary fittings or to provide high rail inspection vehicle, but the cost shall be included in the unit cost for Auto-Tensioned Catenary Installation.

There shall be no separate payment for removal of truss-to-post knee braces or platforms without signals to simplify drop tube installation but the cost thereof shall be included in the unit cost for AUTO-TENSIONED CATENARY. There will be no separate payment for relocation of C&S cables or M.O.D. operating rods or control boxes to clear balance weight assemblies but the cost thereof shall be included in the unit cost for AUTO-TENSIONED CATENARY.

There shall be no separate payment for relocations of existing buss bars or switches to accommodate the installation of the catenary system, but the cost thereof shall be included in the unit cost for AUTO-TENSIONED CATENARY.

It may be necessary, from time to time, to add or to substitute assemblies called for on an erection diagram bill of material in order to meet the requirement that the Contractor provides a complete functioning catenary system. No separate payment will be made for such changes but the cost thereof shall be included in the unit price for AUTO-TENSIONED CATENARY.

No separate payment shall be made for the installation of temporary back guys, but the cost thereof shall be included in the item AUTO-TENSIONED CATENARY.

Basis for Payment: This work will be paid for at the contract unit price for the following pay item including all transportation, materials, equipment, tools and labor incidental thereto:

Pay Item	Pay Unit
AUTO-TENSIONED CATENARY	LF

ITEM #0096056A - SUSPENSION OF C&S CABLE MESSENGERS

Description: Work under this item consists of suspending existing C&S cable messengers including fiber optic cable (FOC) messengers from new catenary structures. Work under this item also includes removing existing C&S cables, FOC and associated messengers from structures to be removed and attaching to new structures.

Materials: Applicable portions of CATENARY FITTINGS AND HARDWARE and STEEL (MISCELLANEOUS) shall apply.

Construction Methods: All existing C&S cable messengers, slated to remain, shall be supported by the new catenary structures upon their erection (except where alignment of structures allows the cables to pass freely by the new structure).

Cable support assemblies and support brackets shall be provided on new and old structures for existing control cable and FOC messengers.

All messenger supports shall be mounted on the field side of catenary structures wherever possible. In some instances, the cables pass above the truss and are to be attached to support steel.

The plans reference the materials required to support the cable messengers.

Method of Measurement: This work will measure for a payment as a lump sum item.

The supply and installation of new C&S, fiber optic and control cables and messengers is not a part of this pay item, only the attachment of their messengers to the support brackets and the relocation of cables.

If new or additional cable support messenger wire is deemed necessary, payment will be covered under item for CABLE SUPPORT MESSENGER WIRE.

The procurement and installation of support brackets and or support steel for cable messengers shall be paid for under STEEL (MISCELLANEOUS)

Basis for Payment: The work shall be paid of the contract lump sum price for the following pay item, which shall include all transportation, material, equipment, tools and labor incidental thereto:

Pay Item	**Pay Unit**
SUSPENSION OF C&S CABLE MESSENGERS	LS

ITEM #0096065A - REMOVAL OF CATENARY

ITEM #0096066A - REMOVAL OF SIGNAL AND COMMUNICATION CABLES

ITEM #0096067A - REMOVAL OF SIGNAL HEAD INCLUDING DROP TUBES

ITEM #0099010A - REMOVAL OF ABANDONED RAILROAD EQUIPMENT

ITEM #0096081A - REMOVAL OF FEEDER OR AERIAL GROUND WIRE

Description: Work under these items consists of the removal of the existing catenary system, guy wires, guy foundations, aerial ground wire, abandoned cable messenger wire with or without signal and communication cables, abandoned platforms and cabinets, and signal heads with drop tubes, signal cables and access cages and walkways.

Work under these items includes the removal of all existing and new bridle wire, bridle wire extensions and temporary bridle wire back guys.

Work under these items includes the removal and disposal of abandoned steel and wood platforms, removal and disposal of abandoned transformers and switches, and removal of abandoned control boxes, from existing structures, as shown on the plans and directed by the Engineer.

Work under this section includes the removal and disposal of fifteen (15) steel poles located between Structure 900 and 905, on the existing south side viaduct wall. Work includes cutting the anchor bolts flush with the top of the stone. Work also includes the removal of 4 (four) wood poles located between Structure 858 South and 864 South.

Work under these items includes the removal of lead paint where required. All existing steel structures, steel attachments, signal head supports, bridle wires, grounded messenger wires, guy wires and hanging beams have been painted with paint containing lead.

The Contractor shall be responsible for coordinating the necessary outages with the Railroad and the utility company along with following the requirements set forth in the Special Provisions.

Submittals: Contractors proposed method of removing catenaries, grounded messengers, hanging beams, aerial ground wires and feeder wires.

Contractors proposed method of removing existing catenary portal structures, existing foundations, signal and communication cables and signal heads.

Contractor's methods for stabilizing and maintaining adjacent track catenary heights and staggers when work to remove the existing catenary, portions of hanging beams and grounded messengers is done. Submittals required for removal work done on each track.

Construction Methods: The removal of existing aerial ground wire and attachment assemblies will occur in the vicinity of electrical energized facilities. De-energizing of the Railroad's and the utility company's electric lines will be required to perform the work. The Contractor shall perform the work in accordance with the following:

1. During the removal of the existing aerial ground wire and along track jumper wire, all equipment and persons will at all times, remain at least 20 feet clear of the utility's existing 115 kV overhead transmission lines, installed on catenary or pole structures along the railroad's mainline right-of-way. When approach closer that the specified distance is required, the Contractor will request in writing, with six months advance notice, the de-energizing of the utility lines or equipment. De-energizing of the utility power line is contingent on power demand and economic dispatch and shall be coordinated with the utility. The Contractor will assume any risk involved in the reasonable denial of a request to de-energize the utility's transmission line and the last minute cancellation of an approved request to de-energize the transmission lines. If so ordered by the Engineer, the Contractor will immediately cease all activity in the areas where the utility's transmission lines are to be re-energized.

2. The Contractor and the utility must cooperate fully in order to avoid damage to the conductors, and to insure that no delays will occur in the progress of the work. Therefore, the Contractor shall furnish the utility with a schedule for this work, which is to include starting and completion dates and, shall notify the utility six months in advance of the commencement of construction work.

All loose paint debris created by the removal of items covered under this section and by lead paint removal, shall be caught and/or vacuumed and disposed of as specified in DISPOSAL OF LEAD DEBRIS. Specifically the Contractor shall comply with the requirements of the OSHA Standard for Lead in Construction and any other applicable Federal and State laws and adhere to LEAD COMPLIANCE FOR MISCELLANEOUS EXTERIOR TASKS specification.

The Contractor shall perform a field walk with the Railroad, the Engineer and the Department to determine and confirm which existing railroad equipment is abandoned and to be removed.

The existing catenary system is defined as the contact(trolley) wire, auxiliary trolley wire, messenger wire, hangers and insulators, switches, and other items incidental thereto including hanging beams, grounded messengers and bridle wires, structural supports for messengers, pull-off wires and tail wires.

The existing catenary system shall be removed, as shown on the plans, and disposed of by the Contractor.

The sequence for removal of catenaries, the hanging beams and the grounded messenger is shown on the plans. Since all catenaries in a span are supported by a common hanging beam, it is of great importance that active catenaries are not displaced when a catenary, a portion of the hanging beam, and/or the grounded messengers are removed. During construction the permissible lateral displacement of an active catenary shall be limited to 1". Vertical displacement is limited to 2" or a gradient of 1:240 which ever is less. Shifting of the grounded messenger support points on adjacent structures may have to be employed to keep the hanging beams or portion of a hanging beam, with its remaining catenaries, in place.

The Contractor is responsible for providing and installing any additional temporary bridles or other restraining systems as may be required to maintain the existing catenary systems heights and staggers on adjacent active tracks. The Contractor is responsible for any adjustments or shifting of the 7/8 grounded messenger support points on the adjacent structures as may be required to keep the hanging beam or portion of the hanging beam, with its remaining catenaries, in place.

Before any existing catenary wire, grounded messenger wire or hanging beams are removed or lowered, temporary bridle wires shall be in place. Temporary bridle wires are to be installed as indicated on the plans, and are to be maintained and adjusted as required throughout the project. All temporary bridle wire installations are to be back guyed as required. When the temporary bridle wires are no longer required, they are to be removed.

When any loads are temporarily added to structures, such as dead-ending of messengers, trolley wires, bridles, feeders, aerial ground wire, etc., adequate back guys are to be installed in order to prevent overloading or excessive deflection of the structure. Back guys are to be terminated to adequately sized, suitable anchors. The Contractor shall calculate all temporary loads to be so terminated and submit for approval, the loads, methods and procedures to be used, materials and anchor locations.

Signal heads including their drop tubes, signal cables and access cages and walkways shall be removed where called for on the plans and as deemed necessary for the construction of the new catenary system.

All 2/0 ground wire shall be removed, and shall be replaced as per the contract drawings. Installation of new ground wire shall be covered under AERIAL GROUND WIRE SYSTEMS. Removal shall be coordinated with replacement so that grounding is maintained at all times.

Form 816 Section 1.04.06 applies and Contractor shall dispose of all removed structures, wires, access cages and walkways, which shall become property of the Contractor unless the Engineer instructs the Contractor otherwise. Removed signal heads with drop tubes shall be turned over to the State and delivered to a location as determined by the Engineer. Signal and communication cables shall become property of the Contractor.

After the removal of catenary messenger support saddles, the top chord of the truss shall be examined for and be subject to repair under another section of these specifications. Should no repairs be required, the corroded area shall be cleaned and painted. For paint specifications see specifications for Repairs (Item #090017A etc.).

No signal or communication cables, platform, transformer, switch or control box shall be removed until removal has been authorized by the Railroad's Signal Department and/or Power Department. Prior to the removal of such items, a walkthrough shall be performed by the Contractor, the Engineer and the Railroad to confirm abandoned equipment and removals.

As called out on the erection diagrams, abandoned platforms and abandoned railroad cabinets shall be removed from the structure and disposed of.

Method of Measurement: REMOVAL OF CATENARY will be measured for payment based on the linear feet of the existing catenary system removed, on each track, measured along the baseline. For payment purposes, the linear foot measurement, along the baseline, for the existing catenary system in inclusive of all messenger, auxiliary trolley and trolley wires. The messenger, auxiliary trolley and trolley wires shall not be measured for payment separately. There shall be no separate payment for the removal of tail wires, but the cost thereof shall be included in the item REMOVAL OF CATENARY.

The removal of temporary auto-tension/fixed tension overlaps will be measured for payment based on the linear feet of catenary removed, on each track, measured along the baseline. For payment purposes, the linear foot measurement is inclusive of all messenger, auxiliary trolley and trolley wires. The messenger, auxiliary trolley and trolley wires shall not be measured for payment separately. There shall be no separate payment for the removal of tail wires, back guys, or catenary supports, but the cost thereof shall be included in the item REMOVAL OF CATENARY.

Payments for the removal of catenary over track cross-overs shall be measured between the switch points of each cross-over. There shall be no separate payments for the removal of catenary or tail wires beyond the points of switch of cross-overs, but the cost thereof shall be included in the item REMOVAL OF CATENARY.

There shall be no separate payment for the removal of hanging beams, bridle wires, insulators and/or grounded messengers, including saddles, but the cost thereof shall be covered under the item REMOVAL OF CATENARY.

No separate payment shall be made for the labor, materials and equipment required for the installation or removal of existing or temporary bridle wires, bridle wire extensions or guys, temporary suspension insulators for support of pull-off span wires, back guys, hanging beam extensions and splice plates, bridle extensions to hanging beams, or other restraining systems required to stabilize the existing catenary system, but the cost thereof shall be included in the item REMOVAL OF CATENARY.

There shall be no separate payment for labor, material and equipment for repairs to the existing hanging beams, but the cost thereof shall be included in the item REMOVAL OF CATENARY.

There shall be no separate payment for the removal of grounded messenger dead end poles and their foundations, but the cost thereof shall be included in the item REMOVAL OF CATENARY.

Payment for the cleaning and painting of corroded areas after messenger support saddles have been removed shall be covered under the Item REPAIR TRUSS TOP CHORD ANGLE.

Removal of signal head including drop tubes, shall include associated signal cables to CIL house, cable trays, access cages and walkways and will be measured for payment based on the number of signal heads to be removed.

REMOVAL OF FEEDER AND AERIAL GROUND WIRE will be measured for payment based on the linear feet of wire removed measured along the base line.

REMOVAL OF SIGNAL AND COMMUNICATIONS CABLES will be measured for payment based on the linear feet of messenger wire removed, regardless of the number of the signal and communications cables bundled together, and measured along the base line.

The item REMOVAL OF SIGNAL AND COMMUNICATION CABLES includes the removal of signal and communications cable including messenger support wire. There shall be no separate payment for the removal of messenger support wire at locations where both the messenger support wire and signal and communications cable is to be removed, but the cost thereof shall be included in the item. For locations where removal of messenger support cable, without signal and communication cable is required, the work shall be paid as linear feet for the amount of messenger support cable removed under the item REMOVAL OF SIGNAL AND COMMUNICATION CABLES.

Temporary supports of existing Along Track Jumpers from new structures will not be measured for payment separately but the cost thereof shall be included in the item REMOVAL OF FEEDER AND AERIAL GROUND WIRE.

Removal of along track jumper disconnect switches will not be measured for payment separately, but the cost thereof shall be included in the item REMOVAL OF FEEDER AND AERIAL GROUND WIRE.

Removal of platforms (not associated with signal heads), transformers or switches, and control boxes/cabinets shall be measured for payment based on the actual quantity removed and paid for under the item REMOVAL OF ABANDONED RAILROAD EQUIPMENT.

Paint recovery and disposal shall be paid for under the item DISPOSAL OF LEAD DEBRIS.

There shall be no separate payment for lead paint removal, but the cost thereof shall be included in the items in this section.

The installation of new permanent pull-off wires and temporary pull-off supports shall be covered under the item AUTO-TENSIONED CATENARY.

The temporary removal and restoration, if any, of a member of the structure or of signal cables, signal cases, ladders, platforms or other impediment attached to the structure, in order to facilitate the removal of the catenary system, signal and communications cables, signal heads, catenary portal structures and feeder or aerial ground wire, will not be paid for separately, but the cost thereof shall be included in the pay item(s) included in this section.

Basis of Payment: This work will be paid for at the contract unit prices for the following unit prices, which shall include all transportation, materials, equipment, tools and labor incidental thereto:

Pay Item	**Pay Unit**
REMOVAL OF CATENARY	LF
REMOVAL OF SIGNAL AND COMMUNICATION CABLES	LF
REMOVAL OF SIGNAL HEAD INCLUDING DROP TUBES	EA
REMOVAL OF ABANDONED RAILROAD EQUIPMENT	EA
REMOVAL OF FEEDER AND AERIAL GROUND WIRE	LF

ITEM # 0096084A - MOTOR OPERATED DISCONNECT SWITCH

ITEM # 0096085A - DISCONNECT SWITCH

Description: Work under this Section consists of furnishing and installing new motor operated disconnect (MOD) switches complete with all attachment hardware, operating tubes, guides, structure mounted motor operator mechanism, new feeder jumpers, cabling, clamps, supports, personal ground mats and all else necessary for complete installation and operation of the switch.

Work also includes furnishing and installing new motor operated vertical break heavy duty 1200 Amp full load vacuum interrupter disconnect (MOD) switches complete with all attachment hardware, operating tubes, guides, structure mounted motor operator mechanism, new feeder jumpers, cabling, clamps, supports, personal ground mats and all else necessary for complete installation and operation of the switch.

Work also includes furnishing and installing new manually operated disconnect switches complete with all attachment hardware, hooksticks, new feeder jumpers, cabling, clamps, supports, operating linkage, personnel ground mats and all else necessary for complete installation and operation of the switch.

The grounding and bonding systems shall meet the requirements of National Electrical Code and the technical and safety recommendations of ANSI and IEEE. Grounding and bonding of personnel ground mats, disconnect switch operating shaft, control box and the disconnect switch shall be provided at disconnect switch locations.

Applicable Standards: Pertinent provisions of the following listed standards shall apply to the work of this Section, except as they may be modified herein, and are hereby made a part of this Specification to the extent required:

Organi-zation	Number	Title
ANSI	C37.30	Standard Definitions and Requirements for High-Voltage Air Switches, Insulators and Bus Supports
ANSI	C37.32	Standard Schedules of Preferred Ratings, Manufacturing Specifications, and Application Guide for High-Voltage Air Switches, Bus Supports and Switch Accessories
ANSI	C37.34	Test Code for High-Voltage Air Switches (and supplements)

ANSI	C37.35	Guide for Application, Installation, Operation and Maintenance of High-Voltage Air Disconnecting and Load Interrupter Switches
ANSI	Z55.1	Gray Finishes for Industrial Apparatus and Equipment
ASTM	B187	Copper Bus Bar, Rod and Shapes
NFPA	70	National Electrical Code (NEC)
NFPA	78	Lightning Protection Code
IEEE	81	Recommended Guide for Measuring Ground Resistance and Potential Gradients in the Earth
IEEE	142	Recommended Practice for Grounding of Industrial and Commercial Power Systems
UL	467	Grounding and Equipment
ASTM	B8	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

Submittals: The Contractor shall submit shop/working drawings, design test reports, technical data, schematics, catalog cuts, material/procurement specifications of component parts and all relevant information for the installation, operation and maintenance of related disconnect switches. Component, small part steel or assembly drawings shall be prepared using AutoCAD 2007 or later.

Spare parts list, and technical manuals.

Complete technical details and ratings of each part of operating mechanism of MOD.

Design and production test plan, test procedures and certified test reports.

Materials: The disconnect switches shall be for outdoor service and of single pole single throw design. They shall be mounted as per the plans. Manual disconnect switches shall be operated by a hookstick or operating linkage from the ground level. MODs shall be operated by DC power through control mechanisms. They shall also be capable of being manually operated through the control linkage, in the event of motor operator malfunction. The manual handle operator shall be pad lockable. The design of the hand operation feature and its interlocking with the motorized mechanism shall be subject to the approval of the Engineer.

The switches shall be assembled on galvanized steel channel base with standard NEMA mounting holes and arranged in coordination with the supporting members as shown on the plans.

Current carrying parts shall be of hard-drawn copper. Contacts shall be high pressure, silver-to-silver, self cleaning by wiping action, self aligning, and shall be capable of breaking system charging currents.

High strength, high conductivity metals shall be used for all live parts. These metals shall not be subject to cracking due to weather conditions and shall be non-ferrous.

Solder-less, NEMA terminal pads of a compatible design shall be provided.

Springs, pivots, bearing and ferrous material shall not be part of a current carrying circuit.

The disconnect switches shall be furnished with mounting bolts, nuts, washers, lock washers, grounding stud and all other parts and materials necessary for complete mounting of the switch and its attachment to the supporting members. All switch bases and associated stationary parts shall be rigidly bolted in place.

2 piece, 14’insulated hookstick with fiberglass head and weatherproof case, or approved substitute, shall be provided with each manual disconnect switch. The hookstick shall provide full safety to the operating personnel.

The bases of all disconnect switches shall be grounded. Operating rods, shafts, and control mechanism enclosures shall also be suitably grounded. All grounding components shall conform to or be interchangeable with the Railroad’s standard components.

Conductors for grounding and bonding shall be ASTM B8, Class B stranded annealed copper, and sized as indicated on the plans.

Connectors and Clamps: Bolts, washers and stop nuts shall be a high copper alloy, such as Everdur, Durium, Duronze or silicone bronze. Ferrous hardware will not be acceptable. Buried ground connections shall be exothermic welded.

Ground rods shall be copper, or copper-clad steel, not less than 3/4 inch in diameter, and in ten-foot lengths, threaded at one or both ends as required for extension.

Ground wire imbedded in foundations and aerial ground wire shall be 4/0 AWG HD stranded copper conductor.

Personnel ground mats shall be fabricated with minimum #6 AWG bare copper wire on 6" X 6" spacing. Overall mat size shall be 4' X 6'.

The switches shall be designed and constructed to assure satisfactory operation under all weather conditions, including snow, sleet and ice, independent of lubrication. Cotter pins shall not be used to transmit stresses. All current carrying parts of the switch as well as contacts shall be designed to operate without lubrication and maintain electrical clearance to all non-live parts.

The MOD control box and the operating mechanism shall be of proven design for outdoor applications and cater to the electrical schematic requirements for remote/local operation and its interface with SCADA RTU as per the plans. Suitable control and interposing relays shall be provided in the motorized operating unit for local/remote control and operation from RTU controlled from the supervisory control system. Safeguards against the initiation of both clockwise and counter-clockwise movement at the same time will be incorporated in the supervisory control. All steel parts shall be hot-dip galvanized. Provision shall be made for 30 percent spare auxiliary contacts in the control box for additional electrical interlocking requirements. The design of the motor operated mechanism shall have a torque at its output shaft under minimum operating voltage adequate to operate the switch under 3/4" ice. Operating time and torque values required shall be in accordance with the switch manufacturer's recommendations and subject to the approval of the Engineer.

Motor operators shall be capable of providing field adjustable speed and torque output, torsion or reciprocal operating movements as required. Motor operator enclosure shall be gray NEMA 4 equivalent for outdoor duties with high resistance to corrosion and weather-proof construction with side panels and front cover removable for complete accessibility to all internal parts. The outer construction shall be suitable for protection against vandalism. The door latch shall be operated with a single handle with provision for padlocking the housing. The equipment shall be suitable for installation on railroad catenary structures as per the plans and withstand satisfactorily the vibrations transmitted from the running trains without affecting its operation and long-term reliability. Suitable mounting brackets and necessary hardware to suit individual structure needs shall be provided.

The motor of the MOD shall be designed for the intended duty and frequent operations without any restrictions. The motor shall have bearings sealed against moisture, dust and fumes and require no lubrication. The motor circuit shall be suitably protected against blocked armature current flow more than the intended duty. Dynamic braking shall be used for motor braking. The opening and closing circuits shall be mechanically and electrically interlocked. In the event of failure of control power supply after disconnect switch movement has been initiated, the movement of the switchblade shall be completed or it shall not start. The design shall be suitable to prevent damage to the operating mechanism in case of attempted operation of the disconnect switch to a position already occupied or from a firmly iced-up position.
The MOD shall not have a local\remote selector switch inside the motor enclosure.

The switches shall be rated as follows:

Rated voltage	13.8kV (to ground)
Poles	1
Minimum Voltage class	25kV

Rated current, continuous	1,200 A
Rated current, momentary	61,000 A
Rated frequency	60 Hz
BIL	150kV
Control Voltage	125V DC
Range of Control Voltage	90V - 140V DC
Auxiliary Contact Rating	3 A at 125V DC

The insulators shall be station post type NEMA TR-208 or approved equal.

The design shall provide for effects of any short circuits up to the maximum value of 20kA. Due to the exposed nature of catenary system, short circuits may be frequent and have varying duration and severity.

Switch identification number shall be made of standard manufactured reflective tape for exterior use, “Scotchlite” or equal.

Construction Methods: The disconnect switch assemblies and the operating mechanisms shall be installed in accordance with recommendations of the manufacturer, the plans and to the satisfaction of the Engineer. Switch shall be examined for broken insulators. All insulators shall be wiped clean after the installation is complete.

Personnel ground mats shall be installed at every MOD or manual operator location on the side where operating handle is located and they will be bonded to the structure

Ground rods shall be driven vertically to the depth of ten feet. Rod points shall be provided with a steel alloy cone and the driven end provided with removable driving stud. Ground rods shall be separated from adjacent buried metallic structure or pipe by a minimum of two feet.

The work shall be arranged in such a manner that each part of the grounding system which is laid below finished grade shall be completed and inspected before backfilling is done. All precautions shall be taken to assure that no damage is done to the grounding and bonding conductors or connections during backfilling, compacting and concreting operations. Testing for ground resistance shall be performed in accordance with the requirements of this Specification before any finish surfacing is laid above the grounding and bonding conductors

Ground tap connections from the equipment to the grounded structural members shall be provided, as required. All paint, scale, rust, oxidation, or other foreign material shall be thoroughly removed from the points of contact on all metal surfaces before any ground connections are made

Any shortfall in the existing ground conductors, when connected to the new structures, shall be dealt with by splicing additional ground wire.

Bond all non-energized connections to structures so that there are no neutral or floating components (i.e., strap across any pin or clevis connection).

Field-testing shall be thorough, continuing throughout the installation, and fully documented, with the following as a minimum and as applicable:

Electrical resistance tests shall be made during installation to verify continuity of the grounding system.

Measure, record, and report the ground resistance at each location, while disconnected from the MNR ground grid, where grounding system is installed. The required ground resistance is five ohms or less. Corrective measures shall be taken by the Contractor to achieve the specified ground resistance.

Resistance-to-earth tests shall be witnessed by the Engineer and written results of these tests shall be submitted to the Engineer for evaluation.

Factory Testing

Factory tests shall include design and production tests, especially those required by ANSI, NEMA, and all alternative standards to which the equipment may be designed. New design tests may not be required where tests equal to, or more stringent than, those specified here have been performed and documented by the Contractor on essentially identical equipment manufactured at the same facility to that being used on this project. The Contractor may provide to the Engineer for review certified documentation of previous tests, and where the specified design test requirements are met, the Engineer at his option may waive certain design tests. The Engineer may inspect the manufacturing and quality assurance procedures during the factory tests on equipment. The factory tests shall be conducted on the various equipment including but not limited to the following items.

Motor Operated Disconnect Switches and Manually Operated Disconnect Switches

Design Tests: All the design tests, described in ANSI C37.34 and supplements, shall be, or shall have been, performed on one manual disconnect switch and one motor operated disconnect switch.

Production Tests: All the production tests, described in ANSI C37.34 and supplements, shall be performed on all manually operated disconnect switches/motor operated disconnect switches.

Method of Measurement: The pay item MOTOR OPERATED DISCONNECT SWITCH refers to both non-load break and load-break types of motor operated disconnect switches.

This work will be measured for payment based on the number of new motor operated or manually operated disconnect switches installed. The pay item DISCONNECT SWITCH refers to manually operated disconnect switches.

No direct payment will be made for personnel ground mats and associated grounding and bonding work and dismantling of the existing manual disconnect switches, if any, but the cost thereof shall be included in the unit prices for the pay item DISCONNECT SWITCH or MOTOR OPERATED DISCONNECT SWITCH.

No separate payment will be made for hooksticks, feeder jumpers, connections, operating linkage, cables and/or buss bar, but the cost thereof shall be included in the unit prices for the pay items covered under this section.

Payment for buss bar supports shall be made under the item STEEL (MISCELLANEOUS).

Basis for Payment: The work will be paid for at the contract unit prices for the following pay items including all transportation, materials, equipment, tools and labor incidental thereto:

Pay Item	**Pay Unit**
MOTOR OPERATED DISCONNECT SWITCH	EA
DISCONNECT SWITCH	EA

ITEM #0100101A - FEEDER WIRE ATTACHMENT

Description: Work under this item includes the attachment of existing railroad feeder, signal and ground wires to new catenary support structures.

The Contractor shall be responsible for coordinating the any installations, relocations and survey work with the requirements set forth in the Special Provisions, obtaining necessary Railroad power and track outages, as well as utility company transmission line outages for conducting work, and turning the work over to the Railroad for its use as specified.

Applicable Standards: Pertinent provisions of the following listed standards shall apply to the work of this Section, except as they may be modified herein, and are hereby made a part of this Specification to the extent required:

Organi-zation	Number	Title
ASTM	A48	Specifications for Gray Iron Castings
ASTM	A153	Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM	A167	Specification for Stainless and Heat Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM	A386	Specification for Zinc Coating (Hot-Dip) on Assembled Steel Products
ASTM	A569	Specification for Steel, Carbon (0.15 Maximum, Percent) Hot-Rolled Sheet and Strip, Commercial Quality
ASTM	A575	Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM	A576	Specification for Steel Bars, Carbon, Hot Wrought, Special Quality
ASTM	B3	Soft or Annealed Copper Wire
ASTM	B8	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

Organi-zation	Number	Title
NFPA	70	National Electrical Code (NEC)
ASTM	B187	Copper Bus Bar, Rod and Shapes
ASTM	B633	Specification for Electro-Deposited Coatings of Zinc on Iron or Steel
ASTM	D149	Tests for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies
UL	467	Grounding and Bonding Equipment

Submittals: Submit the following:

Manufacturer's description, shop/working drawings, material/procurement specifications, installation instructions, technical data and certificates for all materials and items supplied under this Section. List of special tools and associated catalog cuts.

Component, small part steel or assembly drawings shall be prepared using AutoCAD 14.

Design and production test plan, test procedures and certified test reports.

Materials: Wire, insulators, hardware, and steel shall be as called for on the plans and other pertinent Sections of these Specifications.

Submittals: Contractors proposed procedures.

Construction Methods: Existing feeder wires shall be attached by insulators to new structures at the time they are erected.

The wires shall, where required, be tensioned or re-tensioned and, shortened or lengthened by splicing.

When a new span is longer than an existing span, the feeder, signal and control wires shall be spliced or, if instructed by the Engineer, replaced.

The work included in this item will occur in the vicinity of electrical energized facilities. De-energizing of the Railroad's and the utility company's electric lines will be required to perform the work. The Contractor shall perform the work in accordance with the following:

1. All equipment and persons will at all times, remain at least 20 feet clear of the utility's existing 115 kV overhead transmission lines, installed on catenary or pole structures along the

railroad's mainline right-of-way. When approach closer than the specified distance is required, the Contractor will request in writing, with six months advance notice, the de-energizing of the utility lines or equipment. De-energizing of the utility power line is contingent on power demand and economic dispatch and shall be coordinated with the utility. The Contractor will assume any risk involved in the reasonable denial of a request to de-energize the utility's transmission line and the last minute cancellation of an approved request to de-energize the transmission lines. If so ordered by the Engineer, the Contractor will immediately cease all activity in the areas where the utility's transmission lines are to be re-energized.

2. The Contractor and the utility must cooperate fully in order to avoid damage to the conductors, and to insure that no delays will occur in the progress of the work. Therefore, the Contractor shall furnish the utility company with a schedule for this work, which is to include starting and completion dates and, shall notify the utility company six months in advance of the commencement of construction work.

When any loads are temporarily added to structures, such as dead-ending of feeders, signals, along track jumper wire, etc., adequate back guys are to be installed in order to prevent overloading or excessive deflection of the structure. Back guys are to be terminated to adequately sized, suitable anchors. The Contractor shall calculate all temporary loads to be so terminated and submit for approval, the loads, methods and procedures to be used, materials and anchor locations.

Method of Measurement: Feeder and Wire Attachment to new structures and transfer from existing to new structure will be paid for on lump sum basis. There will be no separate payment for insulators or attachment assemblies but the cost thereof shall be included in the lump sum price.

No separate payment will be made for installation of splices, tensioning or re-tensioning of wire, as required, but the cost thereof shall be included in the item.

No separate payment shall be made for the installation of temporary back guys, but the cost thereof shall be included in the item FEEDER WIRE ATTACHMENT.

Replacement of 2/0 or 4/0 wires, if instructed by the Engineer, or additional lengths of 2/0 or 4/0 wire, shall be paid at the unit price for AERIAL GROUND WIRE SYSTEMS.

Basis for Payment: This work will be at the contract lump sum price for the following pay item, which shall include all transportation, materials, equipment, tools and labor incidental thereto:

Pay Item	**Pay Unit**
FEEDER WIRE ATTACHMENT	LS

ITEM #0100244A - SIGNS

Description: Work under this item consists of the fabrication and installation of signs designated Type D signs on all new railroad structures, including catenary structure posts and pull-off poles as shown on the plans or as directed by the Engineer. Work also includes the fabrication and installation of signs, where missing or to be replaced on existing portal columns, pull-off poles and TP towers.

Materials: Signs shall be made of 1/8 inch aluminum plate as specified in Form 816, Section M.18.13, cut to the size indicated on the plans and with rounded corners and smooth edges free from nicks and burrs. Signs shall be furnished with mounting holes. Type D signs shall be baked-on enamel and embossed.

Type D sign structure designation letters and numerals shall be of "Scotchlite" or equal standard manufactured reflective tape for exterior use.

The Contractor shall submit shop drawings and samples of the signs prior to fabrication.

Construction Methods: Signs shall be permanently secured on both sides of catenary structure columns, pull-off poles, cantilever poles, and dead-end poles using fasteners suitable for the installation of aluminum plate including Ramset fasteners subject to the Engineers approval. Signs shall bear the number of the structure as shown on the plans.

Method of Measurement: Type D and Phase Break Signs will be measured for payment based on the number of signs installed and accepted.

Basis for Payment: The Type D signs will be paid for at the contract unit price EACH complete in place, installed and accepted which price shall include all transportation, material, equipment, tools and labor incidental thereto.

Pay Item	**Pay Unit**
SIGNS	EA

ITEM #0100600A - CONSTRUCTION ACCESS

Description: This item consists of all work shown on the plans or as directed by the Engineer to provide the Contractor with access to the railroad tracks at the existing and new locations shown on the access pad location plans.

This work includes, but is not limited to the following:

Furnish and install chain link fence and access gates (6' high or as directed by the Engineer). Access gates shall be 6' high – 12' wide, or as indicated on the plan sheets. Locks to be furnished by MNR and installed by the Contractor, as directed by the Engineer.

Construct temporary access drives, ramps up to on-track access pads and anti-tracking pads at points of vehicular ingress and egress, as shown on the plans or as directed by the Engineer. Includes the removal of topsoil and unsuitable materials from under the areas that access roads are installed.

Remove trees, stumps, brush, dirt and debris, rails, ties, asphalt road curbing and excavated top soil required for the installation of access roads, ramps, fencing and gates, as required and shown on the plans..

Furnish and install construction signs to delineate the area used for access and to notify the public and city or town officials of parking restrictions, as directed by the Engineer.

Restore the access areas to their pre-construction condition.

All work incidental to providing the Contractor access at these locations, maintaining these locations during construction and restoring these areas to their pre-construction condition.

Includes the installation of temporary safety walkways, guardrails, temporary fencing as shown on the plans.

Includes providing ballast or crushed stone between right-of-way and access pads, as well as between access pads on adjacent tracks.

The rubber access pads for the railroad tracks on concrete or wood ties shall be furnished by the Contractor and installed by the Railroad. Access pads for concrete or wood ties are paid separately under the item "RUBBER GRADE CROSSING"

Materials: Materials shall conform with Form 816, as follows:

- 6’ Chain Link Fence shall conform to Section 9.13
- Anti-Tracking Pad Stone shall conform to Article M.01, Size No. 3
- Geotextile shall conform to Article M.08.01-26.
- Clearing and Grubbing shall conform to Section 2.01
- Haybales and Temporary Seeding of Disturbed Slopes shall conform to Section 2.10
- Construction Signs shall conform to section 12.20
- Rolled Granular Base – Section 3.02

Construction Methods: The Contractor shall not disturb the normal flow of traffic at the Stamford Station when he is constructing or using access points. The Contractor shall not use the access point at the stations during the peak commuter hours, if in the opinion of the Engineer, a delay will result to commuters due to the Contractor’s operations.

The access points are for the Contractor’s use to provide the Contractor with access to the tracks with hi-rail equipment, materials or personnel. The access points shall not be used to store equipment or materials, except as approved by the Engineer. The Contractor will not be permitted to remove any parking spaces, except at entrance gates, or as otherwise noted on the construction access plans.

Construction methods shall conform to the appropriate Form 816 items as listed above, under Materials, and also with Section 1.05.06 – Coordination with Utilities (including Railroads) contained elsewhere in these specifications.

Construction methods for anti-tracking pads shall conform to the following and the details contained herein:

1. 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.
A 6-inch thick pad of stone shall be placed on the geotextile. The pad shall have a minimum width of 15 feet and a length as directed by the Engineer.

2. 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.

3. 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.

The Contractor shall not damage existing parking lots. The Contractor, at no expense to the State, shall immediately repair any damage, which results to the parking lot or public streets as a result of the Contractor’s operations to the State.

Access roads shall be constructed of processed stone, and rolled. All top soil and unsuitable materials shall be removed from under the areas that access roads are installed.

The contractor shall confirm which tracks have wood or concrete ties. Contractor shall provide access pads for four tracks at each location, unless otherwise noted below. Locations and work required at each of the access pads in addition to crossing pads, as shown on the plans:

1. Between Stamford Station and Atlantic Street –
2. West of Atlantic St -

Method of Measurement: All work for the construction of the access points described herein, shall be included in the lump sum cost of this item.

Procurement of access pads for use on concrete or wood ties shall be paid for separately under the item RUBBER GRADE CROSSING.

There shall be no separate payment for materials, labor, and equipment required for the maintenance, re-grading and repair of access roads, access ramps, metal beam guardrail, chain link fencing, and gates, but the cost thereof shall be included in the lump sum price of CONSTRUCTION ACCESS.

There shall be no separate payment for materials, labor, and equipment required for removal or disposal of debris, vegetation, tree trimmings, rails, ties, curbing, and excavated top soil, but the cost thereof shall be included in the lump sum price of CONSTRUCTION ACCESS.

There shall be no separate payment for materials, labor and equipment required for the anchoring of chain link fence and metal beam guardrail into the existing stone retaining walls, but the cost thereof shall be included in the lump sum price of CONSTRUCTION ACCESS.

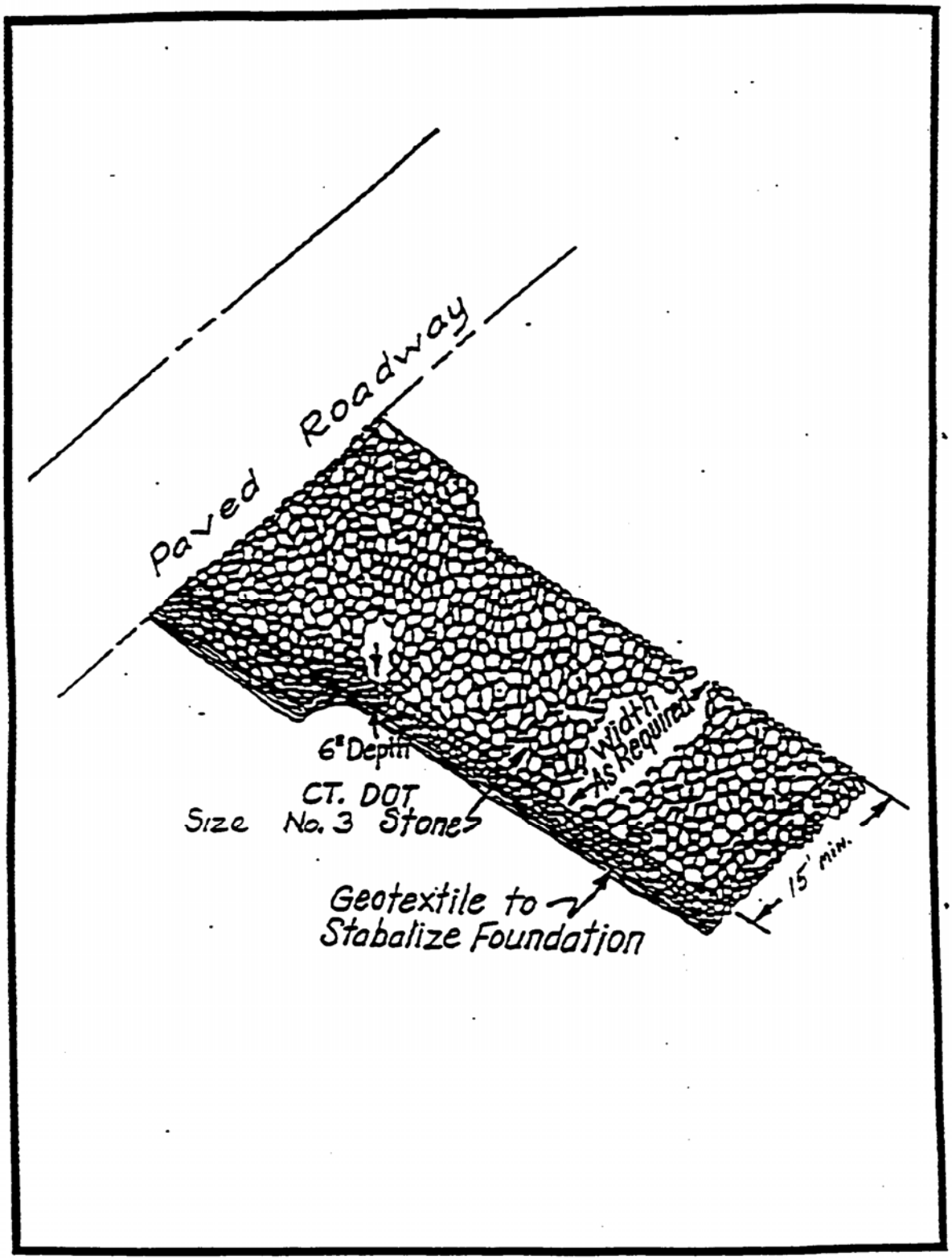
Any areas in addition to those shown on the plans that the Contractor chooses to obtain for his convenience or access points which the contractor chooses to install for his convenience, other than those shown on the plans, shall be temporary easements, and/or leases from the property owners whose property it is intended to traverse, or occupy, if any. The Contractor shall restore, at his own expense, any landscaping or adjacent property damaged, or other damage caused by his operations, to the satisfaction of the Engineer and the property owner. There will be no separate payment for these additional areas or access points but the cost thereof shall be included in the lump sum for Construction Access.

Basis of Payment: This work will be paid for on a lump sum basis for CONSTRUCTION ACCESS, which shall include all work shown on the plans and/or or as described herein.

Pay Item **Pay Unit**

CONSTRUCTION ACCESS	LS

ANTI - TRACKING PAD



ITEM NO. 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 AOEC(s). 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(s), 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 AOEC 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 AOEC(s) 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(s) 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 #0101109A - HAZARDOUS MATERIALS EXCAVATION

Description:

Work under this Item is intended to provide specific procedural requirements to be followed during the excavation of hazardous materials from within the Hazardous AOEC(s) as shown on the Plans. This supplements the Specifications for Section 2.02 – Roadway Excavation, 2.03 - Structure Excavation, 2.05 - Trench Excavation, and 2.06 – Ditch Excavation wherever hazardous 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. Note: For this Project, all materials excavated from within the limits of Hazardous Areas of Environmental Concern, including but not limited to railroad ties, ballast, soils, and concrete are considered to be hazardous materials. All hazardous materials shall be stockpiled separately from any Controlled Materials in the WSA.

Hazardous concentrations of regulated substances have been documented to exist within the Project. These substances include either TSCA-regulated substances, as defined in 40 CFR Parts 700-702, or RCRA-regulated substances, as defined in 40 CFR Parts 261-265 or in CGS Section 22a-449. Specific information concerning the detected substances and their concentrations is documented in the reports listed in the "Notice to Contractor – Environmental Investigations".

Materials:

Materials shall be as shown on the Project Plans.

Plastic Sheet: Polyethylene plastic sheeting for underlayment shall be at least 30 mil thick. Polyethylene plastic sheeting covering excavated material shall be at least 10 mil thick. Both types of sheeting shall have a minimum width of ten feet.

Sand Bags: Sandbags used to secure the polyethylene cover shall be at least 30 pounds.

Sorbent Boom: Shall be eight inch in diameter and ten 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

The Contractor must notify the Engineer of its selected transporter and disposal facility a minimum of 48 hours in advance of beginning excavation in any Hazardous AOEC. The Engineer will then obtain an EPA ID number for this work.

When hazardous 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 the implementation of engineering controls, air and personal monitoring, use of chemical protective clothing (CPC), personal protective equipment (PPE), decontamination procedures and providing a Health and Safety Officer (HSO) on site during construction activities in the Hazardous AOEC(s).

Unless otherwise directed by the Engineer, hazardous materials removed from various excavations within Hazardous AOEC(s) shall be transported directly from their point of origin on the Project to the WSA. Hazardous materials shall be segregated from other excavated materials within the WSA. Stockpiles of different types of hazardous materials (i.e. railroad ties, concrete, earth, etc.), as well as materials generated from different hazardous AOEC's, shall not be commingled inside the WSA. The Bins shall be lined with 30 mil polyethylene sheeting prior to placement of materials. The excavated material shall be placed on a secondary sheeting of 10 mil polyethylene, and covered with 10 mil polyethylene sheeting within the bins as shown on the Project Plans. The Contractor shall plan excavation activities within Hazardous AOEC(s) in consideration of the capacity of WSA, and the material testing and disposal requirements of the applicable Contract item. **No claims for delay will be considered based on the Contractor's failure to coordinate excavation activities as specified herein.**

The Engineer will sample the stockpiled controlled materials 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 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.**

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 hazardous materials:

- Transported hazardous 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 shall have secure, watertight containers free of defects for material transport;
- All vehicles departing the excavation site are properly logged to show the vehicle identification, driver's name, time of departure, destination, and approximate volume and content of materials carried;

- No material shall leave the excavation area until there is adequate lay down area prepared in the WSA;

- Transport vehicles shall not leave the excavation site for the WSA until gross contamination is removed; 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 Hazardous Materials. Plastic polyethylene sheeting shall underlay all excavated hazardous materials to ensure that seepage of material or water from the WSA is prevented. 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 materials, equipment, tools and labor necessary to perform its 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 the WSA, replacement of damaged components (i.e. sand bags, polyethylene sheeting, etc.), and waste inventory record management. The Contractor shall manage all materials handled in the WSA in such a way as to minimize tracking of potential hazardous materials across the site and off-site, and minimize dust generation.

Each stockpile shall be securely covered when not in active use with polyethylene sheeting of sufficient size to prevent the generation of dust and infiltration of precipitation. Such sheeting shall be secured with sandbags to prevent wind erosion.

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 plastic cover has been damaged, or there is evidence of leakage, 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 hazardous material, any residue shall be removed from all 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. Residue shall be disposed of as Hazardous 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 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 site 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 Hazardous 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, or between work in different Hazardous (and non-hazardous) AOEC's.

The Contractor shall use dry decontamination procedures. Residuals from dry decontamination activities shall be collected and managed as Hazardous 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 Specifications to prevent the off-site migration of particulate matter and/or dust resulting from excavation, loading and operations associated with Hazardous Materials. It shall be the Contractor's responsibility to supervise fugitive dust control measures and to monitor airborne particulate matter. The Contractor shall:

Employ reasonable fugitive dust suppression techniques.

Visually observe the amounts of particulate and/or fugitive dust generated during the handling of 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.

Method of Measurement:

The work of Hazardous Material Excavation will be measured for payment by the number of cubic yards of material excavated within the Hazardous AOEC(s) and taken to the WSA. This measurement will 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 and the Contract Special Provisions. Excess excavations made by the Contractor beyond the payment limits specified in the Contract are not permitted. Such excess material will not be measured for payment, and the Contractor assumes all responsibility for 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 will be paid for at the Contract unit price, which will be in addition to the Contract unit price for the applicable excavation item in Specification Sections 2.02, 2.03, 2.05, and 2.06. The unit price shall include: transportation to and stockpiling hazardous materials at the WSA; covering and maintaining the 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.

Securing, construction and dismantling of the WSA will be paid for under Item 101128A. Handling and disposal of contaminated groundwater will be paid for under the appropriate Contract items. Payment for dust control activities will be made under the appropriate Contract items.

Pay Item	Pay Unit
Hazardous Materials Excavation	C.Y.

ITEM NO. 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 AOEC(s) are to be considered controlled materials.

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 not be reusable as backfill, unless authorized by the Engineer in writing, and 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.

Covers for roll-off/storage containers shall be made of polyethylene plastic, or similar water-tight material, that is of sufficient size to completely cover top opening and can be securely fastened to the container.

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.

Unless otherwise directed by the Engineer, materials removed from any excavation within an 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 AOEC(s) 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 shall underlay all excavated controlled materials. Measures shall be implemented to divert rainfall away from the WSA.

No controlled materials shall be excavated or transported to the WSA until registration under the General Permit for Contaminated Soil and/or Sediment Management (Staging and Transfer) has been obtained by ConnDOT.

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 cover shall be to prevent wind erosion.

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:

Employ reasonable fugitive dust suppression techniques.

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 DEP "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 AOEC(s) and taken to the WSA. 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 101128A. Handling and disposal of contaminated groundwater will be paid for under Item 0204210A. Payment for dust control activities shall be made under the appropriate Contract items.

Pay Item	Pay Unit
Controlled Materials Handling	C.Y.

ITEM #0101126A - DISPOSAL OF HAZARDOUS WASTE

Description:

Work under this item shall consist of the loading, transportation and final off-site disposal of hazardous materials (excluding dewatering fluids), which have been generated from various excavations within the Hazardous AOEC(s), brought to the WSA, and determined to be contaminated with regulated substances at hazardous concentrations. These materials contain hazardous concentrations of TSCA-regulated substances, as defined in 40 CFR Parts 700-702, or RCRA-regulated substances, as defined in 40 CFR Parts 261-265 or in CGS Section 22a-449. Specific information concerning the detected substances and their concentrations is documented in the reports listed in the "Notice to Contractor – Environmental Investigations". These materials, after proper characterization by the Engineer, shall be transported from the WSA by a licensed hazardous waste transporter approved by the Department and disposed of at an EPA-permitted and Department-approved hazardous waste landfill within 90 days from the date of its generation. These materials may require special handling within the WSA in order to isolate them from controlled materials being stored therein.

The Contractor must use one or more of the following Department-approved disposal facilities for the disposal of hazardous waste:

Chemical Waste Management of New York 1550 Balmer Rd. Model City, NY 14107 (716)754-8231; Mike Cuddahee	Jones Environmental Services (Northeast) 263 Howard St. Lowell, MA 01852 (860)585-7916
General Chemical Corp. 133-128 Leland St. Framingham, MA 01701 (508)872-5000; Jim Collins	Northland Environmental, Inc. 275 Allens Ave. Providence, RI 02905 (401)781-6340

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 hazardous waste disposal facilities (from the above list) that the bidder, if it is awarded the Contract, will use to receive hazardous 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 disposal facility, (3) a copy of each facility's acceptance criteria and sampling frequency requirements, and (4) a letter listing the names of the hazardous waste transporters (from the list below) that the bidder, if it is awarded the Contract, will use to transport hazardous material from this Project.

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.

The Contractor shall use one or more of the following Department-approved hazardous waste transporters:

American Environmental Technologies	3 Trowbridge Dr., Bethel, CT 06801	(203)744-3477
Auchter Industrial Vac Service	4801 South Wood Ave., Linden, NJ 07036	(908)862-2277
Bechem Transport, Inc.	46 River St., New Haven, CT 06513	(203)562-1280
Buffalo Fuels	2470 Allen Ave., Niagara Falls, NY 14303	(716)285-9101
Clean Harbors Environmental Services	1501 Washington St., Braintree, MA 02184	(617)849-1800
D-Tox Environmental Contractors	14 Tobey Rd., Bloomfield, CT 06002	(860)242-9953
DW Transport	33 Pequot Rd., Uncasville, CT 06382	(860)848-1692
Earth Technology, Inc.	86 Leonardo Dr., North Haven, CT 06473	(203)230-2040
Envirite of Pennsylvania, Inc.	1600 Pennsylvania Ave., York, PA 17404-1725	(717)846-1900
Franklin Environmental Services	PO Box 617, Wrentham, MA, 02093	(508)384-6151
Freehold Cartage, Inc.	PO Box 5010, Freehold, NJ, 07728-5010	(908)462-1001
General Chemical Corp.	PO Box 608, Framingham, MA 01702	(508)872-5000
Jack Gray Transport, Inc.	4600 East 15th Ave., Gary, IN 46403	(219)938-7020
John Pfrommer, Inc.	1320 Ben Franklin Hwy East, Douglassville, PA 19518	(610)385-3051
Laidlaw Environmental Services	PO Box 11393, Columbia, SC 29211	(803)933-4200
New England Disposal Technologies	293 R Hartford Tpke., Shrewsbury, MA 01545	(508)756-1339
Page ETC Inc.	PO Box 1290, Weedsport, NY 13166	(315)834-6681
Price Trucking Corp.	PO Box 70, Buffalo, NY 14220	(716)822-1414
S & J Transportation Co.	PO Box 169, Woodstown, NJ 08098	(609)769-2741

Sealand Environmental Service	PO Box 249, Derby, CT 06418	(203)753-1817
Specialty Transportation Serv., Inc.	5979 McCasland Ave., Portage, IN 46368	(219)764-3636
Tonawanda Tank Transport Service	PO Box H, 1140 Military Rd., Buffalo, NY 14217	(716)873-9703
Tri-S, Inc.	25 Pinney St., Ellington, CT 06029-3812	(860)875-2110
United Industrial	136 Gracey Ave., Meriden, CT 06451-2270	(203)238-6745
US Bulk Transport	6286 Sterrettania Rd., Fairview, PA 16415	(814)838-2558
Waste Management	PO Box 144, Portland, CT 06480	(860)342-0667
West Central Environmental Corp.	250 Watervliet Shaker Rd., Watervliet, NY 12189	(518)272-6891

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 Department. I have personally reviewed this data and intend to accept the following:

Hazardous materials as described in Item # 0101126A Disposal of Hazardous Waste for the subject Project at a cost of $ _____per ton for 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 the waste characterization 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 for final waste characterization at a frequency established by the selected 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 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, including 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 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 hazardous waste manifests utilized to accompany the transportation of the waste 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 to the Engineer the same day the material leaves the Project site.

A load-specific certificate of disposal, signed by the authorized agent representing the waste disposal facility, shall be obtained by the Contractor and promptly delivered to the Engineer for each load.

C. Material Transportation

Excavated materials determined to be hazardous shall be transported in compliance with the applicable federal regulations. Transport vehicles shall not have any indentations or damage and must be free from leaks, and discharge openings must be securely closed during 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 hazardous materials off-site:

- 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 disposal facility willing to accept all of the material being transported has agreed to accept the type and quantity of waste;

- Documentation must be maintained indicating that all applicable laws have been satisfied and that the materials have been successfully transported and received at the disposal facility; and,

- The Contractor shall segregate the waste streams (i.e. soils, railroad ties, etc.) as directed by the receiving disposal facility.

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 Hazardous 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 Hazardous 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.

E. EPA ID Number: Prior the generation any hazardous materials, the Contractor shall notify the Engineer of its selected transporter and disposal facility. The Engineer will then obtain an EPA ID number that he will forward to the Contractor. Any changes in transporter or facility shall be

immediately forwarded to the Engineer for review.

Method of Measurement:

The work of "DISPOSAL OF HAZARDOUS WASTE" will be measured for payment as the actual net weight in tons of material delivered to the disposal facility. Such determinations shall be made by measuring each hauling vehicle on the certified permanent scales at the disposal facility. Total weight will be the summation of weight bills issued by the facility specific to this Project.

The disposal of excavated materials, originally anticipated to be hazardous materials, but determined by characterization sampling not to contain hazardous concentrations of regulated chemicals (Controlled Materials) will not be measured for payment under this Item. Disposal of these materials will be handled in accordance with the provisions of Item 0202315A – Disposal of Controlled Material, Item 0020761A – Handling and Disposal of Contaminated Concrete, or Item 0101133A – Disposal of Contaminate Railroad Ties, as applicable, or in accordance with Article 1.04.05 in the item's absence. 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 all responsibility for 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 will be paid for at the Contract unit price, which shall include the loading and transportation of hazardous materials from the WSA to the disposal facility and the disposal of such materials; the preparation of manifests and fees paid; and all equipment, materials, tools, and labor incidental to loading, transporting, and disposal of materials. **This unit price will be applicable to all of the Contractor-selected disposal facilities 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.

Payment for disposal of materials found to be non-hazardous based upon characterization sampling results will not be made under this item, but under the appropriate Contract item.

Pay Item	Pay Unit
Disposal of Hazardous Waste	Ton

ITEM NO. 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 and hazardous 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 AOEC(s) and Hazardous AOEC(s) 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 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.

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 or Hazardous 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 or hazardous materials.

The Contractor shall comply with the terms and conditions of the DEP "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. Post and maintain a sign that is visible from a distance of at least 25' at the WSA identifying the name of the permittee (State of CT, Department of Transportation), the DOT field office phone number, the hours of operation for the WSA, and the phrase, "Temporary Soil Staging Area". Lettering shall be at least one inch (1") high with a minimum overall sign dimension of four (4) feet wide by two (2) feet high. Such sign is only required if the capacity of the WSA is equal to or greater than 1,000 cubic yards. If initially the WSA capacity is less than 1,000 c.y. and the WSA capacity is subsequently increased, the Contractor shall post and maintain the required sign at no additional cost to the State, prior to stockpiling the additional material.

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 or Hazardous 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 removal of all residual Controlled or Hazardous Materials, the Contractor shall dismantle the WSA and return the area to original condition. 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 101117A "Controlled Material Handling" and/or Item 101109A "Hazardous Materials Excavation".

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 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 NO. 0101133A - DISPOSAL OF CONTAMINATED RAILROAD TIES

Description:

Work under this item shall consist of the loading, transportation and final off-site disposal/ recycling/treatment of contaminated railroad ties (excluding concrete), which have been generated from various excavations within the AOEC(s) 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". Such railroad ties, 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.

The Contractor must use one or more of the following Department-approved treatment/recycle/disposal facilities for the disposal of non-hazardous contaminated railroad ties.

Aroostook & Bangor Resources, Inc. P.O. Box 229 Mattawamkeag, ME 04459 (207)736-3011; Mark	Clean Harbors of Connecticut 51 Broderick Road Bristol, CT 06010 (860)583-8917; John Mullen
KTI Bio Fuels, Inc. 38 Alfred A. Plourde Parkway Lewiston, ME 04240 (207) 783-2941	Waste Management P.O. Box 186 Portland, CT 06480 (800)272-3867; Billy
Chemical Waste Management of NY 1550 Balmer Road Model City, NY 14107 (716)754-8231; Gigi	

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 contaminated railroad ties 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:

Contaminated materials as described in Item # 0101133A Disposal of Contaminated Railroad Ties for the subject Project at a cost of $ _____per ton for disposal and an additional $_____ per ton for transportation from the Project to the disposal 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 railroad ties stored at the WSA at a frequency established by the selected treatment/recycling/disposal facility. 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 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 contaminated railroad tie disposal (such as disposal facility waste profile sheets). It is solely the Contractor's responsibility to co-ordinate the disposal of railroad ties 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 railroad ties in accordance with all Federal and State regulations. **No claim will be considered based on the failure of the Contractor's 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 contaminated railroad ties 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 contaminated railroad ties off-site:

- Transported contaminated 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 the contaminated railroad ties. 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 contaminated 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 CONTAMINATED RAILROAD TIES" 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 Special Provision (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.

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.

The disposal of railroad ties, originally anticipated to be contaminated, but determined by characterization sampling to be suitable for disposal as bulky waste, will not be measured for payment under this Item but will treated as surplus excavated material.

Basis of Payment:

This work will be paid for at the Contract unit price, which shall include the loading and transportation of contaminated railroad ties from the WSA to the treatment/recycling/disposal facility; the treatment/recycling/disposal of such materials; the preparation of manifests and fees paid; and all equipment, materials, tools, and labor incidental to this work. **This unit price will be applicable to all of the Contractor-selected disposal facilities 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.

No separate payment will be made for the disposal of railroad ties found to be suitable for disposal as a bulky waste. Such disposal will be handled in accordance with the applicable provisions of the Contract regarding disposal of surplus excavated material.

Pay Item	Pay Unit
Disposal of Contaminated Railroad Ties	Ton

ITEM #0104061A - FOUNDATION, TYPE 1

ITEM #0104062A - FOUNDATION, TYPE 2

Description: Work under these items includes furnishing all labor, material, and equipment for the excavation for, construction of, and installation of foundations for catenary support structures located on existing stone viaduct walls. Work under this section also includes the painting of exposed concrete foundations.

Work includes the cutting, removal and disposal of existing stone and/or masonry wall material, fill and debris required for construction and installation of new wall foundations. Work also includes any and all shoring and sheet piling, if required.

Materials: Form 816 Section 12.02 - Overhead Sign Support Foundation shall apply, except as noted hereafter.

Concrete shall be Form 816 class "F". Air entrainment or retarding admixture shall only be used with the approval of the Engineer.

Reinforcing steel shall be Grade 60 as specified in Form 816, Section M.06.01. The minimum cover shall be as called for in the plans. Reinforcing steel shall be epoxy coated.

Permanent sheet piling shall be as specified in Form 816, Section 7.13 and shall be adequate to withstand the earth pressure taking into consideration the surcharge from a passing train. (See construction methods for load and influence line). Temporary sheet piling shall be as specified in Form 816, Section 7.14.

Anchor bolts shall conform to ASTM A1554 Grade 105 and supplementary requirement S6, nuts shall conform to ASTM A563 unless otherwise specified on the plans. All surfaces shall be galvanized in conformance with Form 816, Section M.06.03.

Grout shall be of non-shrink type and shall be according to Form 816, Section M.03.01.12.

Ground wire shall be as specified in GROUNDING AND BONDING SYSTEMS.

Rock Anchor assemblies shall be of the hollow core prestressable type as indicated on the plans.

Polymer coating, as specified under the concrete repair items.

Submittals and Tests: Form 816, Section 6.01.03.22 (b) is amended by the requirement that the Contractor shall provide, cure and have tested concrete cylinders representing each separate batch of concrete or as frequently as determined by the Engineer. Seven and 28-day compressive test results are required. The tests shall be performed, at no cost to the State, by a testing

laboratory acceptable to the Engineer and the results shall be submitted to the Engineer within 7 days of the tests. The Contractor shall, at his own expense, remove and replace any concrete that does not meet the specified compressive strength.

Mill certificates for reinforcing steel.
Shop drawings for reinforcing steel in accordance with Form 816 Article 6.03.1.
Shop drawings for rock anchorage.
Proposed concrete mix.
Certified concrete cylinder test results.
Procedure for installing foundations, including methods of shoring.
Procedure for rock anchor installation.
Manufacturer's product description, catalog data, material specifications and detail drawings for adhesive anchor bolts.

Installation procedures for wall foundation construction, including stamped and sealed sheet piling drawings and calculations.

Construction Methods: All applicable portions of Form 816 Section 12.02.03 shall apply except as noted hereafter.

The Contractor may drop the concrete for Wall Foundations to their entire depth subject to the Engineers approval and provided that care is taken to prevent the concrete from hitting the reinforcing steel.

The Contractor shall ascertain that there are no buried cables or duct banks, water lines, sewers or other utilities prior to excavating by the use of metal detectors or by hand digging exploratory test pits 4 feet deep and the same width as the foundation or as directed by the Engineer.

The Contractor shall demolish any buried foundations that may be encountered when excavating for foundations.

Excavation for wall foundations shall be carried out so that the stability of the railroad embankment is not endangered, taking into account the effect of passing trains. The live load influence line is defined as a line originating at the bottom edge of tie and extending downward at a slope of 1 (vertical) on 2 (horizontal). Open excavations must be designed to withstand, in addition to all common loads such as soil pressure and hydrostatic pressure, a railroad live load of Cooper E-80 or other loading magnitudes as may be directed by the Engineer.

The spoil material from excavation shall be disposed of on or off-site in a manner as directed by the Engineer.

The contractor shall reroute or restore ditching at new structures where they otherwise would impede the established drainage course.

Backfill shall be placed in accordance with Form 816 Section 2.03.03.6.

The void between the top of the foundation and the underside of the base plate shall be completely filled with grout after the anchor bolt nuts have been tightened and the structure loaded. The grout shall be mixed and placed in accordance with the manufacturers recommendations.

Rock anchors shall be installed and grouted into place in accordance with the manufacturer's recommendations.

All structures shall be grounded through their foundations as shown on the plans.

Blasting will not be permitted except with the Engineers approval and the obtaining of proper state and local permits, as per Form 816 Section 1.07.08.

Open excavations shall be covered at the end of each shift.

Construction Tolerances: The along the track tolerance for placing foundations is 12".

The maximum deviation from plumb shall be not more than 1%.

The tolerances for placement of anchor bolts for single pole structures shall be:

Horizontally in the direction of the track ±6"

Horizontally perpendicular to the track -0" + 1"

Vertically ± 1/2"

The tolerances for placement of anchor bolts for a portal structure shall be:

Between north and south foundations ± 1"

Opposing portal structure anchor bolts must be within 1" of a perpendicular line across the tracks.

Horizontally in the direction of the track between multiple foundations for the same structure: 1/8"

Method of Measurement: FOUNDATION, TYPE 1 and FOUNDATION, TYPE 2 shall be measured for payment based on the number of separate foundations installed, regardless of the size of the foundation. There will be no separate payment for cutting stone, removing stone, earth excavation or its protection, disposal of excavated material, demolition of underground foundations or man-made obstructions, backfilling, ditching or grading, dewatering, form work, regular or tremmie concrete, grouting, reinforcing steel, anchor bolts, rock anchors, ground wire but the cost thereof shall be included in the unit prices for the foundations. Any excavation

beyond the dimensions shown on the plans shall be filled with concrete at the Contractor's expense.

Foundation Types W-A, as referenced on the plan sheets, shall be covered under item FOUNDATION, TYPE 1.

Foundation Type W-B, as referenced on the plan sheets shall be covered under item FOUNDATION, TYPE 2.

Disposal of excavated contaminated material off-site shall be paid for under other pay items.

There shall be no separate payment for handling, transporting and/or disposal of reusable spoils from foundation excavations, but the cost thereof shall be included in the unit prices for the foundations.

There shall be no separate payment for exploratory test pits, but the cost thereof shall be included in the unit prices for the foundations.

All survey required for construction of new foundations, including locating new foundations, top of rail and high rail references, grades and anchor bolt orientation shall be covered under CONSTRUCTION STAKING.

There shall be no separate payment for engineering, design, installation or removal of sheet piles, but the cost thereof shall be included in the unit prices for the foundation.

The temporary removal & restoration, guying or supporting of overhead obstructions, including but not limited to, railroad signal and feeder wire, track jumpers, communication cables, fiber optic cable or guy wires, shall not be paid for separately, but the cost thereof shall be included in the pay item(s).

There will be no separate payment for restoration or rerouting of existing drainage ditching disturbed due to at new structures, but the cost thereof shall be included in the pay item(s).

Basis for Payment: This work will be paid for at the contract unit or lump sum prices for the following pay items which prices shall include all transportation, materials, equipment, tools and labor incidental thereto.

Pay Item	**Pay Unit**
FOUNDATION, TYPE 1	EA
FOUNDATION, TYPE 2	EA

ITEM #0125499A - ACCEPTANCE TESTING

Description: The work under this item covers the requirements and responsibilities for acceptance testing to be performed by the Contractor on completed installations under this Contract. An Acceptance Testing Plan and Acceptance Test Procedures shall be prepared by the Contractor. The Contractor shall give 20 days advance notice when the Contractor is ready to perform acceptance testing. Actual date and time of testing will be determined by the Engineer.

The Engineer or his representative will witness all tests. Test reports shall be submitted to the Engineer for approval. The Contractor shall be responsible for retesting of any items as necessary at no additional cost.

The Contractor shall be responsible for furnishing all test personnel, test instruments, stagger gauge, inspection vehicle and other equipment/materials necessary for performing and recording field inspections and tests.

Applicable Standards: Pertinent provisions of the following latest standards shall apply to the work of this Section, except as they may be modified herein, and are hereby made a part of this Specification to the extent required.

Organi-zation	Number	Title
ANSI	C2	National Electrical Safety Code
NFPA	70	National Electrical Code

Submittals: Before any testing begins, the Contractor shall a submit their Acceptance Testing Plan and Acceptance Test Procedures, tables, and all forms to be used for recording all results of the inspections and tests, to the Engineer within 60 days of NTP.

The Contractor shall submit the details of the equipment/tools and the test personnel proposed to be used for various tests, measurements and inspections for approval of the Engineer.

Upon completion of the tests and inspections, the Contractor shall submit Inspection and Test Reports containing all data obtained.

Materials: Not used in this Section.

Construction Methods: The Acceptance Test Plan will contain the following:

A flow diagram indicating the logical sequence of inspections and tests.

A list of inspection and test procedures (by procedure number).

An outline and format of each test procedure and data sheets for each type of test or inspection.

Safety program defining general precautions to be taken, notices, signs and barriers to be posted concerning the safety of the public, work personnel and equipment. The program will define, precautionary measures to be taken prior to, during and following the inspection and test until such time as normal work is resumed.

The Contractor shall be fully responsible for site safety and the satisfactory completion of inspection and tests as per the Acceptance Testing Plan. The Contractor shall prepare a detailed site safety plan following the guidelines included in the Acceptance Test Plan. The Contractor shall provide personnel to enforce the site safety plan. If tests and/or inspections are repeated due to discrepancies, defects in the installations and/or the equipment, the Contractor shall bear all costs pertaining to the retest.

The Contractor shall provide a self-propelled, high rail, man lift platform inspection vehicle for final inspection of each completed catenary wire lowering in curves, and each completed catenary wire run. The inspection vehicle shall be capable of lifting four (4) people to trolley wire height and shall be supplied with a vehicle driver.

The Contractor shall provide all manpower, equipment, and grounding devices required to provide equal-potential grounding protection for inspection personnel on the high rail inspection vehicle. The protection shall be provided for the entire length of catenary wire run being inspected and shall be in conformance with all Metro-North rules, procedures, and regulations.

The high rail inspection vehicle will be made available for use by the Engineer and the Railroad Inspectors for final inspection of each completed catenary installation. The inspection vehicle shall also be made available for use for the re-inspection(s) of completed catenary installations when remedial work is required due to deficiencies found during the initial inspection.

Catenary System

The Acceptance Test Procedures will cover:

Acceptance measurements on catenary system and all forms and tables to be used for documenting results.

Visual inspection of completed catenary and all forms and tables to be used for documenting results.

Clearance envelope tests for pantograph and all forms and tables to be used for documenting results.

Overhead catenary system electrical tests and all forms and tables to be used for documenting results.

Inspections and checks on other completed installations and all forms and tables to be used for documenting results.

System electrical tests on other completed installations and all forms and tables to be used for documenting results.

The Acceptance Test Procedures will, as a minimum, include: objective and scope, equipment set-up; equipment to be used; personnel required; estimated duration; chronological sequence of test steps, pass/fail criteria and samples of data sheets to be used.

An outline of the required inspections/checks/tests/measurements is indicated below for information:

ACCEPTANCE MEASUREMENTS ON CATENARY SYSTEM:

Upon completion of each segment of construction, the Contractor shall measure the contact wire height, stagger, and other required dimensions and record the readings on an Acceptance Measurement Form, in the presence of the Engineer.

Tests shall be scheduled in advance with the Engineer, and shall only be made during times of calm, dry weather, with either steady sunshine, or continuous cloud cover.

Acceptance Measurements tables and forms shall be prepared and shall include the following information:

Track designation

Wire Run Number as indicated on the Contractor's Layout Schedule

Drawing number(s) where the structures of the Wire Run are shown

Name(s) of person(s) responsible for performing the acceptance measurements

Sheet number of a Wire Run set

Equipment or catenary style being measured

Temperature of the conductor in degrees F during the time of measurement

Weather condition during time of measurement (e.g., windy, raining)

The date measurement was made

Station location of the pole or location where measurement is being taken

Actual span length (structure spacing) in feet between new installed structures and pull-off poles and adjacent existing structures.

Distance of the pole to the rail measured from the inside of the nearest rail to the face of the pole (for new structures and pull-off poles)

Foundation level, from high rail level (HRL) to top of new foundation

Cross-level difference of the two rails measured at the support (actual super-elevation at the structure)

Contact wire stagger at the support measured from elevated centerline of track.

System height i.e. the vertical distance measured at the support between the contact wire and the messenger wire.

Heel setting, which is measured from the static contact wire datum level to centerline of the steady arm connecting pin on the drop bracket.

Contact wire height at support locations and at mid-span. .

Cross level difference of the two rails measured at the mid-span (referred to as actual super elevation at mid-span).

Distance between the contact wire and the vertical or super elevated centerline of the track measured at mid-span (referred to as midspan offset).

Static offset at mid-span i.e. the distance between the contact wire and the elevated centerline of the track at contact wire level measured at mid-span.

The contact wire gradient – can be calculated from contact wire heights at two adjacent catenary supports.

Rise and fall positions of balance weight measured from the top of foundation to underside of the balance weight stack.

Balance weight anchor height measured from HRL at the support.

Termination height of the conductors at the support structure from HRL.

Guy anchor height at the support structure from HRL.

Contact wire and messenger wire height from HRL to the underside of overhead bridge or station awnings. The measurements will be taken at the bridge fascia low point and bridge center low point.

Electrical clearance from messenger or contact wire support to underside of bridge with uplift force of 50 lbs. on the contact wire measured at each bridge face and mid point of bridge.

At overlaps and turnouts - height of in-running and out-of-running contact wire above rail-referenced level at each structure.

Comments or remarks as required.

The Engineer will use the Acceptance Measurements to determine compliance with the design and will inform the Contractor of necessary corrections to be performed.

The Contractor shall execute corrections at no additional cost.

After execution of corrections, the Contractor shall re-measure and record affected data and submit the results to the Engineer.

The work of this Section shall not be complete until corrections are completed, inspected, and approved by the Engineer.

Completed Acceptance Measurements Tables shall be submitted for approval to the Engineer.

Visual Inspection of Completed Catenary table and forms shall be prepared and include the following information:

At contact wire level (HIGH LEVEL INSPECTION TABLE), the Contractor shall make the following checks, and remedy unsatisfactory conditions detected:

Check fit and tightness of all components

Verify that split pins and locknuts are secure

Check trolley wire for kinks, rolls, and damage

Check messenger wire for damage to strands

Check correct steady arm fittings

Check heel settings

Verify that jumpers are of correct type, have adequate travel capability, are properly fitted, and are well formed to avoid fatigue failure.

Check posture of pulley plates

Verify that hinge fittings have freedom to move under load

Verify that a wire passing through a cantilever and not attached to it, will clear any part of this cantilever by at least 3" throughout the range -10 degrees to +120 degrees F.

Check clearance and insulation between adjacent or crossing catenaries

Check installation for locations of possible interference with passage of pantographs, including spots where pantographs could tangle with wires or suspension assemblies.

From ground level (Ground Level Inspection Table), the Contractor shall make the following checks:

Check each pole and truss is identified by its pole number.

Check foundation anchor bolts and nuts for tightness and any damage.

Check removal of vegetation, dirt and debris from around foundation and pole base.

Check general condition of painted/galvanized poles.

Check general condition of catenary wires and look for obvious wire twist, kinks or strand breakage.

Verify that cantilevers and registration assemblies have correct along-track offset.

Verify that hangers are plumb and within design position.

Verify that balance weights have freedom to travel and the balance weight band does not bear on guide pipe.

A Clearance Envelope Tests for Pantograph table and form shall be prepared and include the following information:

Tests shall be performed initially with a rail mounted height and stagger gauge having the same profile as the vehicle pantograph. This gauge shall be used to verify the mechanical clearances between the pantograph and OCS components such as the heels of steady arms and trolley wire clamps, and the electrical clearances between the OCS/pantograph combination and civil structures such as over bridges. Any section found to have insufficient clearance shall be adjusted to provide the required clearance.

An Overhead Catenary System Circuit Continuity and Loop Resistance Tests tables and forms shall be prepared and include the following information:

This test entails short circuiting a discrete section of the OCS by connecting the OCS to its rails at one end, and applying a DC voltage at the other end to check both the OCS and the rail return system for electrical continuity and the absence of high resistance connections or inadvertent ground connections.

Integrated Tests:

Pantograph tests on the catenary will be performed during integrated testing using an electric rail vehicle with the pantograph in contact with the contact wire. These tests are to assure a smooth, shock-free passage of the pantograph with no interruption to current collection especially at turnouts, section insulators, overlaps and overhead bridge wire height changes. Particular attention will be focused on wire takeover at overlaps, turnouts and crossovers, and the lack of arcing at all locations. The Contractor shall be responsible for all adjustments required as a result of these tests. Any adjustments required shall be performed at the expense of the Contractor.

INSPECTION AND CHECKS ON OTHER COMPLETED INSTALLATIONS:

Upon completion of work at each site, the Contractor, in the presence of the Engineer, shall inspect the installation for conformity with the approved design and drawings and as recommended by the manufacturer. The Contractor shall provide all facilities, labor and equipment and shall be responsible for the satisfactory completion of the inspections and reports thereof. This shall apply to both Contractor and Railroad furnished equipment.

The Contractor promptly in coordination with the Engineer shall attend to any defects in the materials or installation. Any visible defect on the Railroad furnished equipment shall be considered the Contractor's responsibility. Defects noted at time of delivery shall be resolved prior to acceptance testing. Functional failure of Railroad furnished equipment shall be resolved

by the Railroad. Any retesting caused by Railroad furnished equipment failures will be the responsibility of the Railroad.

The inspection and checks on the completed systems shall include, but is not limited to:

Overhead Feeder System:

Verify the clearance of the new structures to the rail from the inside of the nearest rail to the face of the pole

Check for any damage to the structure and galvanizing

Check installation of the structure

Check grounding of the structure and equipment as per approved shop drawings

Verify the vertical clearance between the existing catenary and the new across-track feeders

Check fit and tightness of all components

Verify that split pins and locknuts are secure

Check new conductors for any damage to strands

Verify that the jumpers and feeder taps are of the correct type, have adequate travel capability, are properly fitted, and are well formed to avoid fatigue failures

Check insulators for any damage

Check for clearance and insulation between adjacent or crossing wires

Check installation for location of possible interference with existing wires or suspension assemblies

Check installation of disconnect switches, surge arresters, insulators, cable terminations and their connections, conduits, and conduit seals, and fire proofing of power cables in manholes and pull boxes

Check installation of slack ground wire as applicable.

MOD Control House, Snowmelter Unit Substation and associated equipment

General inspection of the enclosure for scratches or other damage to the paint finish.

Check door operation and locking arrangement.

Verify the removal of all scrap metal, wire cuttings, screws and miscellaneous hardware and debris

Check for proper support and fastening

Check for the complete assembly of all components and equipment and associated wiring.

Check power cables, terminations and their connections as applicable.

Check ground bus, control cables and their connections

Check wire connections to relays and terminal blocks for proper termination and markings

Check installation of auxiliary transformers and their power and control connections.

Check installation of control devices, push buttons and indicating devices

Check raceway systems and cables installations in accordance with specifications, NEC, NESC, the manufacturer's recommendations and local codes. Check rigidity of supports, tight connections, sealing, plugging of conduits etc. insulation and jacket damage, color coding, cable marking and terminations.

Motor Operated Disconnect switches

Check for proper installation, support and fastening of the MOD's, control boxes and associated oper

Check for MOD connections to the overhead catenary system.

General inspection of the control cabinet and the wiring

General inspection of the control cable installation

System Electrical Tests on Other Installations

These tests shall be conducted in phases; with equipment de-energized and with the equipment energized.

The tests in the de-energized state shall consist of the following:

Continuity Tests

Insulation Resistance Test as per applicable standards, NEC and NESC requirements

Hi-pot tests as applicable

Measurement of resistances as applicable

The tests with the equipment energized shall consist of the following:

Functional and Simulated Operational tests to verify that all equipment function in accordance with the approved control schematics, including their interface with existing system as applicable.

Check operation of auxiliary electrical apparatus as applicable.

MOD and Snowmelter Operation checks: Operation of control panel will be verified.

Verify RTU and SCADA interface and operation.

Method of Measurement: ACCEPTANCE TESTING will be paid on a lump sum basis.

There shall be no separate payment if tests and/or inspections are required to be repeated due to discrepancies or defects in the installation or equipment. The Contractor shall bear all costs pertaining to those defects, corrections and repeated inspections and tests.

There shall be no separate or additional payment for providing high rail, man lift platform inspection vehicle, driver and equal-potential grounding for acceptance testing and inspections, or for required re-testing of each completed catenary wire installation.

The electric vehicle for the integrated tests will be provided by the Railroad at no cost to the Contractor.

Basis for Payment: The work of this Section will be paid for at the lump sum price for the following pay item including all transportation, materials, equipment, tools and labor incidental thereto.

Pay Item	**Pay Unit**
ACCEPTANCE TESTING	LS

ITEM #0201001A – CLEARING AND GRUBBING

This work shall comply with Section 2.01 supplemented as follows:

Article 2.01.01 – Description
At the end of the first paragraph add the following.

"The work shall also consist also consist of cleaning entirely the new and existing drainage structures and storm drains throughout the duration of the project and at the project completion."

Pay Item	Pay Unit
Clearing and Grubbing	LS

ITEM #0202000A – EARTH EXCAVATION

Work under this item shall conform to Section 2.02 supplemented as follows:

Article 2.02.01 – Description:

Add the following: The work shall include the excavation, removal and disposal of sidewalk and curbing as called for on the plans or as directed by the Engineer. The work will include all sidewalk and curb type. Curb to be reset shall be removed and stockpiled as part of the item "Earth Excavation" and reset under the individual item for reset curb. Curbing to be reset and later deemed unsuitable shall be discarded by the Contractor as part of the work Earth Excavation.

Article 2.02.04 – Method of Measurment:

Add the following: Sidewalk and Curbing to be removed will be measured for payment by the volume in cubic yards of the sidewalk or curbing removed. Stockpiling of curbing to be reset shall be included in the measurement for removal.

Article 2.02.01 – Basis of Payment:

Add the following: Sidewalk and Curbing to be removed will be paid for at the contract unit price per cubic yard for "Earth Excavation". No separate payment will be made for stockpiling of curbing to be reset but the cost to transport, stockpile and discard curbing deemed not suitable to be reset will be included in the cubic yard payment for Earth Excavation.

Pay Item	Pay Unit
Earth Excavation	C.Y.

ITEM NO. 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 AOEC(s), 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:

Phoenix Soil LLC P.O. Box 1750 Waterbury, CT 06721 (800) 586-4774	American Reclamation Corporation 100 West Main Street Northborough, MA 01532 (508) 393-6333; George Camougis
ESMI of New York 304 Towpath Road Fort Edward, New York 12828 (800) 511-3764	Waste Management of New Hampshire P.O. Box 27065 97 Rochester Neck Road Gonic, NH 03839 (603) 330-0217

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 # 202315A 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 <u>not</u> 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.

Any materials, which are determined through characterization sampling to be contaminated but reusable in accordance with the Remediation Standard Regulations, and which are reused within Project limits, will not be measured for payment under this item. This material will be paid for under Item 0202318A – Management of Reusable Controlled Material or in accordance with Article 1.04.05 in the item’s absence.

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 Contractor-selected 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 NO. 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.

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 DEP 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 202315A, "Disposal of Controlled Material".

Pay Item	Pay Unit
Management of Reusable Controlled Materials	C.Y.

ITEM NO. 0202452A – TEST PIT

Description

This item shall consist of test pits which shall be excavated as directed by the Engineer to determine the location of existing utilities and structures. The average depth of a typical test pit to be 6 feet.

Construction Methods

Test pits will be excavated in locations directed by the Engineer.

Test pits shall be backfilled immediately after examination.

In some cases, hand tools may be required to perform the excavation. The Contractor shall be required to perform hand excavation at the same unit price.

Test pits in roadway shall be patched with bituminous concrete unless trench excavation will occur within 24 hours at that same location.

Method of Measurement

The quantity to be paid for under this item will be the number of completed test pits as directed by the Engineer.

Basis of Payment

This work will be paid for at the contract unit price each for "Test Pits' as directed by the Engineer. Which price shall include all necessary equipment, tools, backfill labor and work incidental thereto. No direct payment will be made for furnishing and placing bituminous concrete pavement for patch, but the cost shall be included in the cost of the test pit item.

Pay Item	Pay Unit
Test Pit	Each

ITEM #0202629A – SETTLEMENT MONITORING PROGRAM

Description: This item consists of monitoring movement of the existing railroad tracks and retaining walls during construction for Site No. 17 (03086). The monitoring program shall be adequate to document any settlement or horizontal movement of the railroad track(s) and retaining walls during construction activities at the site having the potential to cause movement. Construction activities specifically identified as having the potential to cause movement include the following activities when performed within 50' of the nearest track or retaining wall: excavation; dewatering; and pile installation. The monitoring program shall be in conformance with the minimum requirements detailed in this specification or as noted on the plans.

Construction Methods: The Contractor shall develop and submit his Settlement Monitoring Plan for the work at Site No. 17 to the Engineer and the designated Amtrak Project Engineer for approval a minimum of 60 days prior to the planned commencement of any construction at the site. Upon receiving approval of such plan, the Contractor shall implement the plan as required. Suggested monitoring plans with the minimum requirements follow.

Suggested Track Monitoring Plan

Scope: If any work that could potentially affect the stability of the track is occurring within 50 feet of a track, or within the influence line of a track, then monitoring points shall be established along the track. The influence line descends from a point one foot horizontally away from the outside end of the tie bottom one unit vertically for every unit and a half horizontally.

Safety: All work close enough to foul a track must only be performed under the direction of qualified railroad personnel. People performing track monitoring are classified as Roadway Workers and must be trained in Roadway Worker Protection.

Points: Each location shall include a point on the top of rail marked with paint or crayon on the field side of the rail and used for vertical measurements, and a point on the tie for horizontal measurements. In wood ties, the point shall be marked with a PK nail or similar surveyor's marker; on concrete or steel ties the point shall be marked with paint.

Point Locations: Reference points shall be established along the track to point where the work ends or does not meet the conditions outlined above, and then at 50 feet, 100 feet, and 200 feet away from the end point(s). Where more than one track may be affected, points shall be established on each track that could be affected.

Measurement Accuracy: Monitoring points shall be established to within 0.001 feet, and monitoring shall be done to 0.01 feet.

Monitoring: Monitoring shall be performed at the beginning and end of every shift of work. Points shall be measured, and the measurements recorded, and the numbers compared with previous measurements. All points shall be measured each time monitoring occurs, except for the

points 200 feet away from the end of work; these points shall only be measured if any of the other measurements exceeds an allowable deviation.

Allowable deviations: If track is found to have moved either vertically or horizontally by more than one half of the Amtrak Maintenance limits as specified in Amtrak's MW-1000 for the particular class of track involved (all tracks at Site No. 17 are classified as Track Class 3), then all work shall cease immediately and the contractor shall immediately notify the Engineer and the designated Amtrak Project Engineer. Work may not resume until the designated Amtrak Project Engineer has inspected the site and approved the work to commence.

Track Maintenance: Deficiencies in track surface and alignment caused by construction activities shall be corrected solely by Amtrak forces. The Contractor shall be responsible for the cost of all such corrective work.

Suggested Retaining Wall Monitoring Plan

Scope: If any work that could potentially affect the stability of a wall required for the safety and stability of a track, then monitoring points shall be established along the wall at maximum 50' intervals measured along the track.

Safety: All work close enough to foul a track must only be performed under the direction of qualified railroad personnel and people performing such wall monitoring are classified as Roadway Workers and must be trained in Roadway Worker Protection.

Points: Each location shall include a point on the wall marked with paint or crayon on the track side of the wall and used for vertical and horizontal measurements.

Point Locations: Reference points shall be established along the walls to a point where the work ends or does not meet the conditions outlined above, and then at 50 feet, 100 feet, and 200 feet away from the end point(s).

Measurement Accuracy: Monitoring points shall be established to within 0.001 feet, and monitoring shall be done to 0.01 feet.

Monitoring: Monitoring shall be performed at the beginning and end of every shift of work. Points shall be measured, and the measurements recorded, and the numbers compared with previous measurements. All points shall be measured each time monitoring occurs, except for the points 200 feet away from the end of work; these points shall only be measured if any of the other measurements exceeds an allowable deviation.

Allowable deviations: If a wall is found to have moved either vertically or horizontally by more than 0.5 inches, then all work shall cease immediately and the contractor shall immediately notify the Engineer and the designated Amtrak Project Engineer. Work may not resume until the Engineer and the designated Amtrak Project Engineer have inspected the site and approved the work to commence.

Amtrak MW-1000

TRACK CLASS	MAX. PASSENGER SPEED (MPH)	CROSS LEVEL (INCHES) The Difference In Cross Level Between Any Two Points Less Than		DEVIATION FROM PROFILE 31' CHORD INCHES		DEVIATION FROM HORIZONTAL ALIGNMENT INCHES	DEVIATION FROM HORIZONTAL ALIGNMENT INCHES
		10'	62'	31' CHORD	62' CHORD	31' CHORD	62' CHORD
MAINTENANCE LIMITS							
1	15	1	2 1/4	2 5/8	2 1/4	N/A	3 3/4
2	30	1	1 5/8	2 1/4	2	N/A	2 1/4
3	60	1	1	1 1/2	1 5/8	N/A	1 1/4
4	80	1	1	1 1/8	1 1/2	N/A	1
5	90	1	1	3/4	1	N/A	1/2
6	110	3/4	1	3/4	3/4	3/8	1/2
7	125	3/4	1	3/4	3/4	3/8	3/8
8	160	3/4	1	1/2	3/4	3/8	3/8
9	200	3/4	1	3/8	1/2	3/8	3/8
1/2 MAINTENANCE LIMITS							
1	15	1/2	1 1/8	1 5/16	1 1/8	N/A	1 7/8
2	30	1/2	13/16	1 1/8	1	N/A	1 1/8
3	60	1/2	1/2	3/4	13/16	N/A	5/8
4	80	1/2	1/2	9/16	3/4	N/A	1/2
5	90	1/2	1/2	3/8	1/2	N/A	1/4
6	110	3/8	1/2	3/8	3/8	3/16	1/4
7	125	3/8	1/2	3/8	3/8	3/16	3/16
8	160	3/8	1/2	1/4	3/8	3/16	3/16
9	200	3/8	1/2	3/16	1/4	3/16	3/16

Method of Measurement: This item, being paid for on a lump sum basis, will not be measured for payment.

Basis of Payment: This work will be paid for at the contract lump sum price for "Settlement Monitoring Program", which price shall include the furnishing and installation of monitoring points, survey monitoring of the points at the required intervals, maintenance and protection of the points, replacement of damaged monitoring points, removal or abandonment of monitoring

points, the recording of the data, the transfer of data to the Engineer, the railroad safety training for all workers performing monitoring and all materials, equipment, tools, and labor incidental thereto.

Pay Item	**Pay Unit**
Settlement Monitoring Program	L.S.

ITEM #0210100A – ANTI-TRACKING PAD

Description:

Work under this item shall consist of the installation, maintenance, and removal of anti-tracking pad(s), in accordance with the contract plan details at the plan locations or as ordered by the Engineer. Where anti-tracking pads are to be installed adjacent to paved surfaces with curbing, the work shall include the removal of the curbing and the replacement of the curbing when the pad is removed.

Materials:

The crushed stone for this work shall conform to the requirements of Article M.01.01 for No. 3 coarse aggregate. Geotextile shall conform to the requirements of Article M.08.01-26. 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.

Materials for the curbing shall conform to the requirements of Division III, Materials, Section, of the Standard Specifications, for the appropriate curbing type.

Construction Methods:

The area(s) on which the anti-tracking pad(s) are to be placed shall be shaped to a reasonably true surface prior to the installation of the geotextile. The geotextile shall be installed at the location(s) and to the dimensions as shown on the plans or as directed by the Engineer. Geotextile shall be installed as recommended by the manufacturer for the specific use. Crushed stone shall be placed over the geotextile to the depth shown on the plans and shall be finished to a smooth uniform surface matching into the surrounding grade.

The Contractor shall add crushed stone and regrade the pad during the construction phase as required to maintain the depth of stone as noted on the plans. Upon completion of work at a site, the anti-tracking pad(s) shall be removed in its entirety and the site restored to its original condition.

Excavated material from the installation of the anti-tracking pad(s) shall be stockpiled by the Contractor and shall be used for the restoration of the site when the pad is removed with the following exception. When pad(s) are required in Areas of Environmental Concern (AOEC), excavated material shall be handled and transported in accordance with the project environmental requirements.

At locations where the anti-tracking pad is adjacent to a paved surface with curbing, the Contractor shall remove the curbing from the pavement in a manner to minimize any damage to the pavement. The anti-tracking pad shall be installed to match the pavement grade.

Upon removal of the pad(s), the Contractor shall construct replacement curbing matching the material, dimensions and details of the existing curbing at the site. Construction of the curbing shall be in general accordance with the Standard Specifications for the appropriate curbing material type (concrete, stone, or bituminous).

Method of Measurement:

This work shall be measured by the actual number of square yards of completed and accepted anti-tracking pad(s).

Basis of Payment:

This work will be paid for at the contract unit price per square yard for "Anti-Tracking Pad" which price shall include all excavation, backfill, stockpiling of material, handling and transport of excavated material within AOECs, removal of curbing, disposal of surplus material, crushed stone, geotextile, backfill, tack coat, curbing and all equipment, tools, labor and materials incidental to the installation, maintaining and removal of the anti-tracking pad(s) and adjacent curbing.

Pay Item	Pay Unit
Anti-Tracking Pad	SY

ITEM #0210200A – TEMPORARY SLOPE PROTECTION

Work under this item shall conform to the requirements of Section 2.10 – Water Pollution Control (Soil Erosion), amended as follows:

Article 2.10.02 – Materials:
The materials for this item shall consist of hay or wood chips conforming to Section M.13.05 of the Specifications as well as Section 5-4 of the 2002 Connecticut Guidelines for Soil Erosion and Sediment Control, or as approved by the Engineer.

Tackifiers shall include, but are not limited to, water soluble materials that cause mulch particles to adhere to one another, generally consisting of either a natural vegetable gum blended with gelling and hardening agents, or a blend of hydrophilic polymers, resins, viscosifiers, sticking aids and gums, but in no case shall emulsified asphalt be used as a tackifier.

Article 2.10.01 – Construction Method:

Replace the fourth paragraph with:

When the Engineer determines the use of hay mulch for temporary slope protection is required, it shall be mechanically applied in two inch (50 mm) minimum deep layers with each layer held down with a non-petroleum based tackifier. The tackifier must be a qualified product as determined by the Engineer. The hay mulch shall be spread uniformly resulting in 95%-100% coverage of the slope area requiring temporary protection. The hay material will be available for use during all seasons throughout the year.

When the Engineer determines the use of wood chips for temporary slope protection is required, it shall be applied at the rate of 5.3 cu. yards per 120 sq. yards.

Article 2.10.05 – Basis of Payment:

Temporary slope protection will be paid for at the contract unit price per square yard for "Temporary Slope Protection", which price shall include the installation and removal, where necessary, of the protective material and all equipment, materials, tools, and labor incidental thereto. The cost of the temporary seeding will be paid under Item No. 0950010A – Temporary Seeding.

Pay Item	Pay Unit
Temporary Slope Protection	SY

ITEM #0213901A – BALLAST

Description: This item shall consist of furnishing and placing of ballast material necessary for the construction of the track beds complete. The work shall be in conformance with the details shown on the plans or as ordered and in accordance with the provisions of this Specification Section.

Contractor shall perform work in accordance with applicable recommended practices set forth in the 2014 AREMA Manual for Railway Engineering and as specified herein.

Materials: Ballast shall be crushed trap, flint or other rock approved by the Metro-North Railroad. It shall be: a) composed of angular fragments which are clear and free from deleterious substances, b) of proper gradation and c) meet all requirements of this specification.

Gradation: Ballast shall conform to the following scale when tested with laboratory sieves having square openings. (Sieves must conform to current ASTM Specifications for sieves of Testing Purposes, Designation E 11):

Size No.	Nom. Size Sq. Opening	Amount Finer Than Each Sieve (Sq. Opening Laboratory Sieve-Pct. By Wgt.) 2 in	1 ½ in	1 in	¾ in	½ in	3/8 in	#4
4	1 ½ in - ¾ in	100	90 - 100	20 - 55	0 -15		0 -5	
5	1 in - 3/8 in		100	90 - 100	40 - 75	15 - 35	0 - 15	0 - 5

Ballast Quality Requirements:

1. Deleterious substances in ballast shall be present in excess of the following amounts:

Description	Percent by Weight	Method of Test
Soft and friable pieces	3.0 percent	
Material finer than No. 200 sieve	0.5 percent	ASTM C117
Clay Lumps	0.5 percent	ASTM C142

2. Hardness:

   Average hardness shall be at least 5.5 as measured on Moh Hardness scale.

3. Absorption:

   Water absorption shall not exceed 1.2% when tested in accordance with ASTM C127.

4. Chemical Analysis:

   Type A ballast chemical analysis shall reveal quantitatively that at least 70% of test sample is composed of silicon dioxide, aluminum oxide, and iron oxide, but that not more than 25% of test sample is comprised of magnesium oxide, magnesium carbonate and calcium carbonate.

5. Los Angeles Abrasion:

   Percent of wear shall not exceed grading of sample (14.6%).

6. Cementing Value:

   When LA abrasion is in excess of 13.0% wear, cementing value in pounds per square inch shall not exceed 375.

7. Sodium Sulphate Soundness:

   Soundness of the prepared ballast shall be such that when tested in the sodium sulphate soundness test in accordance with ASTM C88, weighted average loss shall not exceed 1.5 percent after 10 cycles of test.

8. Impedance:

   Impedance must be in excess of 2.6 K ohms.

9. Testing:

   The quality of stone for ballast from any quarry or new strata opened up, including its soundness, resistance to abrasion, chemical composition, absorption, impedance, hardness and mass per cubic meter, shall be determined prior to its acceptance, at a testing laboratory selected by the purchaser. Each stratum or portion of quarry containing a variation of quality of stone shall be tested separately and not averaged. Quality tests and gradation tests shall subsequently be made from time to time as deemed necessary by the purchaser to control the quality and size of ballast furnished by the producer.

   Sufficient visual observations, determinations of deleterious substances and analyses of gradation shall be made by the producer prior to shipment to assure compliance with these specifications.

   The Contractor shall provide certified results of tests required by specifications. The railroad reserves the right to witness the performance of tests. If the Contractor desires to use its own testing facilities to make the aforementioned tests, the Railroad's concurrence must be received.

10. Method of Testing:

    a. The Sieve Analysis shall be made in accordance with the Method of Tests for Sieve Analysis of Fine and Course Aggregate (ASTM. Designation C136).

    b. Los Angeles Abrasion Loss shall be treated in accordance with Method of Test for Abrasion of Course Aggregate by use of the Los Angeles machine (ASTM Designation C131) except that Grading of the Sample for testing shall be as follows:

Sieve Size – Square Openings		
Passing	Retained On	Weight in Grams (oz.)
50 mm (2 in)	44.5 mm (1 ¾ in)	1250 (44)
44.5 mm (1 ¾ in)	37.5 mm (1 ½ in)	1250 (44)
37.5 mm (1 ½ in)	32 mm (1 ¼ in)	1250 (44)
32 mm (1 ¼ in)	25 mm (1 in)	1250 (44)

    c. Soundness shall be treated in accordance with the current Method of Test for Soundness

of Aggregate by use of Sodium Sulphate (ASTM Designation C88).

d. Cementing Values shall be tested in accordance with the Logan Walter Page Method (U.S. Dept. of Agriculture, Bulletin No. 347, 1916, Page 15) except as modified as follows:
   1. 500 grams (1.1 pounds) of fines developed from the Los Angeles Abrasion Test (ASTM C131) that has been screened through a 100-mesh sieve, mixed with sufficient water, kneaded for five minutes and allowed to stand in an air tight container for two hours, thereby forming a stiff dough that is to be molded into cylindrical briquettes 2.54 cm. (1 in.) diameter by 2.54 cm. (1 in.) in height under pressure of 132 kgs. per sq. cm (1877.5 pounds per square inch), after which they are dried for 20 hours in air at room temperature, 4 hours in a hot air bath at a temperature of 100^{o}C (212^{o} F), then cooled for 20 minutes in a desiccator, and immediately tested in a compression testing machine for static crushing strength, the bearing heads being suspended by pivots to secure uniform distribution of load which is applied at 2.7 kN (600 pounds) per minute approximately.

   2. The average crushing strength in pounds per square inch of 5 specimens measures the cementing value of this stone.

11. Contractor Certification:

The Contractor shall certify that ballast delivered to the site is typical of that upon which specified tests have been made.

Construction Methods:

1. Submittals: Submit name and location of proposed ballast supplier. Submit the type and specifications of equipment to be used in placing and compacting ballast. All submittals will be reviewed for general conformance with the intent of the contract documents. This review will not relieve the Contractor of final responsibility for the means, methods, procedures and sequences to be utilized.

2. Cleaning: The Contractor shall be responsible for assuring ballast cleanliness. A suitable washing facility shall be provided at the quarry for this purpose. This facility shall consist of a high pressure spray over the ballast as in passes in the belt. A quality control plan along with washing procedures must be submitted with Contractor's quotation. These will be subject to approval by the Engineer.

3. Handling: Prepared ballast shall be handled in such a manner that it is kept clean and free from segregation. It shall be loaded only into cars, which are in good order, tight enough to prevent leakage and waste of material, and clean and free from rubbish or any substance, which would foul the ballast.

4. Quality Control: Ballast Production Site Testing: Notify the Engineer, no less than 30 days prior to shipment of any ballast to work site, of the proposed source and location of crushed stone ballast. The Engineer shall obtain samples of proposed material and test them for conformance to classification, quality, and grading requirements specified.

5. Samples: The selection of samples is as important as the laboratory testing, and care must be taken that the samples obtained show the true nature and conditions of the material to be

examined.

Samples of all ballast and samples of stone at quarries for test to determine the acceptability of the source, as well as samples for quality control, shall be selected by a representative of the purchaser. The owner of the quarry or producer may submit samples for inspection or preliminary testing if such action is approved by the Engineer.

Samples of the finished product for gradation and other required tests shall be taken from each 1,000 tons of prepared ballast unless otherwise ordered by the Engineer. Samples shall be representative (full belt) and shall have a mass not less than 110 pounds. Where the acceptability of stone from a quarry is to be determined, a 165 pound sample consisting of pieces of approximately 6 x 6 x 4 inches should also be furnished. Method of sampling shall be furnished to the Engineer for approval.

The Engineer will notify the Contractor of test results. If ballast fails to meet these specifications, ballast quarry will be rejected.

Ballast material shall be approved in writing by the Engineer prior to commencing work site delivery.

If, during ballast installation, the source of ballast changes, the Engineer will perform tests at the new production site in accordance with these Specifications. Ballast shall have the same or higher classification, quality, and grading as the former ballast used. Work site delivery shall not commence until the Engineer has approved the new ballast source in writing.

6. Ballast Job-Site Testing: Periodically during progress of track construction, the Engineer will test samples of ballast obtained from in-place locations designated by the Engineer to insure a uniform quality of ballast.

   If material prior to, during or after being loaded, does not conform to specifications, the Engineer shall notify Contractor to stop operations until all faults have been corrected. Disposal and/or removal of defective material shall be done at no additional cost.

   As it is impractical to inspect all ballast at the quarry, the Engineer reserves the right to reject any car of ballast (whether previously inspected or not) that does not conform to specifications upon arrival at unloading site.

   No ballast shall be unloaded unless it has been approved by the Engineer.

   Should ballast that does not meet specifications be unloaded prior to the Engineer's approval, then payment will not be made to Contractor. Contractor must remove all defective material from site at no additional cost.

   Defective material arriving at site for unloading shall be rejected by the Engineer and disposed of at expense (including all freight and switching costs) of Contractor.

7. Ballast Placement

   a. Clean the trackway area of all debris and standing water prior to placing of ballast. Do not place ballast on frozen subgrade or sub-ballast.
   b. Check grade lines and cross section of sub-ballast or finished subgrade prior to placing

ballast. Bring subgrade to proper elevation as shown on Contract Drawings.

c. Deliver ballast at a rate no faster than can be satisfactorily incorporated into the work, and as such times as to permit proper inspection by the Engineer.
d. To the extent practicable, unload ballast in position for use with a minimum of redistribution.
e. Place ballast in multiple layers not exceeding 4 inches in thickness each.
f. Self-spreading vehicles may be used as approved by the Engineer. When stone is initially spread by self-spreading vehicle a power grader may be used to assist spreading operations
g. Thoroughly compact ballast until stones are firmly interlocked and the surface is true and unyielding. Compact each lift with not less than four passes of a roller or a vibratory compactor subject to the following requirements:

    1. Compact by rolling using either a self-propelled, three-wheel, two axle roller of such weight that will provide compression under the rear wheels of not less than 350 pounds per linear inch of tread; or using a two or three-wheel tandem roller having a weight per meter of drive roll of not less than 350 pounds, and every part of the surface receiving compression from the drive wheels.

    2. Compact by vibration using vibration compactors of either the roller or pad type. Dynamic force for either type shall not be less than 20,000 pounds and the frequency range shall be 1100 to 1500 vpm. Use machines equipped with a governor, which can be set and locked to control rate of impulse. Provide a tachnometer or other suitable device for accurately checking the frequency of vibration during the compacting operation.

h. Top surface of initial layers of ballast shall be smooth, flat and uniformly compacted.

Method of Measurements:

This work will be measured for payment by the number of cubic yards of ballast furnished, placed, compacted, and accepted in place.

Basis of Payment:

Payment for this work will be made at the contract unit price per cubic yard for "Ballast" complete in place, which price shall include all material, equipment, tools, labor and work incidental thereto.

Pay Item	Pay Unit
Ballast	C.Y.

ITEM #0213902A – SUB-BALLAST

Description: This item shall consist of furnishing and placing of sub-ballast as necessary for the construction of the track bed. The work shall be in conformance with the details shown on the plans or as ordered and in accordance with the provisions of this Specification Section.

Contractor shall perform work in accordance with applicable recommended practices set forth in the 2009 AREMA Manual for Railway Engineering and as specified herein.

Materials: Sub-ballast shall be crushed stone or granulated, expanded or air-cooled slag with an average hardness of 5.5 minimum on Moh's Scale of Hardness. It shall be: a) composed of clean, hard, uncoated particles free from lumps of clay, shale and other object ional materials, b) of proper gradation and c) meet all requirement of this specification.

Gradation shall be in accordance with ASTM C136 and C117 as follows

Sieve Size	Percent Passing by Weight
1 inch	100
3/8 inch	50 to 85
No. 4	35 to 65
No. 10	25 to 50
No. 40	15 to 25
No. 200	4 to 10

The fraction passing the No. 200 sieve shall be less than two-thirds of the fraction passing the No. 40 sieve.

Deleterious substances in sub-ballast shall not be present in excess of the following amounts:

Description	Percent by Weight	Method of Test
Soft Particles	5 percent	
Clay lumps and friable particles	0.5 percent	ASTM C 142
Wear	20 percent	ASTM C 131
Absorption:	0.5 percent	ASTM C 127

Crushing of sub-ballast shall not be required except the supplier may, at his option, elect to crush any oversize particles present in the deposit as an alternative to screening.

Notify the Engineer at least 30 days prior to delivery, of the source and location of the source of materials to be used in order that the approval test may be made. Use only the one approved material to complete the order. Do not change the source of material unless the Engineer approves the new source and material in writing.

Sub-ballast shall be handled during all stages of production and delivery in a manner that will provide a uniform product and will prevent contamination or segregation.

To satisfy the requirements of this specification sub-ballast may be screened, crushed, washed or otherwise processed to produce a uniform acceptable product. Blending of materials to improve quality will not be permitted.

Construction Methods:

Shipping: Load sub-ballast only into rail cars or trucks, which are in good order, tight enough to prevent leakage and waste of material, and are clean and free of rubbish or any substance, which would foul the sub-ballast material.

Submittals: Submit name and location of proposed sub-ballast supplier. Submit the type and specifications of equipment to be used in placing and compacting sub-ballast. All submittals will be reviewed for general conformance with the intent of the contract documents. This review will not relieve the Contractor of final responsibility for the means, methods, procedures and sequences to be utilized.

Handling: Handle prepared sub-ballast at production plant, during shipment and at work site so that it is kept clean and free from segregation.

Do not make repeated passes of equipment over the same level in stockpile area.

Sub-ballast Job-Site Testing: Periodically during progress of track construction, the Engineer will test samples of sub-ballast obtained from in-place locations designated by the Engineer to insure a uniform quality of sub-ballast.

If material prior to, during or after being loaded, does not conform to specifications, the Engineer shall notify Contractor to stop operations until all faults have been corrected. Disposal and/or removal of defective material shall be done at no additional cost.

As it is impractical to inspect all sub-ballast at the quarry, the Engineer reserves the right to reject any car of sub-ballast (whether previously inspected or not) that does not conform to specifications upon arrival at unloading site.

No sub-ballast shall be unloaded unless the Engineer has approved it.

Should sub-ballast that does not meet specifications be unloaded prior to the Engineer's approval, then payment will not be made to Contractor. Contractor must remove all defective material from site at no additional cost.

Defective material arriving at site for unloading shall be rejected by the Engineer and disposed of at expense (including all freight and switching costs) of Contractor.

Placing of Sub-ballast:

A. Subgrade Preparation

1. Place initial layer of sub-ballast material only on subgrade, which has been inspected and accepted by the Engineer.

2. If unsuitable subgrade material, in the judgment of the Engineer, is found at or below the grade to which excavation would normally be carried in accordance with the Contract Drawings, the Contractor shall remove such materials to the required width and depth and replace it with thoroughly compacted Ordinary Borrow as directed by the Engineer.

B. Sub-ballast Placement

1. Place sub-ballast in layers not exceeding 4 inches in thickness. Use multiple layers to build up the thickness as shown on Contract Drawings or as required by the Engineer.

2. Unless otherwise indicated or specified, each layer shall be compacted to 95 percent of maximum, dry density in accordance with ASTM D1557 Method D or C or ASTM D4253.

3. Remove, replace and recompact any sub-ballast, which after being rolled does not form a satisfactory solid stable foundation.

Method of Measurement:

This work will be measured for payment by the number of cubic yards of sub-ballast furnished, placed, compacted, and accepted in place.

Basis of Payment:

Payment for this work will be made at the contract unit price per cubic yard for "Sub-Ballast" complete in place, which price shall include all materials, equipment, tools, labor and work incidental thereto.

Pay Item	Pay Unit
Sub-Ballast	C.Y.

ITEM #0213904A – BALLAST MAT

Description: This work consists of furnishing and installation of a vibration mitigating ballast mat with geotextile fabric for materials separation as indicated on the Contract Drawings. Ballast mats shall be provided on the deck and curbs of the safety walks.

Materials:

1. Ballast mat shall consist of reinforced natural rubber designed to provide reduction of ground or structure borne vibrations, of the impact on structures and of the crushing of ballast. The upper structure of the mat shall be textured to permit ballast to nest for trackbed stability and be designed for protection against attack by contaminants that may filter through ballast over time. The subsurface shall contain fabric reinforcement for strength and load distribution. The underside shall provide for subsurface drainage under the mat.

2. Other items required for ballast mat installation are as follows:

   Appurtenances and installation of tools for joining and sealing abutting mat edges as recommended by the manufacturer.

   Galvanized steel retention devices (flashing) and bolts furnished by the Contractor to retain ballast and secure the mat respectively.

   Ballast Mat Properties:

   A. Ballast mat material shall satisfy the following requirements:

      Capacity: An axle load of 44 tons.

      Dimensions:

      1) Width no less than 48", not including joint overlaps.
      2) Thickness 9/16 "

      Fabric:

      1) Tensile strength $\geq$ 1,150 lb/inch
      2) Elongation at break $\geq$ 10%

   Elastomer Properties (natural rubber unless otherwise specified):

      1) Top layer (synthetic):
         a. Tensile strength $\geq$ 1,450 psi
         b. Elongation at break $\geq$ 350%
         c. Tera-resistance 28 lb/inch
         d. Hardness (Shore A) = 58 ($\pm$ 5)

2) Isolating Layer:
   a. Tensile strength $\geq$ 2,175 psi
   b. Elongation at break $\geq$ 28 lb/inch
   c. Hardness (Shore A) = 70 ($\pm$ 5)
   d. Compression Set (for 24 hours at 158 degrees F) $\leq$ 25%

Dynamics: Dynamic to static stiffness ratio (related to a preload of 8.5 psi) K_d = 1.7 (+0.1/-free).

Temperature Range: Standard quality is suitable for service where ballast mat temperature range between (-) 4 degrees F and (+) 158 degrees F.

B. The material used for the sealing of ballast mat joints shall be an integral extension of the top surface of the mat or a separate material having strength characteristics equal to those of the top layer of the ballast mat.

3. Quality Control:

A. A representative of the manufacturer of the ballast mat shall be present on the project site at least two days prior to the commencement of ballast mat installation and shall remain on the site and to otherwise supervise the ballast mat installation work for the duration of the installation or for a period of at least one week, as deemed necessary by the Engineer to ensure proper installation.

B. Securely store and properly protect ballast mat and all associated materials required for installation and take necessary precautions for the handling and delivery to the job site. Damaged materials will not be accepted for installation.

C. Provide an independent testing laboratory certification of the test results certified by a recognized independent authority that the material specifications of the ballast mat to be installed on this project is as specified herein and is compatible with substrates on which the mat is to be installed.

4. Submittals:

A. Submit complete details of the proposed ballast mat and any required related materials, including shop drawings and a detailed procedure for the storage, handling, transport, installation and protection of the ballast mat (including compaction procedures and equipment for initial layer of ballast) for approval by the Engineer.

B. Contractor shall investigate delivery time for ballast mat materials in order to assure timely delivery for stages of work.

Construction Methods:

1. Preparation:

Construction of the trackbed and bridge deck shall be completed as shown on the Contract Drawings. The bridge deck ballast mat shall be continued upward from the floor along the

vertical face of the concrete safety walk. Other inside and outside, horizontal and vertical wall corners shall be square. Ballast mat shall be continuous across all phases of staged construction.

2. Ballast Mat Installation:

A. Prior to installation of the ballast mat, the railroad deck waterproofing shall be thoroughly cleaned of all debris and dust. Rough or uneven area shall be removed until the surface is made to be acceptable by the Engineer.

B. Unroll ballast mat from reels positioned close to point of installation in accordance with approved procedures and as directed by the manufacture's representative. At bridge decks, push one end under the upper floor plate and measure to accurately determine the length of mat required. Edges shall be cut straight and smoothly to assure a uniform fit at all joints, tapered at trackway curves, and at ends, which shall be sealed as recommended by the manufacturer.

C. Secure ballast mat at all seams as recommended by the manufacturer providing a watertight seam at abutting mats.

D. At all times exercise extreme care to prevent intrusion of silt and debris into the void space provided under the mat. The joints shall be protected and the galvanized steel strips shall be placed over the edges of the ballast mat as soon as the mat is installed. At no time shall water, silt, and debris be allowed to enter into newly installed ballast mat from the trackway or from other sources.

Temporary positive seals shall be installed along the open edges of the mat to prevent such intrusion. Permanent seals with an approved mastic shall be installed on the open edges of the ballast mat. Ballast mats contaminated with silt and debris shall be removed, cleaned, and re-installed or replaced with new materials at no additional cost to the State.

E. Place a caulking sealant compatible with the ballast mat at all extremity edges, mat joints where the mat interfaces concrete and/or steel surfaces to assure water tightness.

3. Placement of Ballast:

A. The Engineer will witness the handling and compaction of ballast over top of ballast mat. Equipment to be used for tamping of ballast shall be subject to approval by the Engineer. Ballast mat shall be protected per manufacturer's requirements prior to placement of ballast.

B. Ballast shall not be transported across the ballast mat. Trucks and any other construction equipment shall not operate on the ballast mat unless it is covered with at least six (6) inches of ballast.

Method of Measurement: This work will be measured by the square foot furnished and installed including all materials and incidentals shown on the Contract Drawings, measured in place prior to backfilling with ballast.

Basis of Payment: Payment for Ballast Mat will be paid at the contract unit price per square foot "Ballast Mat" complete in place, which price shall include all technical support, materials, equipment, tools and labor incidental thereto.

Pay Item	Pay Unit
Ballast Mat	S.F.

ITEM #0219011A – SEDIMENT CONTROL SYSTEM AT CATCH BASIN

Description: This work shall consist of furnishing, installing, cleaning, maintaining, replacing, and removing sedimentation control at catch basins at the locations and as shown on plans and as directed by the engineer.

Materials

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 or an approved equal:

Siltsack®
SI Geosolutions:
www.sigeosolutions.com
(800)621-0444

Dandy Sack™
Dandy Products Inc.
P.O. Box 1980
Westerville, Ohio 43086
Phone: 800-591-2284
Fax: 740-881-2791
Email: dlc@dandyproducts.com
Website: www.dandyproducts.com

FLeXstorm Inlet Filters
Inlet & Pipe Protection
24137 W. 111th St - Unit A
Naperville, IL 60564
Telephone: (866) 287-8655
Fax: (630) 355-3477

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 the emptying of sack and lifting loops as an integral part of the system to be used to lift 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.

Construction Methods:

Installation, removal, and maintenance shall be per manufacturer instructions and recommendations.

Method of Measurement: Sediment Control System at Catch Basin will be measured as each installed, maintained, accepted, and removed. There will be no separate measurement for maintenance or replacement associated with this item.

Basis of Payment:

Sediment Control System at Catch Basin will be paid for at the contract unit price each complete in place and accepted, which price shall include all maintenance throughout construction, materials, equipment, tools, and labor incidental thereto.

Pay Item	Pay Unit
Sediment Control System at Catch Basin	Each

ITEM #0406267A - MILLING OF HMA (0" TO 4")

Description: This work shall consist of the milling, removal, and disposal of existing HMA pavement.

Materials: The existing HMA surface shall be disposed of offsite by the Contractor at an approved disposal facility unless otherwise stated in the contract documents.

Construction Methods: The Contractor shall remove the HMA material using means acceptable to the Engineer. The pavement surface shall be removed to the line, grade, and existing or typical cross-section shown on the plans or directed by the Engineer.

The equipment for milling the pavement surface shall be designed and built for milling flexible pavements. It shall be self-propelled with sufficient power, traction, and stability to maintain depth and slope and shall be capable of removing the existing HMA pavement.

The milling machine shall be equipped with a built-in automatic grade averaging control system that can control the longitudinal profile and the transverse cross-slope to produce the specified results. The longitudinal controls shall be capable of operating from any longitudinal grade reference, including string line, contact ski (30 feet minimum), non-contact ski (20 feet minimum), or mobile string line (30 feet minimum). The transverse controls shall have an automatic system for controlling cross-slope at a given rate. The Engineer may waive the requirement for automatic grade or slope controls where the situation warrants such action.

The rotary drum of the machine shall utilize carbide tip tools spaced not more than ⅝ inches apart. The forward speed of the milling machine shall be limited to no more than 45 feet/minute. The tools on the revolving cutting drum must be continually maintained and shall be replaced as warranted to provide a uniform pavement texture. The Contractor may request to perform a test strip to demonstrate that the same surface tolerance can be attained at an increased forward speed. The test strip shall be a maximum length of 500 feet and shall have the same criteria for surface tolerance as noted in this specification. The final decision for implementing the increased forward speed will be at the discretion of the Engineer.

The machine shall be equipped with an integral pickup and conveying device to immediately remove material being milled from the surface of the roadway and discharge the millings into a truck, all in one operation. The machine shall also be equipped with a means of effectively limiting the amount of dust escaping from the milling and removal operation.

When milling smaller areas or areas where it is impractical to use the above described equipment, the use of a lesser equipped milling machine may be permitted when approved by the Engineer.

Protection shall be provided around existing catch basin inlets, manholes, utility valve boxes, and any similar structures. Any damage to such structures as a result of the milling operation is the Contractor's responsibility and shall be repaired at the Contractor's expense.

To prevent the infiltration of milled material into the storm drainage system, the Contractor shall take special care to prevent the milled material from falling into the inlet openings or inlet grates. Any milled material that has fallen into inlet openings or inlet grates shall be removed at the Contractor's expense.

Surface Tolerance: The milled surface shall provide a satisfactory riding surface with a uniform textured appearance. The milled surface shall be free from gouges, longitudinal grooves and ridges, oil film, and other imperfections that are a result of defective equipment, improper use of equipment, or poor workmanship. The Contractor, under the direction of the inspector, shall perform random spot-checks with a Contractor supplied ten-foot straightedge to verify surface tolerances at a minimum of five locations per day. The variation of the top of two ridges from the testing edge of the straightedge, between any two ridge contact points, shall not exceed ⅜ inch. The variation of the top of any ridge to the bottom of the groove adjacent to that ridge shall not exceed ⅜ inch. Any unsatisfactory surfaces produced are the responsibility of the Contractor and shall be corrected at the Contractor's expense and to the satisfaction of the Engineer.

The depth of removal will be verified by taking a measurement every 250 feet per each pass of the milling machine, or as directed by the Engineer. These depth measurements shall be used to monitor the average depth of removal.

Where a surface delamination between HMA layers or a surface delamination of HMA on Portland cement concrete causes a non-uniform texture to occur, the depth of milling shall be adjusted in small increments to a maximum of a +/- ½ inch to eliminate the condition.

When removing a HMA pavement entirely from an underlying Portland cement concrete pavement, all of the HMA pavement shall be removed leaving a uniform surface of Portland cement concrete, unless otherwise directed by the Engineer.

Any unsatisfactory surfaces produced by the milling operation are the Contractor's responsibility and shall be corrected at the Contractor's expense and to the satisfaction of the Engineer.

No vertical faces, transverse or longitudinal, shall be left exposed to traffic unless it meets the requirements below. This shall include roadway structures (catch basins, manholes, utility valve boxes, etc.). If any vertical face is formed in an area exposed to traffic a temporary paved transition will be established according to the requirements shown on the plans. If the milling machine is used to form a temporary transition, the length of the temporary transition shall conform to Special Provision Section 4.06 - Bituminous Concrete, "Transitions for Roadway Surface", the requirements shown on the plans, or as directed by the Engineer. At all permanent limits of removal, a clean vertical face shall be established by saw cutting prior to paving.

Roadway structures shall not have a vertical face of greater than 1 inch exposed to traffic as a result of milling. All structures within the roadway that are exposed to traffic and greater than 1 inch above the milled surface shall receive a transition meeting the following requirements:
For roadways with a posted speed limit of 35 mph or less*:

Round structures with a vertical face of greater than 1 inch to 2.5 inches shall be transitioned with a hard rubber tapered protection ring of the appropriate inside diameter designed specifically to protect roadway structures.

Round structures with a vertical face greater than 2.5 inches shall receive a transition of bituminous concrete formed at a minimum 24 to 1 taper.

All rectangular structures shall receive a transition of bituminous concrete formed at a minimum 24 to 1 taper.

*Bituminous concrete tapers at a minimum 24 to 1 taper may be substituted for the protection rings if approved by the Engineer.

For roadways with a posted speed limit of greater than 35 mph:

All structures shall receive a transition of bituminous concrete meeting the temporary transition requirements in Special Provision Section 4.06- Bituminous Concrete, "Transitions for Roadway Surface".

The milling operation shall proceed in accordance with the requirements of the "Maintenance and Protection of Traffic" and "Prosecution and Progress" specifications, or other contract requirements. The more stringent specification shall apply.

Prior to opening an area which has been milled to traffic, the pavement shall be thoroughly swept with a sweeper. The sweeper shall be equipped with a water tank and be capable of removing the millings and loose debris from the surface. Other sweeping equipment may be provided in lieu of the sweeper where acceptable by the Engineer.

Any milled area that will not be exposed to live traffic for a minimum of 48 hours prior to paving shall require a vacuum sweeper truck in addition to, or in lieu of, mechanical sweeping. The vacuum sweeper truck shall have sufficient power and capacity to completely remove all millings from the roadway surface including any fine particles within the texture of the milled surface. Vacuum sweeper truck hose attachments shall be used to clean around pavement structures or areas that cannot be reached effectively by the main vacuum. Compressed air may be used in lieu of vacuum attachments if approved by the Engineer.

Method of Measurement: This work will be measured for payment by the number of square yards of area from which the milling of asphalt has been completed and the work accepted. No area deductions will be made for minor unmilled areas such as catch basin inlets, manholes, utility boxes and any similar structures.

The depth of removal will be calculated by taking a measurement at a minimum every 250 feet per each pass of the milling machine, or as directed by the Engineer. The average depth of each section will determine which payment item is applicable.

Basis of Payment: This work will be paid for at the contract unit price per square yard for "Milling of HMA (0 to 4 inches) (greater than 4 to 8 inches) (greater than 8 inches)". This price shall include all equipment, tools, labor, and materials incidental thereto.

No additional payments will be made for multiple passes with the milling machine to remove the bituminous surface.

No separate payments will be made for cleaning the pavement prior to paving; providing protection and doing handwork removal of bituminous concrete around catch basin inlets, manholes, utility valve boxes and any similar structures; repairing surface defects as a result of the Contractors negligence; providing protection to underground utilities from the vibration of the milling operation; removal of any temporary milled transition; removal and disposal of millings; furnishing a sweeper and sweeping after milling. The costs for these items shall be included in the contract unit price.

Pay Item	Pay Unit
Milling HMA (0” to 4”)	Sq. Yd

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 #0502182A - RUBBER GRADE CROSSING

Description: Work under this item shall consist of furnishing full depth rubber grade crossing material for track crossings with timber or concrete ties at access points shown on the plans.

Materials: Materials shall conform to the following as specified by Metro-North Railroad:

Specifications for Rubber Crossings for Concrete Ties

Elastomer Classification:	ASTM D2000
Tensile Strength	ASTM D412, 2,000 psi
Hardness:	ASTM D2240 55-75 Durometer Shore A
Ultimate Elongation:	ASTM D412, 350% Min.
Resistance to Ozone Cracking:	ASTM D1171, C12
Accelerated Aging:	ASTM D573, A13
Fasteners Used in Crossing:	Pandrol Fast Clips
Field Panels:	Must be full depth rubber panels with width to match Metro-North Standard Concrete Cross Tie (enclosed drawing). Panels must interlock and be capable of installation without use of lag screws.
Gauge Panels:	Must be full depth rubber panels that encompass the gauge of the track from inside web of both rails (see enclosed drawings for Metro-North Railroad Standard Concrete Cross-Tie). Panels must interlock and be capable of installation without use of lag screws.
End Ramps (deflector plates):	To be included in price and needed for all crossings.

Specifications for Rubber Crossings for Timber Ties

Similar as for Rubber Crossings for Concrete Ties with following exceptions:

Fasteners Used In Crossing:	Track spikes
Width of Field Panels:	20" for 8'-6" Cross Tie

Materials shall be supplied by the following vendors or an approved equal:

Hi-Rail, Inc.
2539 Woodcliff Court
Lisle, Ill 60532
(630) 961-1659

Omni Grade Crossing, Inc.
Radnor Station Building #1, Suite 300
290 King of Prussia
Radnor, PA 19087
(610) 971-9966

Railway, Inc
120 Nixon Street
P.O. Box 849
Cascade, Iowa 52033
(319) 852-7794

The Contractor shall submit shop drawings of the Rubber Crossing for Timber or Concrete Ties to the Railroad for their review and approval. The crossing panels shall be full depth with the height of panel matching the rail size for the crossing location.

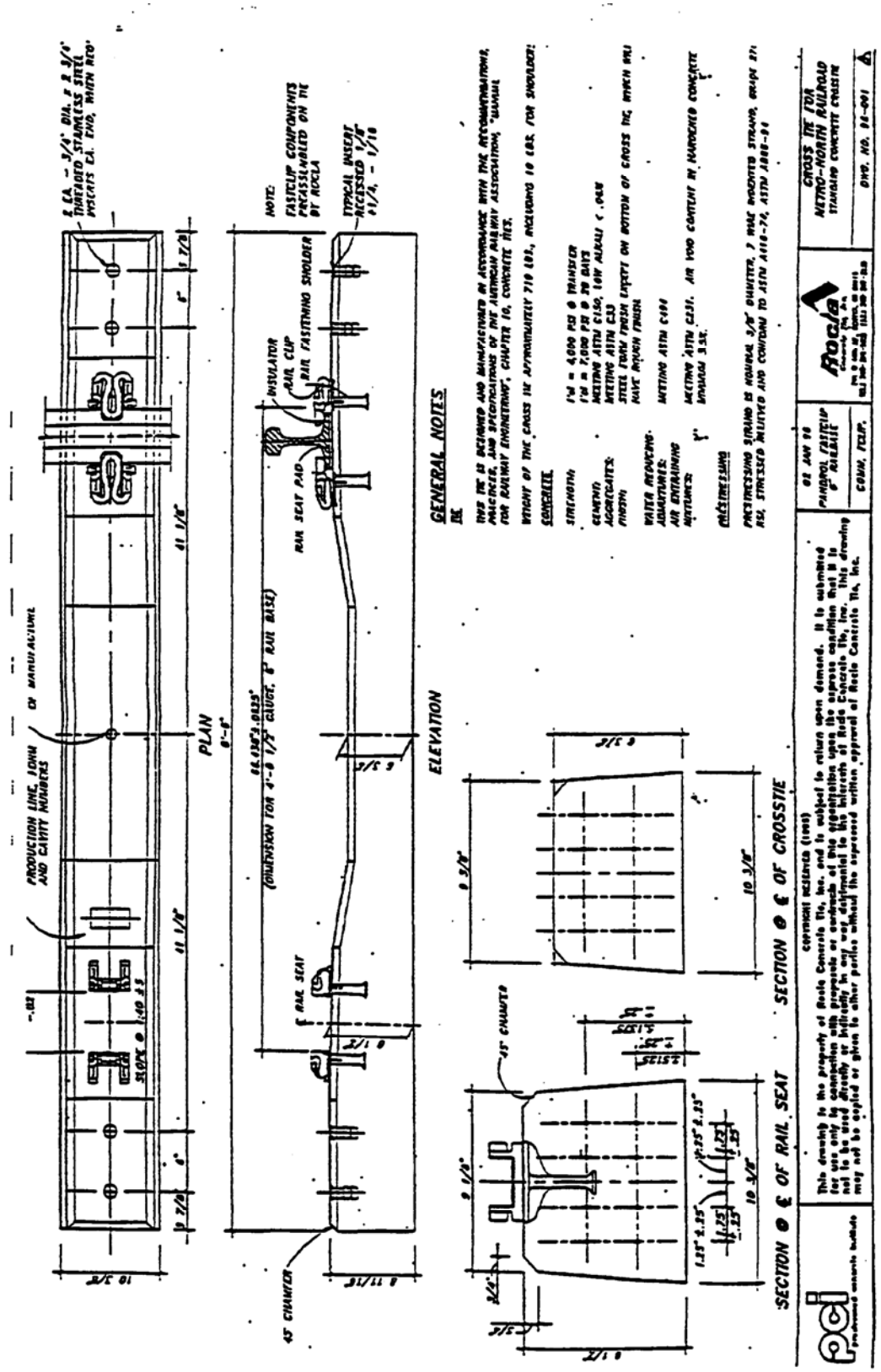
Construction Methods: The Contractor shall procure and deliver the rubber crossing material to the project site. The Contractor shall coordinate the delivery location with Metro-North Railroad. Installation of rubber crossing(s) shall be performed by Metro-North Railroad. There will be no charge to the Contractor for this installation work.

Method of Measurement: Rubber Grade Crossing(s) shall be measured for payment per linear foot of rubber crossing supplied, as measured along the centerline of the track. The deflector plates shall not be included in the above measurement.

Basis of Payment: This work will be paid for at the contract unit price per linear foot for "Rubber Grade Crossing", of the required depth and width, which price shall be for materials and delivery only.

No additional payment will be made for the required gauge and field deflector plates which price shall be considered incidental to the cost of the rubber grade crossing.

Pay Item	**Pay Unit**
RUBBER GRADE CROSSING	LF


PLAN
ELEVATION
SECTION @ ℄ OF RAIL SEAT
SECTION @ ℄ OF CROSSTIE
GENERAL NOTES
CROSS TIE FOR
KETRO-NORTH RAILROAD
STANDARD CONCRETE CROSSTIE
DWG. NO. 84-001
Rocla

ITEM #0503001A – REMOVAL OF SUPERSTRUCTURE

Article 5.03.01 – Description: Amend as follows:

For Section 5.03, the term superstructure shall also include the steel portion of the existing piers.

Article 5.03.05 – Basis of Payment: Delete paragraph two and replace with the following:

Payment for removing the stone masonry and concrete portions of piers, abutments and substructures generally shall be at the contract unit price per cubic yard for "Removal of Existing Masonry", or in the absence of this item, as extra work.

ITEM # 0504009A – RAILROAD PROTECTION

Section 5.04 "Railroad Protection" is amended as follows:

Article 5.04.04 – Method of Measurement:

Only Railroad Protection services approved by the Engineer will be measured for payment. Railroad Protection services will be measured for payment by the actual number of hours for each person rendering services in accordance with these specifications. Railroad Protection services utilized by the Contractor for which the Engineer did not approve or deems not necessary for the proper completion of the project will not be measured for payment.

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Article 5.04.05 - Basis of Payment:

The first paragraph is hereby deleted and replaced by the following:

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.

"Railroad Protection " will be paid for at the actual hourly rate charged (monthly statement or receipted bills from the entity which actually provided the services) only for railroad protection services which have been approved by the Engineer, plus a five percent (5%) markup. This price shall include all work, material and services provided by the railroad for protective services required by the operations of the Contractor on, over, under or adjacent to the railroad.

Pay Item	**Pay Unit**
Railroad Protection	Est.

ITEM #0506070A – GROUND ANCHORS

ITEM #0506071A – PERFORMANCE TEST FOR GROUND ANCHORS

ITEM #0506073A – PROOF TEST FOR GROUND ANCHORS

DESCRIPTION:
The work shall consist of installing permanent ground anchors as specified herein and as shown on the plans. The Contractor shall furnish all labor, materials, supervision and equipment required to complete the work. The contractor shall select the foundation anchor type, drilling method, grouting method, grouting pressures, and subject to the minimum values in the contract documents, determine the bond length, and anchor diameter. The Contractor shall also be responsible for surveying, designing, installing, quality control, and testing ground anchors that will develop the load-carrying capacity indicated on the Contract Drawings in accordance with this Specification.

Subsurface conditions are provided on the boring logs contained in the plan sheets.

The Contractor shall also be responsible for containment, hauling and legal disposal of all-drilling fluids and excavated materials, in accordance with this Specification, Section 1.10 of the Form 816 and all applicable local codes and regulations.

The use of down-hole hammers will not be permitted unless the Engineer provides written authorization.

QUALIFICATIONS AND SUBMITTALS:
1-Qualifications: The Contractor performing the work described in this Specification shall have installed permanent ground anchors for a minimum of 3 years.

The Contractor shall assign an engineer, licensed in the State of Connecticut, to supervise the work. The Contractor's engineer will have at least 3 years of experience in the design and construction of permanent anchored structures. The Contractor may not use consultants or manufacturer’s representatives in order to meet the requirements of this section.

Drill operators shall also have a minimum of 3 years experience installing permanent ground anchors with the Contractor’s organization.

The Engineer shall suspend the work if the Contractor substitutes personnel without prior written approval. If work is suspended due to the unauthorized substitution of personnel, the Contractor shall be fully liable for additional costs resulting from the suspension of work and no adjustment in contract time resulting from the suspension of work will be allowed.

2-Design Criteria: Unless shown on the plans or otherwise directed in writing by the Engineer, the Contractor shall select the type of tendon to be used. The maximum tendon loading can not exceed the following percentages of the specified minimum tensile strength (SMTS):

Tendon Design Load……	60 percent of the SMTS of the prestressing steel
Lock-off Load……..	70 percent of the SMTS of the prestressing steel
Test Load ……	80 percent of the SMTS of the prestressing steel

The Contractor shall be responsible for determining the bond length necessary to develop the design load indicated on the Contract Drawings or in accordance with this Specification. However, minimum bond length shall be 15 feet for strand and bar tendons in either soil or weathered bedrock or 10 feet for strand or bar tendons in bedrock.

The free stressing length (unbonded length) shall be not less than 15 feet for bar tendons or strand tendons regardless of soil or rock or as shown on the plans whichever is greater.

Strand and bar tendons shall not extend beyond the right-of-way limit shown on the contract drawings.

3-Submittals: The Contractor shall submit with the Working Drawings, their qualifications including resumes of the Contractors personnel (drill operator(s), and Contractors engineer). For each project, include (1) name of client contract, address, and telephone number; (2) location of project; (3) contract value; (4) relevant anchor work and (5) scheduled completion date and actual completion date for the work.

Working Drawings and supporting documentation for the design and construction of the ground anchors shall be submitted to the Engineer for review in accordance with Article 1.05.02-2. The Working Drawing submission shall include:

A) Proposed start date and detailed construction sequence with the proposed drilling methods and equipment including drill hole diameter proposed to achieve the specified pullout resistance values. Information on space requirements and excavation methods (if required) to access each anchor location will also be provided.

B) Ground anchor schedule giving: anchor number; design load; type and size of tendon; minimum total anchor length; minimum bond length; minimum tendon bond length; and minimum unbonded length.

C) A scale drawing of the ground anchor tendon and the corrosion protection system including spacers; centralizers; unbonded length corrosion protection system; bond length corrosion protection system; anchorage and trumpet; and anchorage corrosion protection system.

D) Plan view showing location of anchor and location of property line and/or limits of permanent easement.

E) Certified Test Reports and Materials Certification for the following materials, if used: prestressing steel (stand or bar); portland cement; prestressing hardware; bearing plates; and corrosion protection system.

F) Quality Control details including anchor drilling, anchor installation with lifting methods and grout placement.

G) Grout Mix Design including compressive stress strength test results (AASHTO T106/ASTM C109) supplied by a qualified independent testing lab verifying the specified minimum 7 day and 28 day grout compressive strengths.

H) Identification number and certified calibration report for each test jack, load cell primary pressure gauge and reference pressure gauge to be used. Jack and pressure gauge shall be calibrated as a unit. Calibration records shall include the date tested, device identification number, and the results shall be certified to an accuracy of 2 percent or less traceable to the National Bureau of Standards by a qualified independent testing laboratory within 90 days prior to submittal. The Engineer may request additional calibration(s) at any time during construction if there is evidence of improper handling of equipment or improper readings. No compensation will be provided for additional calibrations.

MATERIALS:

1-Grout:

Cement shall be Portland Cement Type I, II, III (ASTM C150)
Fine Aggregrate meeting Section M.03.01-2
Potable water

The grout mixture shall have a minimum 28-day compressive strength of at least 3000 psi measured in accordance with ASTM C 109 at the time of stressing and 60 percent of design strength at 7 days. Bleed shall be less than 2 percent. Admixtures will be used in strict accordance with the manufacturers' recommendations, subject to the approval of the Engineer. Accelerators, and expansive admixtures, will not be permitted.

Non-shrink, non-staining grout meeting Section M.03.01 may be used for filling sealed encapsulations, trumpets, and anchorage covers.

2-Steel Elements:

A) Prestressing Steel: Ground anchor tendons shall be fabricated from single or multiple elements of one of the following prestressing steels:
   ASTM A 722 Steel Bars
   ASTM A 416 (uncoated seven-wire strand)
   ASTM A 886 (indented seven-wire strand)
   ASTM A 882 (epoxy coated, seven-wire strand)

B) Prestressing Steel Couplers: Prestressing steel bar couplers shall be capable of developing 100 percent of the minimum specified ultimate tensile strength of the prestressing steel bar. Steel strands used for a soil or rock anchor shall be continuous with no splices.

C) Anchorage devices: shall be capable of developing 95 percent of the specified minimum ultimate tensile strength (SMTS) of the prestressing steel tendon.

D) Bearing plate: ASTM A 709 Grade 36 or ASTM A536

E) Trumpet: ASTM A 53 for pipe, ASTM A 500 for tubing. Minimum wall thickness of 0.25 inches.

F) Anchorage Covers: ASTM A 709 Grade 36 or ASTM A53 for pipe, ASTM A536 for ductile iron, or ASTM 500 for tubing.

G) Wedges: new steel elements be designed to preclude premature failure of the prestressing steel due to notch or pinching effects under static and dynamic strength meeting requirements of Section 3.1.6 (1) and Section 3.1.8 (1) and 3.1.8 (2) of the Guide Specification contained in the PTI "Post Tensioning Manual". Wedges for epoxy coated strand shall be designed to be capable of biting through the epoxy coating and into the strand. Removal of the epoxy coating from the strand to allow the use of standard wedges is permitted. Anchor nuts and other threadable hardware for epoxy coated bars shall be designed to thread over the epoxy coated bar and still comply with the requirements for carrying capacity.

3-Miscellaneous Anchor Elements:

A) Bondbreaker: The bondbreaker shall be fabricated from a smooth plastic tube or pipe having the following properties:
   1. resistant to grout, or corrosion inhibiting compound;
   2. resistant to aging and by ultra-violet light;
   3. nondetrimental to the tendon;
   4. capable of withstanding handling and installation methods;
   5. enable the tendon to elongate during testing and stressing; and
   6. allow the tendon to remain unbonded after lock-off.

B) Centralizers and Spacers: Centralizers and spacers shall be fabricated from plastic, steel or other material that is nondetrimental to the prestressing steel. Wood shall not be used. A combination centralizer-spacer may be used.

4-Corrosion Protection Elements:

A) Tendon Bond Length Protection for Grout Protected Tendons:
   A grout-filled, corrugated plastic encapsulation or a grout-filled, deformed steel tube shall be used. The prestressing steel can be grouted inside the encapsulation prior to inserting the tendon into the drill hole or after the tendon has been placed.

Tendon Bond Length Encapsulations: The tendon bond length to be encapsulated to provide additional corrosion protection, the encapsulation shall be fabricated from one of the following:

1. High density corrugated polyethylene tubing conforming to the requirements of AASHTO M 252 and having a minimum wall thickness of 1/16 inch except pregrouted tendons, which may have a minimum wall thickness 3/64 inch.
2. Deformed steel tubing or pipes conforming to ASTM A 52 or A 500 with a minimum wall thickness of 3/16 inch.
3. Corrugated, polyvinyl chloride tubes manufactured from rigid PVC compounds conforming to ASTM D 1784, Class 13464-B.
4. Fusion-bonded epoxy conforming to the requirements of AASHTO M 284.

B) Unbonded Length Protection:

1. Bar Tendons

A smooth bond breaker shall provide corrosion protection of the unbonded length over a grout filled bar sheath. The corrosion inhibiting compound shall completely coat the tendon element.

2. Strand Tendons

Corrosion protection of the unbonded length shall encapsulate tendons composed of individual grease filled extruded strand sheaths with a common smooth sheath; or individual grease filled strand sheaths with a grout filled smooth sheath. The corrosion inhibiting compound shall completely coat the tendon elements, fill the void between them and the sheath, and fill the interstices between the wires of 7-wire strands. Provisions shall be made to retain the compound within the sheath.

Sheath: A sheath shall be used as part of the corrosion protection system for the unbonded length portion of the tendon. The sheath shall be fabricated from one of the following:

1. A polyethylene tube (minimum 1/16 in wall thickness) pulled or pushed over the prestressing steel. The polyethylene shall be Type II, III or IV as defined by ASTM D 1248.
2. A hot-melt extruded polypropylene tube (minimum 1/16 in wall thickness). The polypropylene shall be cell classification B55542-11 as defined by ASTM D 4101.
3. A hot-melt extruded polyethylene tube (minimum 1/16 in wall thickness). The polyethylene shall be high density Type III as defined by ASTM D 1248.
4. Steel tubing (minimum 3/16 in wall thickness) conforming to ASTM A 500.
5. Steel pipe (minimum 3/16 in wall thickness) conforming to ASTM A 53.
6. Schedule 40 plastic pipe or tube of PVC conforming to ASTM D 1784 Class 13464-B.

Where corrugated pipe is used as a sheath a separate bondbreaker or common smooth sheath shall be provided in the unbonded length to allow the prestressing steel to freely elongate during stressing and to remain unbonded to the surrounding grout after lock-off.

C) Unbonded Length/Bond Length Transition:
The transition between the corrosion protection for the bonded and unbonded length shall be designed and fabricated to ensure continuous protection from corrosive attack.

The corrosion protective sheath surrounding the unbonded length of the tendon shall be long enough to extend into the trumpet, but shall not come into contact with the stressing anchorage during testing. Any excessive protection length shall be trimmed off.

D) Anchorage Protection:
The corrosion inhibiting compound placed in either the free length or the trumpet area shall be an organic compound (i.e., grease or wax) with appropriate polar moisture displacing, corrosion inhibiting additives and self-healing properties. The compound shall permanently stay viscous and be chemically stable and nonreactive with the tendon, sheathing material, and the anchor grout.

1. Anchorages shall be encased in a minimum 2 inch thick concrete or grout-filled cover, or be completely covered in a corrosion inhibiting compound.

2. Centralizers and spacers (multi-element tendon) shall be provided at maximum intervals of 10 feet with the deepest centralizer located within two foot of the end of the anchor and the upper centralizer for the bond zone located no more than 5 feet from the top of the tendon bond length. Centralizers shall be able to support the tendon in the drill hole and position the tendon so a minimum of 1 inch of grout cover is provided and shall permit grout to freely flow around the tendon and up the drill hole. Spacers shall be used to separate elements of a multi-element tendon and shall permit grout to freely flow around the tendon and up the drill hole.

3. The trumpet shall be sealed to the bearing plate and shall overlap the unbonded length corrosion protection by at least 4 inch. The trumpet shall be long enough to accommodate movements of the structure and the tendon during testing and stressing without damaging the encapsulation, regardless of type of tendon.

4. The trumpet shall be completely filled with grout, except restressable anchorages must use corrosion inhibiting compounds. Compounds may be placed any time during construction. Compound-filled trumpets shall have a permanent seal between the trumpet and the unbonded length corrosion protection. Grout must be placed after the ground anchor has been tested and stressed to the lock-off load. Trumpets filled with grout shall have either a temporary seal between the trumpet and the unbonded length corrosion protection or the trumpet shall fit tightly over the unbonded length corrosion protection for a minimum of 4 inch.

E) Coupler Protection:
The coupler and any adjacent exposed bar sections shall be covered with a corrosion-proof compound of wax-impregnated cloth tape. The coupler area shall be covered by a smooth plastic tube complying with the requirements set forth in this Specification, overlapping the adjacent sheathed tendon by at least 1 inch. The two joints shall be sealed each by a coated heat shrink sleeve of at least 6-inch length, or approved equal. The corrosion-proof compound shall completely fill the space inside the cover tube.

Heat shrinkable sleeves shall be fabricated from crosslinked polyolefin tube coated with an adhesive sealant. Prior to shrinking, the tube shall have a nominal wall thickness of 0.02 inches. The adhesive sealant shall have a nominal thickness of 0.02 inches.

Strand couplers are not permitted.

A minimum of 1 inch of grout cover over the encapsulation shall be provided.

Construction Methods:

1-Records

The Contractor shall compile the following report on an accepted form, for each anchor that is installed:

A) **As-built drawings** showing the location, elevations, and orientation of each ground anchor, anchor type, anchor capacity, tendon type, total anchor length, bond length, unbonded length, and tendon bond length.

B) **Drilling and grouting conditions** containing date of drilling and grouting, diameter of drill hole, drilling method, depth of stratum penetration, quantity of water entering the hole during grouting, groundwater elevation, grouting pressures and quantity injected.

C) **Testing requirements and results**, anchor test results and graphs, extended creep tests, and lock-off loads. Testing equipment shall include dial gauges, dial gauge support, jack and pressure gauge, electronic load cell, and a reaction frame.

The Contractor shall provide the Engineer with a copy of this report immediately after each anchor is tested and/or locked-off.

2-Tendon Storage and Handling:

Tendons shall be handled and stored in such a manner as to avoid damage or corrosion. Heavy corrosion or pitting, damage to the prestressing steel, the corrosion protection, and/or the epoxy coating shall be cause for rejection by the Engineer. Grounding of welding leads to the prestressing steel is forbidden. Prestressing steel exposed to excessive heat (i.e., more than 400^{o} F) shall be rejected.

Lifting of pre-grouted tendons shall be to manufacturers' recommendations and not cause excessive bending, which can debond the prestressing steel from the surrounding grout.

3-Drilling:
The Contractor shall be responsible for selecting drilling equipment and methods suitable to establish a stable hole of adequate dimensions, within the tolerances specified. Down-hole hammers are not permitted unless the Engineer provides **written** authorization.

Holes for anchors shall be drilled at the location [± 3 inches], orientation [± 3°inclination and/or lateral direction] and to the length as shown on the Contract Drawings, the approved Working Drawings or as directed by the Engineer. The Contractor is to select the diameter of the hole required to develop the specified pullout resistance. The drill bit or casing crown shall not be more than 1/8 inch smaller than the specified hole diameter. If caving ground is encountered the Contract is to adjust his drill method, including drilling fluid, use of drilling casing, etc..

4-Tendon Insertion:
The tendon shall be inserted into the drill hole at a rate that does not damage the sheathing, coating, and grout tubes; and shall not be driven or forced. When the tendon cannot be completely inserted, the Contractor shall remove the tendon from the drill hole and clean and/or redrill the hole to permit insertion. Strand tendons shall be straightened by hand during installation. The bottom end of the tendon may be fitted with a cap or bullnose to aid its insertion into the hole, casing, or sheathing.

5-Grouting:
The grouting equipment shall produce a uniformly mixed grout free of lumps and undispersed cement, and be capable of continuously agitating the grout. A positive displacement grout pump shall be used. The pump shall be equipped with a pressure gauge capable of measuring pressures of at least 145 Psi or twice the actual grout pressures used whichever is greater. The grouting equipment shall be sized to enable three times the theoretical grout volume to be placed in one continuous operation.

The grout shall be injected from the lowest point of the drill hole. The grout can be placed before or after insertion of the tendon. The quantity of the grout and the grout pressures shall be recorded. The grout pressures and grout takes shall be controlled to prevent excessive heave or fracturing. Grout will be placed by means of a tremie pipe from the bottom of the pile upward to avoid segregation. The grout will be placed immediately after the drill hole is cleaned to the satisfaction of the Engineer, and the steel reinforcing with centering devices is installed.

The grout at the top of the drill hole shall not contact the back of the structure or the bottom of the trumpet.

If the ground anchor is installed in a fine-grained soil using drill holes larger than 6” in diameter, then the grout above the top of the bond length shall be placed after the ground anchor has been tested and stressed. The Engineer will allow the Contractor to grout the entire drill hole at the same time if the Contractor can demonstrate that his particular ground anchor system does not derive a significant portion of its load-carrying capacity from the soil above the bond length portion of the ground anchor.

If grout protected tendons are used for ground anchors anchored in rock, then pressure grouting techniques shall be utilized. Pressure grouting requires that the drill hole be sealed and that the grout be injected until a minimum 50 Psi grout pressure (measured at the top of the drill hole) can be maintained on the grout for at least five (5) minutes.

The grout tube may remain in the hole on completion of grouting if the tube is filled with grout.

After grouting, the tendon shall not be loaded for a minimum of 3 days and the grout has achieved a minimum of 60% of the ultimate design strength.

5-Anchorage Installation:
The anchor bearing plate and the anchor head or nut shall be installed perpendicular [± 3°] to the tendon, centered on the bearing plate, without bending or kinking of the prestressing steel elements. Wedge holes and wedges shall be clean.

The stressing tail shall be cleaned and protected from damage until final testing and lock-off. After the anchor has been accepted by the Engineer, the stress tail shall be cut to its final length according to the tendon manufacture's recommendations.

The corrosion protection surrounding the unbonded length of the tendon shall extend up beyond the bottom seal of the trumpet or 4 inch into the trumpet if no trumpet seal is provided. The corrosion protection surrounding the unbonded length of the tendon shall not contact the bearing plate or the anchor head during testing and stressing.

STRESSING, LOAD TESTING AND ACCEPTANCE:
1 – General: Each ground anchor shall be tested. No load greater than ten (10) percent of the design load can be applied to the ground anchor prior to testing. The maximum test load shall be no less than 1.50 times the Service Design Load (SDL) for ground anchors designed to meet the requirements of the AREMA Manual for Railway Engineering, nor 1.00 times the Factored Design Load (FDL) for ground anchors designed to meet the requirements of the AASHTO LRFD Bridge Design Specifications. Loads shall not exceed 60 percent of the guaranteed ultimate tensile strength. The test load shall be simultaneously applied to the entire tendon. Stressing of single elements of multi-element tendons shall not be permitted.

2 – Stressing Equipment: The testing equipment shall consist of:
A dial gauge or vernier scale capable of measuring to the nearest 0.001 inch shall be used to measure the ground anchor movement. The movement-measuring device shall have a minimum travel equal to twice the theoretical elastic elongation of the total anchor length at the maximum test load and it shall have adequate travel so the ground anchor movement can be measured without resetting the device at an interim point.

A hydraulic jack and pump shall be used to apply the test load. The jack and a calibrated primary pressure gauge shall measure the applied load. Testing cannot commence until the Engineer has approved the calibration. The primary pressure gauge shall be graduated in 100 Psi increments or less. Stressing equipment shall be capable of stressing the whole tendon in one

stroke to the specified Test Load and the equipment shall be capable of stressing the tendon to the maximum specified Test Load within 75 percent of the rated capacity. The pump shall be capable of applying each load increment in less than 60 seconds.

The equipment shall permit the tendon to be stressed in increments so that the load in the tendon can be raised or lowered in accordance with the test specifications and allow the anchor to be lift-off tested to confirm the lock-off load.

A calibrated reference pressure gauge shall also be kept at the site to periodically check the production (i.e., primary pressure) gauge. The reference gauge shall be calibrated with the test jack and primary pressure gauge. The reference pressure gauge shall be stored indoors and not subjected to rough treatment.

The Contractor shall provide an electrical resistance load cell and readout to be used when performing an extended creep test.

The stressing equipment shall be placed over the ground anchor tendon in such a manner that the jack, bearing plates, load cells and stressing anchorage are axially aligned with the tendon and the tendon in centered within the equipment.

3 – Load Testing Setup:

A) Dial gauges shall bear on the pulling head of the jerk and their stems shall be coaxial with the tendon direction. The gauges shall be supported on an independent, fixed frame, which will not move as a result of stressing or other construction activities during the operation.

B) Prior to setting the dial gauges, an Alignment Load (AL) of no more than 5 % of design load shall be placed on the tendon.

C) Regripping of strands, which would cause overlapping wedge bites, or wedge bites on the tendon below the anchor head, shall be avoided.

D) Stressing and testing of multiple elements tendons with single element jacks is not permitted.

E) Stressing shall not begin before the grout has reached adequate strength.

4 – Performance Tests:

A) The number of ground anchors as shown on the plans or as directed by the Engineer shall be Performance Tested in accordance with the procedures described below. The Engineer shall select the ground anchors to be performance tested. The remaining ground anchors shall be tested in accordance with the proof test procedures (see Part 5).

B) The performance test shall be made by incrementally loading and unloading the ground anchor in accordance with the schedule provided. The load shall be raised from one increment to another immediately after recording the ground anchor movement. The ground anchor movement shall be measured and recorded to the nearest 0.001 inch with respect to an

independent fixed point at the alignment load and at each increment of load. The load shall be monitored with the primary pressure gauge. The reference pressure gauge shall be placed in series with the primary pressure gauge during each performance test. If the load determined by the reference pressure gauge and the load determined by the primary pressure gauge differ by more than ten (10) percent, the jack, the primary pressure gauge and the reference pressure gauge shall be recalibrated at no expense to the State. At load increments other than the maximum test load, the load shall be held just long enough to obtain the movement reading.

C) The maximum test load in a performance test shall be held for ten (10) minutes.

PERFORMANCE TEST SCHEDULE

Step	Load
1	AL
2	0.25SDL or 0.20FDL
3	AL
4	0.25SDL or 0.20FDL
5	0.50SDL or 0.40FDL
6	AL
7	0.25SDL or 0.20FDL
8	0.50SDL or 0.40FDL
9	0.75SDL or 0.60FDL
10	AL
11	0.25SDL or 0.20FDL
12	0.50SDL or 0.40FDL
13	0.75SDL or 0.60FDL
14	1.00SDL or 0.75FDL
15	AL
16	0.25SDL or 0.20FDL
17	0.50SDL or 0.40FDL
18	0.75SDL or 0.60FDL
19	1.00SDL or 0.75 FDL
20	1.20SDL or 0.90FDL
21	AL
22	0.25SDL or 0.20FDL
23	0.50SDL or 0.40FDL
24	0.75SDL or 0.60FDL
25	1.00SDL or 0.75FDL
26	1.20SDL or 0.90FDL
27	1.33SDL or 1.00FDL
28	HOLD FOR 10 MINUTES
29	AL
30	Adjust to lock-off load

D) The jack shall be adjusted as necessary in order to maintain a constant load. The load-hold period shall start as soon as the maximum test load is applied and the ground anchor movement, with respect to a fixed reference, shall be measured and recorded at 1 minute, 2, 3, 4, 5, 6 and 10 minutes. If the ground anchor movement between one (1) and ten (10) minutes exceeds 0.04 inch, the maximum test load shall be held for an additional 50 minutes. If the load-hold is extended, the ground anchor movement shall be recorded at 15 minutes, 20, 30, 40, 50 and 60 minutes.

5 - Proof Tests:

The proof test shall be performed by incrementally loading the ground anchor in accordance with the following schedule. The load shall be raised from one increment to another immediately after recording the ground anchor movement. The ground anchor movement shall be measured and recorded to the nearest 0.001 inch with respect to an independent fixed reference point at the alignment load and at each increment of load. The load shall be monitored with the primary pressure gauge. At load increments other than the maximum test load, the load shall be held just load enough to obtain the movement reading.

PROOF TEST SCHEDULE

Step	Load
1	AL
2	0.25SDL or 0.20FDL
3	0.50SDL or 0.40FDL
4	0.75SDL or 0.60FDL
5	1.00SDL or 0.75FDL
6	1.20SDL or 0.90FDL
7	1.33SDL or 1.00FDL
8	Reduce to lock-off load
9	AL (optional)
10	Adjust to lock-off load

The maximum test load in a proof test shall be held for ten (10) minutes. The jack shall be adjusted as necessary in order to maintain a constant load. The load-hold period shall start as soon as the maximum test load is applied and the ground anchor movement with respect to a fixed reference shall be measured and recorded at 1 minute, 2, 3, 4, 5, 6 and 10 minutes. If the ground anchor movement between one (1) and ten (10) minutes exceeds 0.04 inch, the maximum test load shall be held for and additional 50 minutes. If the load hold is extended, the ground anchor movements shall be recorded at 15 minutes, 20, 30, 40, 50 and 60 minutes.

6 – Extended Creep Tests:

A) Extended creep tests are not anticipated to be required. Should creep-susceptible soils be identified during construction, the item “Extended Creep Test for Ground Anchors” shall be added to the contract, and testing shall be conducted as follows. The Engineer shall select the ground anchors to be performance tested. The stressing equipment shall be capable of

measuring and maintaining the hydraulic pressure within 50 psi. A load cell shall be used to monitor small changes in load during constant load-hold periods.

B) The extended creep test shall be made by incrementally loading an unloading the ground anchor in accordance with the performance test schedule in Part 4. At the end of each loading cycle, the load shall be held constant for the observation period indicated in the extended creep test schedule below. The times for reading and recording the ground anchor movement during each observation period shall be 1 minute, 2, 3, 4, 5, 6, 10, 15, 20, 25, 30, 45, 60, 75, 90, 100, 120, 150, 180, 210, 240, 270 and 300 minutes as appropriate for the load increment. Each load-hold period shall start as soon as the test load is applied. In a creep test, the primary pressure gauge and reference pressure gauge will be used to measure the applied load and the load cell will be used to monitor small changes in load during constant load-hold periods. The jack shall be adjusted as necessary in order to maintain a constant load.

C) The Contractor shall plot the ground anchor movement and the residual movement measured in an extended creep test. The Contractor shall also plot the creep movement for each load hold as a function of the logarithm of time.

EXTENDED CREEP TEST SCHEDULE

Load	Observation Period (min.)
AL	
0.25SDL or 0.20FDL	10
0.50SDL or 0.40FDL	30
0.75SDL or 0.60FDL	30
1.00SDL or 0.75FDL	45
1.20SDL or 0.90FDL	60
1.33SDL or 1.00FDL	300

7 – Ground Anchor Acceptance Criteria:

A) A performance- tested or proof- tested ground anchor with a 10 minute load-hold shall be acceptable if the: (1) ground anchor resists the maximum test load with less than 0.04 inch of movement between 1 minute and 10 minutes; and (2) total elastic movement at the maximum test load exceeds 80 percent of the theoretical elastic elongation of the unbonded length.

B) A performance- tested or proof- tested ground anchor with a 60 minute load-hold shall be acceptable if the: (1) ground anchor resists the maximum test load with a creep rate that does not exceed 0.08 inch in the last log cycle of time; and (2) total elastic movement at the maximum test load exceeds 80 percent of the theoretical elastic elongation of the unbonded length.

C) A ground anchor subjected to extended creep testing is acceptable if the: (1) ground anchor resists the maximum test load with a creep rate that does not exceed 0.08 inch in the last log cycle of time; and (2) total elastic movement at the maximum test load exceeds 80 percent of the theoretical elastic elongation of the unbonded length.

D) The initial lift-off reading shall be within plus or minus five (5) percent of the designed lock-off Load. If this criterion is not met, then the tendon load shall be adjusted accordingly and the initial lift-off reading repeated.

8 - Procedures for Anchors Failing Acceptance Criteria:

A) Anchors that do not satisfy the minimum apparent free length criteria shall be either rejected and replaced at no additional cost to the State or locked off at not more than 50 percent of the maximum acceptable load attained.

B) Regroutable anchors which satisfy the minimum apparent free length criteria but which fail the extended creep test at the test load may be post-grouted and subjected to an enhanced creep criterion. This enhanced criterion requires a creep movement of not more than 0.04 inch between 1 minute and 60 minutes at test load. Anchors which satisfy the enhanced creep criterion shall be locked off at the design lock-off load. Anchors which cannot be post-grouted or regroutable anchors that do not satisfy the enhanced creep criterion shall either be rejected or locked off at 50% of the maximum acceptable test load attained.

C) In the event that an anchor fails, the contractor shall immediately modify the design and/or construction procedures. These modifications may include, but are not limited to, modifying the installation methods, reducing the anchor design load by increasing the number of anchors, increasing the anchor length, or changing the anchor type. Any modification of design or construction procedures, or increase in the number of anchors shall be at no cost to the State. A description of any proposed modifications must be submitted to the Engineer in writing. Proposed modifications shall not be implemented until the Contractor receives written approval from the Engineer.

9- Anchor Lock–Off:

A) After testing has been completed, the load in the tendon shall be such that after seating losses (i.e., wedge seating), the specified lock-off load has been applied to the anchor tendon. If no lock-off load is provided on the plans the lock-off load is to be between 75 and 100 percent of the Service Design Load for ground anchors designed to meet the requirements of the AREMA Manual for Railway Engineering, or between 55 and 75 percent of the Factored Design Load for ground anchors designed to meet the requirements of the AASHTO LRFD Bridge Design Specifications.

B) The wedges shall be seated at a minimum load of 50% ultimate load for tendon (Fpu). If the lock-off load is less than 50% Fpu, shims shall be used under the wedge plate and the wedges seated at 50% Fpu. The shims shall then be removed to reduce the load in the tendon to the desired lock-off load.

10- Anchor Lift-Off Test:

After transferring the load to the anchorage, and prior to removing the jack, a lift-off test shall be conducted to confirm the magnitude of the load in the anchor tendon. This load is determined by reapplying load to the tendon to lift off the wedge plate (or anchor nut) without unseating the

wedges (or turning the anchor nut). This moment represents zero time for any long time monitoring.

Method of Measurement: The quantity of ground anchors to be paid for will be the number of ground anchors installed and accepted. Should the Contractor elect to use an alternate number of ground anchors, the number of ground anchors to be paid for will not exceed that shown in the Contract Documents. The quantity of performance and extended creep tests to be paid for a maximum of once each per anchor location and this/these test(s) will only be the paid if the ground anchor is accepted.

Basis of Payment: The quantity of ground anchors as determined above will be paid for at the contract price per unit of measurement for the particular pay item listed below and shown in the bid schedule, which price and payment will be full compensation for the cost of furnishing all labor, equipment and material required to complete the work described in this section.

Payment will be made under:

Pay Item	Pay Unit
Ground Anchors	Each
Performance Test for Ground Anchors	Each
Proof Test for Ground Anchors	Each

ITEM NO. 507263A - TYPE "C" CATCH BASIN DOUBLE GRATE - TYPE II WITHOUT SUMP
ITEM NO. 507301A - TYPE "C" DROP INLET
ITEM NO. 507501A - TYPE "C-L" DROP INLET
ITEM NO. 507601A - MANHOLE
ITEM NO. 507687A - MANHOLE - 5' DIAMETER
ITEM NO. 507771A - RESET CATCH BASIN
ITEM NO. 507781A - RESET MANHOLE

The work shall conform to Section 5.07 supplemented as follows:

Article 5.07.01 – Description: add the following:

The work will include temporary shoring needed for excavations adjacent to the existing travel way. Temporary shoring will not be paid for separately but will be included in the cost of the work.

In areas of rock, rock will be removed by mechanical means only; no blasting is permitted unless approved by the Engineer.

In areas where incremental lowering is required to lower the roadway during off peak traffic periods and open the roadway full width during off work periods, resetting catch basins and manholes shall be reset to accommodate the incremental lowering as required so that the difference in the structure rim or grate elevation is no more than 3 inches above or below the roadway grade at the time the roadway is opened to traffic at the end of the work day. Reset catch basin and or manhole regardless of how many times they are needed to be reset shall be measured for payment one time.

The work shall also include the pipe connection to the existing pipe in I-95 required for the construction of the new RPW Catch Basins. Of the type of pipe required to match the existing condition. The work shall include the pipe and ant required fitting to perform the work.

Section 5.07.04 – Method of Measurement: is supplemented with the following:

There will be no measurement for resetting the structure to accommodate the incremental lowering for the roadway construction. Reset Catch basin and or Reset Manhole shall be measured one time. Incremental lowering to accommodate traffic and roadway grades shall be considered incidental to the work.

There will be no payment for the pipe required to connect Catch Basin to the existing pipe. This work will be paid as part of the Catch Basin Item for the type specified including the pipe and fitting.

Section 5.07.05 – Basis of Payment: is supplemented with the following:

There will be no separate payment for resetting catch basins and or manholes to accommodate the incremental lowering for the roadway construction. The work, materials and labor required to reset the structure, no matter how many times a structure requires resetting to accommodate the incremental lowering of the roadway shall be paid one time. Incremental lowering to accommodate traffic and roadway grades shall be considered incidental to the work.

There will be no payment for the pipe required to connect Catch Basin to the existing pipe. This work will be paid as part of the Catch Basin Item for the type specified including the pipe and fitting.

Pay Item	Pay Unit
TYPE "C" CATCH BASIN DOUBLE GRATE - TYPE II WITHOUT SUMP	Each
TYPE "C" DROP INLET	Each
TYPE "C-L" DROP INLET	Each
MANHOLE	Each
MANHOLE - 5' DIAMETER	Each
RESET CATCH BASIN	Each
RESET MANHOLE	Each

ITEM #0512016A – 8” HALF-ROUND STEEL DRAINAGE PIPE

Description: This work consists of fabricating and installing the railroad bridge deck drains as shown on the Plans. The deck drains consist of perforated half-round corrugated pipe sections with bottom pans to collect the water and collector troughs. The 4” diameter galvanized stubs are included in this item.

Materials: Sections of half-round galvanized corrugated metal pipe shall be fabricated from pipe that conforms to AASHTO M36 Type III with a minimum of 0.20 percent copper. The cutting of the corrugated metal pipe shall be by shearing or sawing. Flame cut edges will not be accepted. The pan for the half-round corrugated metal pipe shall be formed from galvanized iron or steel sheet that conforms to ASTM A444 with a minimum of 0.20 percent copper. The 4” diameter stub shall be made from the same material as the pan.

Miscellaneous structural steel required for the collector trough and 8” half-round steel drainage pipe shall be ASTM A709 Grade 36 galvanized in accordance with ASTM A123. Anchor bolts shall be ASTM A307 galvanized in accordance with ASTM A153.

Construction Methods: The deck drains shall be installed at the locations shown on the plans after the waterproofing and ballast mat is in place and before the ballast is placed.

Method of Measurement: 8” Half-Round Steel Drainage Pipe shall be measured for payment by the number of linear feet of 8” half-round drainage pipe and drain pan installed and accepted in the finished structure without measurement of attachments or supports.

Basis of Payment: This work shall be paid for at the contract unit price per linear foot for “8” Half-Round Steel Drainage Pipe” complete, accepted in place, which price shall include deck drains, supports, collectors and all materials, equipment, tools, and labor incidental thereto.

Pay Item	Pay Unit
8” Half-Round Steel Drainage Pipe	L.F

ITEM #0521021A - STEEL-LAMINATED ELASTOMERIC BEARINGS

Work under this item shall conform to the requirements of Section 5.21 amended as follows:

Description: Work of this section shall consist of furnishing and installing elastomeric bearing pads with internal steel laminae as shown on the Contract Drawings. The location, type and required load capacities of the bearings are shown on the Contract Drawings.

REFERENCES

Comply with the provisions of the following except as otherwise indicated:

A. AREMA Manual for Railway Engineering, Chapter 19, Section 1.6, "Elastomeric Bearings".

SUBMITTALS

A. Manufacturer's Data

Submit five (5) copies of producer's or manufacturer's specifications and installation instructions for the following products. Include laboratory test reports, certifications and other data as required to show compliance with these specifications.

1. Elastomeric (Neoprene) material (Durometer 60 min.), including certified copies of manufacturer's reports covering chemical and physical properties.

Materials:

A. Steel-Laminated Elastomeric Bearing.

1. Elastomer: The elastomeric compound used in the construction of a bearing shall contain only virgin chloroprene (Neoprene) as the raw polymer. The polymer shall not be less than 60 percent by volume of the total compound. No reclaimed rubber shall be used. The elastomeric compound shall be Type CR, Grade 3, as classified by ASTM D4014.

2. Laminae: Steel reinforcement for the elastomeric bearing shall be rolled from mild steel sheet conforming to ASTM A570, Grade 36 or 40, ASTM A611, Grade C or D, or an approved equal.

3. Manufacture: The steel-laminated elastomeric bearings shall be cast as a unit in a mold and bonded under heat. The molds shall have a standard shop practice finish.

The internal steel laminae shall be blasted and cleaned of all surface coatings, rust, and mill scale before bonding, and shall be free of sharp edges and burrs. It guide pins or other devices are used to control the side cover over the steel laminates, any exposed portions of the steel laminates shall be sealed by vulcanized patching.

Flash tolerance, finish and appearance of the finished bearings shall meet the requirements of the latest edition of the Rubber Handbook, published by the Rubber Manufacturer's Association, Inc., RMA F3 and T.063 for molded bearings.

All of the bearings shall be manufactured by the same company.

Steel-laminated bearings shall be built to the dimensions shown on the plans, and these specifications.

4. Fabrication:

    a. Fabricate and assemble structural assemblies in the shop.
    b. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence, which will expedite erection and minimize field handling of materials.
    c. Provide finish surfaces of members exposed in the final structure free of markings, burrs, and other defects.

5. Test Bearing: Three (3) test bearings shall be furnished to the Department for each size and type as indicated on the Contract Drawings, at no charge to the Department. The completed steel-laminated elastomeric bearing shall be subjected to the following tests:

Proof Load Test: All bearings shall be brought to a temperature of 73 degrees +/- 11 degrees Fahrenheit and tested at this temperature.

The manufacturer shall proof load each completed bearing with a compressive load equal to 1.5 times the maximum design load. The load shall be maintained while the bearing is inspected for visual faults. If bulging patterns imply laminate placement does not satisfy design criteria and manufacturing tolerance, or if bulging suggests poor laminate bond, the bearing shall be rejected. If there are three (3) separate surface cracks, which are greater than 0.8 inch wide and 0.08 inch deep, the bearing shall be rejected.

Compression Stiffness Tests: At random, a minimum of three (3) bearings shall be chosen from each lot for compressive stiffness testing. A lot consists of a single type of bearing, of the same design and manufactured from the same batch of elastomer, submitted for inspection at the same time. A batch of elastomer in the quantity of elastomer prepared and compounded at one time. If the number in the lot exceeds 50, or part thereof, one additional bearing shall be taken for testing.

All bearings shall be brought to a temperature of 73 degrees +/- 11 degrees Fahrenheit and tested at this temperature.

Load the bearing to the design load by increments of one fifth the design load. For each load increment, the loading time shall be within the range of 1.4 to 2.6 minutes. When the increment has been applied, the load or deflection (depending on the type of testing machine) shall be maintained constant for 30 seconds then the load and deflection measured. From a plot of load against

deflection, the compressive stiffness shall be determined as the slope of the best straight line through the points, ignoring the first point at zero load. Record the compressive stiffness for each bearing.

The compressive stiffness shall vary by no more than +/- 10% from the median value of all the bearings tested. For each bearing that fails to meet this requirement, two additional bearings shall be tested and shall meet the requirement or the lot shall be rejected.

If the lot is not rejected, the bearing median stiffness shall be subjected to the elastomeric material tests.

Elastomer Material Tests: The elastomer compound shall meet the requirement of ASTM D4014, Section 9.2-Elastomer Material Tests as amended as follows:

The elastomer shall have a Shore 'A' durometer hardness of 60 +/- 5 points as specified on the plans.

The shear modulus of the elastomer shall fall within the following limits:

Nominal Hardness (Shore 'A' Points)	Shear Modulus (psi)
60	120 to 160

The ozone test partial pressure shall be 100 millipascals (mpa).

Construction Methods:

Before fabricating any materials, the Contractor shall submit drawings to the Engineer for approval in accordance with Subarticle 1.05.03 (Shop Drawings). Theses drawings shall include, but not be limited to the following information: manufacturer's name, complete details of the bearings, material designations, nominal hardness of the elastomer and allowable shear modulus range, design load, the quantity of bearings required and the location of the bearing identification.

INSPECTION

Examine the areas and conditions under which the bearing installation is to be performed. Do not proceed with the work until unsatisfactory conditions have been corrected in an acceptable manner, as approved by the Engineer.

INSTALLATION

The bearings indicated on the Contract Drawings are shown for representative purposes. The Contractor may supply an alternate bearing design, subject to the approval of the Engineer. Alternate bearing designs shall be structurally equal in all respects to the representative bearings indicated.

The bearing area upon which the steel-laminated elastomeric bearings are to rest shall be carefully finished to a smooth, even level surface of the required elevation, and shall show no variations from a true plane greater than 1/16 of an inch over the entire area upon which the bearings are to rest.

The steel-laminated elastomeric bearings shall be installed when the temperature of the ambient air and the bearings is between 40 degrees to 80 degrees Fahrenheit and has been within this range for at least two (2) hours.

The bearings actually used shall be of such horizontal dimensions that each individual bearing will fit within the bridge seat or pedestal limits indicated on the Contract Drawings.

Vertical dimensions of the bearing may vary from those indicated on the Contract Drawings. However, the Contractor's submission shall indicate the adjustments to bridge seat, or to pedestal elevations necessary to maintain the established profile. Changes to the established profile will not be allowed. All approved adjustments to the bridge seat, or pedestal elevations will be done at no additional cost.

FIELD QUALITY CONTROL

Provide access for the Engineer to places where the bearings are being installed.

The Department reserves the right, at any time before final acceptance, to reject material not complying with specified requirements.

Correct deficiencies in the work, which inspections and laboratory test reports have indicated to be not in compliance with requirements. Perform additional tests as may be necessary to reconfirm any non-compliance of the original work, and as necessary to show compliance of corrected work.

Method of Measurement: This work will be paid for at the number of cubic inches of elastomer of "Steel-Laminated Elastomeric Bearings," which price shall include all equipment, tools, and labor incidental for completion.

Basis of Payment: This work will be paid for at the contract unit per cubic inch of "Steel-Laminated Elastomeric Bearings", complete in place, which price shall include all materials, testing, equipment, tools, and labor incidental thereto, including all costs of furnishing test bearings.

Pay Item	Pay Unit
Steel-Laminated Elastomeric Bearings	C.I.

ITEM #0522425A – POT, SPHERICAL OR DISC BEARINGS (600 KIPS)

NOTE: THIS SPECIAL PROVISION TO BE CONVERTED TO STANDARD UNITS.

Description:

The work covered by this specification shall consist of designing, furnishing, fabrication, and installation where called for on the plans, of high-load multi-rotational, spherical bearings, including sole, top, masonry, and auxiliary plates, in accordance with the plans and this specification. The high-load multi-rotational bearings may be of any type covered by this specification provided they are supplied by only one manufacturer.

Materials:

Steel: All steel, except steel for guide bars and shear-restriction pins and sleeves shall conform to the requirements of ASTM A709M, Grade 345W and for plates over 100mm thick ASTM A588. Guide bars and shear-restriction devices shall be as detailed by the manufacturer, unless otherwise specified.

Stainless steel sliding surfaces shall conform to the requirements of ASTM A167, Type 304 or A240, Type 304 with a #8 mirror surface finish. Welded stainless steel overlay shall be produced using Type 309L electrodes.

Elastomeric Disc (Pot Bearings): The elastomeric disc for pot bearings shall be a single piece of material comprised of either 100% virgin polyisoprene (natural rubber) or 100% virgin polychloroprene (neoprene) meeting the requirements of the Tables below:

Physical Property	ASTM Test Method	Requirements; Neoprene	Requirements; Natural Rubber
Durometer Hardness Shore A	D2240	50 ± 5	50 ± 5
Tensile Strength (minimum)	D412	15.5 MPa	15.5 MPa
Ultimate Elongation (minimum)	D412	400%	450%

Heat Resistance			
Change in Durometer Hardness (maximum)	D573	10 points	10 points
Change in Tensile Strength (maximum)	D573	- 15%	- 25%
Change in Ultimate	D573	- 40%	- 25%

Elongation (maximum)			

Low Temperature	ASTM Test Method	Requirements; Neoprene	Requirements; Natural Rubber
Brittleness at -40°C (Procedure B)	D476	No Failure	No Failure

Compression Set			
Permissible Set Maximum (%)	D395	35	25

OZONE			
	D1149	No Cracks	No Cracks

The ASTM test methods specified above shall be conducted in accordance with the following limits provided in Notes 1 through 3 indicated below:

Note 1. ASTM D573 Neoprene - Oven aging, 70 hours @ 100 °C
Natural Rubber - Oven aging, 70 hours @ 70 °C

Note 2. ASTM D395 Neoprene - Oven aging, 22 hours @ 100 °C
Natural Rubber - Oven aging, 22 hours @ 70 °C

Note 3. ASTM D1149 At 20% strain, 38 ± 1 °C; Mounting procedure D518
Neoprene - 100 hours using Procedure A
Natural Rubber - 48 hours using Procedure A

Elastomeric Disc (Disc Bearings): The elastomeric disc for disc bearings shall be Polyether Urethane conforming to the requirements of the Table below:

Physical Property	ASTM Test Method	Requirement		
Durometer Hardness - Shore D	D2240	45	55	65
Tensile Strength @ 100% Elongation @ 200% Elongation	 D412 D412	 10.3 MPa 19.3 MPa	 13.1 MPa 23.4 MPa	 15.8 MPa 27.6 MPa
Tensile Strength	D412	27.6 MPa	34.5 MPa	41.4 MPa
Ultimate Elongation (min.)	D412	350%	285%	220%
Compression Set (see Note 4)	D395	40%	40%	40%

Note 4. Oven aging, 22 hours @ 70 °C, (maximum)

Polytetraflouroethylene (PTFE): PTFE sliding surfaces shall be virgin PTFE resin filled or unfilled PTFE sheets or PTFE fabric. PTFE resin shall be virgin material (not reprocessed) meeting the requirements of ASTM D4894. Filler material, when used, shall be milled glass fibers, carbon, or other inert filler materials.

Unfilled PTFE sheet shall be made of virgin PTFE resin and shall be in accordance with ASTM D3293, Type III, Grade I, Class C.

Filled PTFE sheet shall be made from virgin PTFE resin uniformly blended with inert filler material conforming to the following requirements:

Property	ASTM Method	15% Glass Fibers	25% Carbon
Tensile Strength (minimum)	D4894	13.8 MPa	9.0 MPa
Elongation (minimum)	D4894	150%	75%
Specific Gravity (minimum)	D792	2.20 ± 0.03	2.10 ± 0.03
Melting Point	D4894	327 ± 10 ^{o}C	327 ± 10 ^{o}C

Fabric PTFE shall be made from virgin PTFE oriented monofilament and other fibers. The minimum thickness under the application of vertical load shall be:

1.6 mm up to a 24 MPa load
1.2 mm from 24 MPa to 41 MPa

Where the PTFE is to be epoxy bonded, the PTFE shall be etched by the sodium naphthalene or sodium ammonia etching process.

Sealing Ring: Sealing rings shall be made of brass, round in cross section, and shall conform to CDA 360 ASTM B 16.

Lubricant (Pot Bearing Disc): Lubricant for pot bearing discs shall be a silicone compound conforming to MIL-S-8660, or an equal approved by the Engineer.

Prefabricated Pads: Prefabricated pads shall be 4 mm thick and shall conform to the requirements of M.12.02-2.

High Strength Bolts: High strength bolts,where required, shall be ASTM A 325M and shall conform to the requirements of M.6.05.02-5.

Anchor Rods: Anchor rods shall conform to the requirements ASTM F1554 (Fy = 380 MPa), unless noted otherwise on the Plans. The anchor rods, nuts, washers, and couplers shall be galvanized in accordance with ASTM 123 and ASTM 153. Where couplers are required per the plans, they shall be fabricated such that the anchor bolt and anchor rod cannot be threaded past the midpoint of the coupler.

The contractor shall guarantee accurate positioning of the anchor rods by the use of a template. Anchor rods may be cast-in-place or formed and grouted in place.

Non-Shrink Grout: The non-shrink grout shall be a commercial, pre-packaged grout conforming to the requirements of M.03.01-12(a), and shall be flowable type capable of being pumped with a positive displacement pump through an opening 4 mm in diameter.

Non-Shrink Epoxy Grout: The non-shrink epoxy grout shall be a product from the following list:

- Five Star Epoxy Grout, by Five Star Products, Inc
- Mark-194 or Mark-198, by Poly-Carb, Inc.
- Pro-Poxy 100 LV, Pro-Poxy 200, Pro-Poxy 300, Pro-Poxy 300 FAST, Pro-Poxy 400, or Pro-Poxy 50 Super LV, by Unitex
- Sikadur 31, Sikadur 32, Sikadur 35, or Sikadur 42, by Sika Corporation
- SurePoxy HM, SurePoxy HMLV, or SurePoxy HM-SLV, by Kaufman Products, Inc.

Paint: Paint shall conform to the requirements of Contract special provision item "Structural Steel (Site No.)", or "Abrasive Blast Cleaning and Field Painting of Structure (Site No.)" as provided on the plans.

Material Certification: The Contractor shall provide a Certified Test Report and a Material Certificate for the following materials in accordance with the requirements of Article 1.06.07:

Elastomer disc
PTFE Sheets
High strength bolts
Anchor rods
Zinc silicate primer
Prefabricated Pads
Non-Shrink Grout
Non-Shrink Epoxy Grout

The Contractor shall provide a Materials Certificate for steel and lubricant for elastomeric discs (pot bearing) in accordance with requirements of Article 1.06.07.

Construction Methods:

Plans: Design calculations and detailed working drawings for the bearings shall be sealed by a Professional Engineer, licensed in the State of Connecticut, and submitted to the Engineer for review, in accordance with the requirements of Article 1.05.02. The drawings shall include, but not be limited to, the following:

A. Plan view and section elevations, providing all fabrication dimensions and required surface finishes.

B. All ASTM, AASHTO, and other material designations.

C. Vertical and horizontal load capacity; rotation and movement capacity.

D. A Schedule of all bearing offsets if required by the project.

E. Shop paint or coating requirements.

F. A warning note shall be inserted on all pot bearing shop plans or working drawings on which field welding is required that no welding current shall be permitted to pass between pot and piston components.

The design calculations shall be complete; verifying conformance of the bearing to provisions of this specification.

Design Parameters:

Notations: The symbols defined in the following notations are used in bearing design requirements presented subsequently in this specification:

DEFINITIONS

C	=	exterior vertical clearance in millimeters between stationary and moving bearing parts.
D_d	=	diameter in millimeters of elastomeric disc (disc bearing).
D_p	=	Diameter in millimeters of elastomeric disc; inside diameter in millimeters of pot.
D_s	=	projected diameter in millimeters of loaded spherical segment.
G	=	depth of pot bearing pot cavity in millimeters.
k	=	depth of chamfer in millimeters on pot bearing piston.
L_h	=	horizontal design load, in kilograms, on bearing.
L_v	=	vertical design load in kilograms, on bearing.
R_s	=	maximum design rotation of structure in radians, specified on the plans, but not less than 0.02 radians.
R_c	=	maximum construction tolerance rotation 0.005 radians unless otherwise specified on the plans.
R_b	=	minimum design rotation capacity of bearing in spherical surfaces.
R_{max}	=	maximum radius in millimeters to prevent unseating of spherical surfaces.
OD	=	Outside diameter in millimeters of round pot base or round disc base.
S	=	side (outside dimension) in millimeters of a square pot base or square disc base.
t	=	thickness in millimeters of elastomeric disc.
theta	=	arctan (Lh max/Lv min) radians.
W	=	piston face width in millimeters of pot bearing.
Delta C	=	compression deflection of elastomeric disc.

Bearing Proper = the components of the bearing that are between the girder flange and the bearing base.

General Requirements: Multi-Rotational bearings shall be designed to accommodate the loads, forces, and movements specified in the bearing schedule. Particular care shall be taken that all components of the bearings provide adequately for the horizontal loads and forces specified.

Maximum design stresses for all bearing components shall not exceed the allowable design stresses of the applicable issue of the AASHTO "Standard Specifications for Highway Bridges" and the applicable sections of this specification.

Minimum rotation capacity (R_b) shall be the sum of $R_s + R_c$.

Minimum horizontal load capacity for fixed and guided bearings shall be as specified on the contract plans but in no case less than 10% of the vertical dead load shown on the plans. Expansion bearings shall be designed for additional movement capacity, in each direction, beyond the design movement indicated on the plans. The additional movement capacity shall be 10% of the design movement or 25 mm, whichever is greater. Spacing between the guides of the bearing do not require this additional movement capacity.

Where shown on the plans, an auxiliary plate shall be provided for all bearings as noted in the specification herein. The auxiliary plate shall be designed to fit between the bearing proper and the masonry plate. The auxiliary plate shall be engaged with the bearing proper by means of a properly designed shop weld, or by a "saucer-like" machined recess to snugly fit the base of the bearing. The purpose of the auxiliary plate is the following:

to provide a means of field installation adjustment and sufficient horizontal restraint for the base of the bearing proper without a field weld directly to the bearing where access is often difficult

to simplify the future removal and replacement of the bearing assembly in the event maintenance is required

to reduce the possibility of heat damage to critical bearing components during field welding installation

Bearing shall be designed so that all rotational and sliding elements can be replaced with a minimum lifting not to exceed 13 mm.

All specified machined surface finish tolerances shall be verified using a calibrated profilometer provided by the Contractor and approved by the Engineer.

Overall bearing height if different from that shown on the contract plans shall be accompanied by the necessary adjustment in the bearing pad elevation. Overall bearing height shall

be not more than 5 mm greater than, or zero (0) millimeters less than detail dimension provided on the working drawings.

All finished bearing components shall be painted in accordance with the Contract special provision item for "Structural Steel (Site No.)", or "Abrasive Blast Cleaning and Painting of Structure (Site No.)", as provided on the plans, except for the following materials and surfaces: elastomer, stainless steel, PTFE, brass sealing ring, inside surfaces of pot bearing pot, and pot bearing piston in contact with elastomer.

Welding shall conform to the requirements of AWS D1.1 Structural Welding Code.

Pot Bearings:

The Pot: The pot shall be machined from a single solid piece of steel. The pot inside diameter (D_p) shall be the same as the elastomeric disc.

Depth of pot cavity (G) shall be as follows:

$G = Dp/2 \times (R_s + R_c) + 0.1 + K + (t + t_t) + W$, where;

K = 1.7 x the ring cross-section diameter for sealing rings where rings sit 100% in the chamfer

K = 1.2 x the ring cross-section diameter for sealing rings where rings sit half recessed in the elastomeric disc and half in the piston chamfer.

t_t = fabrication tolerance of elastomer

The section thickness of the pot beneath the elastomer shall be a minimum of 13 mm or $0.045 \times D_p$ for bearings on steel masonry plates.

The minimum outer plan dimensions of pots shall be determined by analyzing horizontal loads, internal elastomer pressure and piston force due to friction, shear, bending, and tension but the wall thickness shall in no case be less than 19 mm.

No coating shall be applied to the inside surface of the pot to be in contact with the elastomeric disc, except silicone lubricant required for the lubrication.

The underside of pots shall be machined to a tolerance equal to 0.0005 x outside pot dimension. Where an auxiliary plate with a machined recess is used, the underside of pots shall be circular in shape. Square pots shall be milled on the bottom surface to a circular shape equal in diameter to the pot width and to a minimum depth of 13 mm, to permit snug fit into the auxiliary plate.

Elastomeric Disc: Elastomeric discs shall have the following minimum thickness (t) where t = $(R_s + R_c) \times D_p / 0.3$. The disc shall be composed of no more than three separate layers, none of which may have a nominal thickness less than 13 mm.

The area of the elastomeric disc shall be designed for an average compressive stress not to exceed 24 MPa.

The disc shall be lubricated with a silicone compound conforming to the requirements of MIL-S-8660 or other approved equal.

Piston: The piston shall be machined from a single solid piece of steel. The outside diameter of the piston (at piston face width) shall be equal to D_p - 1.0 mm.

Piston thickness shall provide vertical clearance (C) between the rotating and non-rotating bearing parts no less than 3.2 mm at maximum rotation as follows:

Pots square in plan; $C = (R_b \times 0.7 \times S) + 0.03$
Pots round in plan; $C = (R_b \times OD/2) + 0.03$

When designing pistons for horizontal forces, piston face width (w) shall be designed assuming contact area with the pot wall to be one third of the circumference and maximum compressive stress of 0.8 x Fy, but not less than 4 mm.

Pistons shall have the lower corner chamfered at 45 degrees for a maximum depth equal to 1.7 times the diameter of the sealing ring where the seal will seat wholly within the piston thickness (above elastomeric disc), and 1.2 times the diameter where it extends into the elastomeric disc.

Sealing rings shall be round in cross section with an outside diameter of D_p. Sealing rings shall have a cross-sectional diameter not less than either $0.0175 \times D_p$ or 8 mm.

Rings shall be rolled into a circle from round rod and brazed or soldered to form a ring. The brazing or soldering process shall be adequate to fully develop the tensile strength of the rod. The ring shall fit the pot snugly (ANSI Class LC1, Standard Fit) so that it is in full contact with the pot wall and the top of the elastomer when installed. Tensile stress in the ring as a result of elongation at maximum bearing design rotation and maximum vertical and horizontal design loads shall not exceed 0.55 x Fy.

Silicone lubricant shall be applied to all surfaces in contact with the ring during assembly.

<u>Spherical Bearings:</u>

Spherical Elements: The radius of the spherical element concave PTFE surface shall be determined such that the resulting geometry of the bearing is capable of withstanding the greatest ratio of horizontal load to vertical load under all loading conditions to prevent unseating of the concave element.

Unseating of the curved surfaces relative to each other shall be prevented by transferring horizontal forces through specifically designed restraints or by control of the radius. Radius control shall satisfy the following requirement:

R_{max} = D_s / 2 sin (theta + R_s + R_c), where;

D_s = projected diameter of loaded spherical segment

theta = arctan (L_h max / L_v min) radius

Calculations showing the determination of the radius shall be submitted for review.

The projected area of woven fiber PTFE shall be designed for an average stress not to exceed 41 MPa. The concave surface shall face down whenever possible.

PTFE fabric in the free state shall be a minimum of 2 mm thick when measured in accordance with ASTM D1777. Minimum center thickness of spherical surfaces shall be 19 mm.

Design of bearing shall provide vertical clearance (C) between rotating and non-rotating bearing parts as follows:

Spherical bearings square in plan, C= (R_bx 0.7 x S) + 0.03 but not less than 3 mm

Spherical bearings round in plan, C= (R_bx OD/2) + 0.03 but not less than 3 mm

The convex element shall be designed for rotation (R_b), where R_b = R_s + R_c.

The edge thickness of the convex element shall be a minimum of 19 mm for bearings directly on concrete or 13 mm for bearings directly on steel.

The stainless surface shall be one of the following:

Stainless steel sheet (1.5 mm to 2.3 mm thick) ASTM A167, Type 304 or A240, Type 304 with a #8 mirror surface finish.

Solid stainless steel ASTM A240, Type 304 or 304L with a #8 mirror surface finish.

Stainless steel weld overlay a minimum of 2.4 mm thick with a #8 mirror surface finish.

<u>Disc Bearings:</u>

Elastomeric Disc: The elastomeric disc shall be designed so that its instantaneous deflection under total load does not exceed 10% of the thickness of the unstressed disc, and the additional deflection due to creep does not exceed 8% of the thickness of the unstressed disc.

It shall be held in place by a positive location device. The dimensions shall be such that hard contact between metal components, which prevents further displacement or rotation, will not occur under the least favorable combination of design displacements and rotations.

The average compressive stress due to the maximum design load on the disc shall not exceed 34.5 Mpa. If the outer surface is not vertical, the stress shall be computed using the smallest plan area of the disc.

Recesses in plates for discs shall have a tolerance of ± 0.76 mm for all diameters. Inside surfaces facing disc shall be commercial shot blast finished in accordance with SSPC SP-6.

Limiting Ring: A limiting ring may be provided by a welded ring, by machining a recess in the bearing plate, or by other limiting means. The depth of the limiting ring, if provided, shall be equal to or greater than D_d x 0.03. The inside diameter of the limiting ring shall be equal to D_d x 1.05.

Plate Beneath Disc: The section thickness of the plate beneath the disc shall be:

D_d x 0.06 for bearings directly on concrete,
D_d x 0.045 for bearings directly on steel masonry plates,
but in no case less than 19 mm on concrete and 13 mm on steel.

Vertical Clearance: Design of disc bearings shall provide vertical clearance, between rotating and non-rotating bearing parts no less than 3 mm at maximum rotation as follows:

Bearings square in plan,	$C = (R_b \times 0.7 \times S) + 0.03 + 2 \times \text{Delta C}$
Bearings round in plan,	$C = (R_b \times OD/2) + 0.03 + 2 \times \text{Delta C}$

Shear Mechanism: The shear restriction mechanism shall be designed to allow free rotation and withstand the specified horizontal forces. The mechanism shall be designed to withstand the design forces on the bearing without exceeding allowable shear of 0.33Fy, bending stress of 0.55Fy, and maximum bearing stress of 0.8Fy. Shear resistance of the disc shall not be included. The shear mechanism shall be connected to the bearing plates by welding, machining out of the solid unless otherwise approved by the Engineer.

Non-Rotational Bearing Elements:

PTFE: Sheet PTFE primary sliding surfaces filled or unfilled, shall be designed for an average stress not to exceed 24 MPa. The maximum edge stress shall be 34.5 MPa at maximum combined rotation, vertical, and horizontal load. The stresses on the PTFE for Disc Bearings shall not exceed 75% of these values.

Sheet PTFE sliding surfaces shall be bonded by the bearing manufacturer under controlled conditions and in accordance with the requirements of the manufacturer of the approved adhesive

system. After completion of bonding, the PTFE surface shall be smooth and free from bubbles. Filled PTFE surfaces shall be polished after bonding until smooth.

Sheet PTFE shall be a minimum of 3 mm thick, epoxy-bonded into a square-edge recess equal in depth to one half the thickness of the PTFE.

Fabric PTFE sliding surfaces shall be designed for an average stress not to exceed 41 MPa and, in the free state, shall be a minimum of 1.6 mm thick when measured in accordance with ASTM D1777.

Fabric PTFE shall be epoxy-bonded, or epoxy-bonded and mechanically fastened to the substrate using a system that prevents migration of epoxy through the fabric. Any edges, other than the selvedge shall be oversown or recessed so that no cut fabric edges are exposed.

Fabric PTFE sliding surfaces shall be suitably bonded to a rigid substrate.

The maximum coefficient of friction for PTFE sheet or fabric shall be equal to or less than the following:

PTFE Compressive Stress	Coefficient of Friction
3.45 MPa or less	0.08
3.45 to 13.80 MPa	0.06
13.80 MPa or more	0.04

Stainless Steel: The stainless steel surface shall cover the mating surface in all operating positions plus one inch in each direction of movement.

Sheet stainless steel shall be 12 to 16 gauge in thickness. It shall be connected to the substrate by a continuous weld around the entire perimeter. The sheet shall be in full contact with the substrate. Stainless steel sliding surfaces shall, preferably, be face down.

Stainless steel welded overlay shall be a minimum of 3 mm thick after welding, grinding and polishing and be produced using Type 309L electrodes.

Stainless steel sheet shall be seal-welded around the entire perimeter using techniques which ensure it remains in contact with the backing plate.

Guide Bars and Guide Keys: Central Guide keys may be made integral by machining from the solid. Where a separate key or guide bar is used they shall be fitted in a keyway slot machined to give a press fit and bolted or welded to resist overturning. Guide bars may be made integral by machining from the solid or fabricated from bars welded, bolted, and or recessed at the manufacturing option.

Guide bars and central guide keys shall be designed for the specified horizontal forces, but not for less than 10% of the vertical capacity of the bearing.

The sum of clearances between guided surfaces shall not exceed 3 mm. Net contact area between guiding surfaces must remain constant throughout all operating positions.

All guide bars and guide keys shall be self aligning and shall bear on elements of suitable size and strength to resist lateral forces indicated on the plans (i.e., guides in pot bearings must bear against piston components; guides in spherical bearings must bear against unfixed spherical components.)

Guiding directly between fixed bearing components shall not be permitted. Stainless steel and PTFE are required on guiding surfaces. The compressive stress on PTFE shall not exceed the following average bearing stresses:

	Unfilled PTFE	Filled PTFE
All loads except seismic loads	24 MPa	24 MPa

(PTFE on guiding surfaces need not be designed for seismic loading.)

Edge load pressure due to all loads and rotation (except seismic) shall not exceed 34.5 MPa for filled or unfilled PTFE.

PTFE on guiding surfaces shall be 5 mm minimum thickness, epoxy bonded into a square edged recess 2.5 mm deep in the substrate. In addition, the PTFE shall be mechanically fastened by a minimum of two screws into the substrate, located at a distance equal to twice the nominal screw diameter from the end of the PTFE strip. The top of the screws shall be recessed an amount not less than the minimum of one half the PTFE relief.

Travel Stops: Travel stops if detailed on the plans shall be capable of resisting the horizontal forces specified. The stops shall be set at 150% of the longitudinal movement or as directed on the plans.

Top Plate, Sole Plate, Auxiliary Plate, and Masonry Plate: Where top plates, sole plates, and masonry plates bear on concrete the concrete bearing stress on the loaded area shall not exceed the limits specified in the AASHTO Standard Specifications for Bridges, Section 8.15.

Top or sole plates shall be beveled where they bear on steel to such that the lower surface of the top plate is level in the transverse and longitudinal directions when the bridge is opened to traffic.

Special consideration shall be given to the design of top and sole plates (or plate to which sliding elements are attached) to assure that any bending forces imparted during field installation do not deflect the sliding surfaces. (The top or sole plate, for example, may be subject to extreme bending forces during a retrofit installation as a result of vertical load conditions prior to the completion of field welding.)

The top, sole, or masonry plates shall be shop welded to the bearing proper, unless otherwise noted on the plans. Auxiliary plates, where required, shall be located between the bearing proper and the masonry plate. The auxiliary plate shall be shop welded to the bearing proper, or shall have a "saucer-like" recess which shall snugly fit and restrain the bearing, and have adequate capacity to resist all required design forces. All field welds required for the anchoring of the lower bearing unit shall be limited to the interface between the masonry plate and auxiliary plate.

The top, sole, auxiliary, or masonry plates shall be designed for all required shear and bending forces in accordance with the AASHTO Standard Specifications for Bridges. If a recess is machined for the bearing or guide bars, it shall be not less than 13 mm in depth. The recessed surface on which the bearing proper will bear shall be machined to a tolerance equal to 0.0005 x the diameter or width or recess. The minimum thickness of the auxiliary plate after machining of the recess shall be 25 mm.

Unless otherwise approved by the Engineer, the auxiliary and sole plates shall extend a minimum of 25 mm beyond the plan limit of the pot (or lower spherical element); bearing travel stops; or other bearing components in all plan directions, to provide access for required field welds.

Fabrication Tolerances: The classes of tolerances are defined as follows:

Class A = 0.001 x nominal dimensions
Class B = 0.002 x nominal dimensions
Class C = 0.005 x nominal dimensions

Fabrication tolerances shall be in conformance with the following table:

Item	Thickness Tolerance (mm)	Dimension Tolerance (mm)	Flatness or out-of-round tolerance (mm)	Surface finish (mm) (rms.)
Pot Bearings				
Overall dimensions	-0.00, +6.35	-0.00, +3.17	---	---
Pot depth (inside)	---	-0.00, +0.64	---	---
Pot wall; thickness & ave. I.D.	-0.00, +3.17	-0.08, +0.08	-0.03, +0.03	0.8
Pot base; top & bot. surfaces	-0.00, +0.64	---	Class C	1.6
Piston; rim	-0.00, +1.60	-0.08, +0.08	-0.03, +0.03	0.8
Piston; top & bot. surfaces	-0.00, +0.64	---	Class C	1.6
Elastomeric disc (unstressed)	-0.00, +3.17	-1.60, +0.00	---	---
Disc Bearings				
Overall dimensions	-0.00, +6.35	-0.00, +3.17	---	---
Shear-restricting element	---	-0.00, +0.12	Class A	0.8
Other machined parts	-0.00, +1.60	-0.00, +1.60	Class B	1.6
Urethane disc	-0.00, +1.60	-0.00, +3.17	Class B	1.6

Flat PTFE Sliding Bearings				
PTFE	-0.00, +1.60	-0.00, +0.75	Class A	---
Stainless steel	-0.00, +1.60	-0.00, +3.17	Class A	0.2
Curved PTFE Sliding Bearings				
Convex radius	---	-0.25, +0.00	-0.05, +0.05	0.2
Concave radius	---	-0.00, +0.25	-0.05, +0.05	3.2
Guides				
Contact surface	---	-0.00, +3.17	Class A	0.8
Distance between guides	---	-0.00, +0.75	---	---
Parallism of guides (radians)	---	±0.005	---	---
Load Plates				
Overall dimensions	-1.60, +1.60	-6.35, +6.35	Class A	3.2
Bevel slope (radians)	±0.002	---	---	---

Load plate overall dimensions for flatness tolerance and surface finish shall apply only to the surfaces in contact with the bearing.

Testing:

General: Tests shall be performed on test bearings as specified below to ensure the requirements of the specification have been met. Bearings with capabilities that exceed the manufacturer's testing capacity shall be tested at an approved testing laboratory. If suitable test equipment is not available in the United States, alternative testing/inspection procedures will be agreed between the Department and the manufacturer.

Sampling: Tests shall be performed on randomly selected samples from the production bearings. One bearing per "lot" shall be tested. A lot shall be defined as the smallest number of bearings as determined by the following criteria:

One lot shall not exceed a single contract or project quantity. One lot shall not exceed 25 bearings.

A lot shall consist of those bearings of the same type within a "Load Category". Bearing types shall be fixed type bearings or expansion type bearings. Guided and non-guided expansion bearings will be considered a single type.

One load category shall consist of bearings of differing vertical load capacity within a load range as outlined below:

For bearings less than or equal to 5 MN capacity, the Load Category shall be based on a range of 2.5 MN.

For bearings greater than 5 MN capacity but less than or equal to 15 MN capacity, the Load Category shall be based on range of 5 MN.

For bearings in excess of 15 MN capacity the Load Category shall be based on a range of 10 MN.

Friction Test: A sample from each lot of expansion bearings shall be tested. Specially made bearings shall not be used; only actual bearings to be used in the project shall be tested.

The test method and equipment shall be approved by the Engineer and include the following requirements:

1. The test must be arranged so that the static coefficient of friction on the first movement of the manufactured bearing can be determined.

2. The bearing surface shall be cleaned prior to testing.

3. The test shall be conducted at the maximum working stress for the PTFE surface with the test load applied for 12 hours prior to measuring the friction.

4. The first movement static and dynamic coefficients of friction shall be determined at a sliding speed of 25 mm per minute or less and shall not exceed the coefficient of friction stated on the contract drawing.

5. The bearing specimen shall be subjected to a minimum of 100 movements of at least 25 mm of relative movement at a speed of less than 305 mm per minute. After cycling the static and dynamic coefficients of friction shall be determined again at a speed of less than one inch per minute and shall not exceed the coefficient of friction specified for the PTFE elsewhere in this special provision. The bearing shall show no visible sign of bond failure or other defects.

Proof Load Test: One bearing shall be tested from each production "lot" of fixed and expansion bearings. Except as noted in the subsequent paragraph, load shall be applied to the test bearings equal to 150% of the rated service level design capacity of the bearing simultaneously rotated 0.02 radians or the design rotation, whichever is greater, for one hour. During the test or subsequently upon disassembly, the bearing shall show no sign of deformation or extrusion of elastomer or PTFE.

Long-Term Deterioration Test: This test shall be performed on at least one expansion bearing, manufactured for the project, with a rated capacity of 1335 KN or higher. The test does not have to be performed if documentation is submitted demonstrating a Long-Term Deterioration Test has been successfully performed and accepted on another Connecticut Department of

Transportation project, for a bearing of equal or greater capacity, and of the same type and material properties to be supplied for the current project. The successful Long-Term Deterioration Test must have been completed within one year of the current project advertising date.

The Long-Term Deterioration Test shall be conducted as follows: The test bearing shall be loaded to the rated capacity and while loaded subjected to a rotational displacement of plus and minus 0.02 radians for a total of 5000 cycles. The test bearing while loaded to the rated capacity shall also be displaced through at least 1000 cycles with an amplitude of plus and minus 25mm at a rate no more than 250mm per minute, except when pressure readings are taken for calculation of the coefficient of friction at which time the sliding rate shall be 60mm per minute. The calculated coefficient of friction for the test bearing shall be included in the report. Close-up photographs of the complete bearing assembly and each of the primary components with before and after test shots shall be also be included. The following shall be a cause for rejection of the bearing: a) a coefficient of friction which exceeds the value used in the design, and b) damage visible to the naked eye upon disassembly of the bearing such as excessive wear with loss of material, or cracks or splits in the material.

PTFE Bond Test: Bearings with Sheet PTFE Primary Surfaces shall, at the option of the Engineer, have a 180 degree peel test performed on the primary PTFE sliding surface of a test specimen using the same adhesive and surface preparation procedures for bonding the Sheet PTFE as the actual bearings, in accordance with the ASTM D903 Test Method. Minimum peel strength shall be 3500 N/m. One bearing from each production lot shall be tested.

Bearings with Fabric PTFE Primary Sliding Surfaces shall have the primary PTFE tested in shear. One bearing from each production lot shall be tested as follows:

The component carrying the Fabric PTFE (or complete bearing at the option of the manufacturer) shall be subjected to the maximum vertical design load of the bearing and simultaneously but transversely, a load equal to 13% of the vertical design load for a period of one minute. Slip or creep shall not exceed 3.2 mm during the test.

Only bearings from lots from which test specimens have passed all the above requirements will be approved for use in the structure.

Shipping and Packing: Bearing assemblies shall be securely fixed together as units so that they may be shipped to the job site and stored without relative movement of the bearing parts or disassembly at any time. Bearings shall be wrapped in moisture resistant and dust resistant material to protect against shipping and job site conditions.

Care shall be taken to ensure that bearings at the job site are stored in a dry sheltered area free from dirt or dust until installation.

When bearings are to be inspected on site, they shall be inspected within one week of arrival and may not be disassembled except under the supervision of the manufacturer or his

representative or with the written approval of the manufacturer. Following inspection, the wrapping shall be reapplied and the bearings kept clean until installation.

Removal of top plates of bearings for separate attachment to the structure is not permitted except under the direct supervision of the manufacturer and by approval of the Engineer.

Installation: Bearings shall be evenly supported over their upper and lower surfaces under all erection and service conditions.

Bearings shall be lifted only by their underside or specially designed lifting lugs.

When installing bearings, extreme care shall be exercised to protect bearing surfaces from damage and contamination.

The bearing assembly shall be aligned with the superstructure as shown on the plans. On guided bearings, special care must be taken to properly align the guiding mechanism with the designated expansion direction of the structure as shown on the plans.

Bearing straps or retaining clamps shall be left in place as long as possible to ensure parts of bearings are not inadvertently displaced relative to each other. Care must be taken to remove straps or clamps before any normal structural movement takes place.

Offsets of upper and lower bearing parts shall be set as required by the plans to compensate for load deflection, temperature movement, and elastic shortening and creep of steel superstructure or of post-tensioned concrete superstructure as the case may be.

Bearings installed on a concrete substructure shall be installed over a preformed fabric pad, or shall bear upon non-shrink grout, as indicated on the plans.

Where bearings are installed over a prefabricated pad on a concrete bearing pad, the concrete bearing pad surface shall be prepared to the correct elevation and finished to the following flatness tolerance:

For bearings seats up to 80 mm in length or width ± 1.6 mm
For bearings seats over 80 mm but less than 115 mm ± 2.4 mm
Bearing seats over 115 mm ± 3.2 mm
There shall be no projecting irregularities exceeding 0.8 mm.
Bearings seats shall be level within 1:200 slopes.

Where bearings are installed with non-shrink grout, the masonry plate must be set to the proper elevation and leveled by adjusting the anchor bolt leveling nuts as shown on the plans.

The masonry plate shall be installed level to within 1:200 slopes. The anchor bolt protrusions above the masonry plate surface shall be cut off with the annulus filled with a silicone sealant. For masonry plates set on a grout pad, the flowable non-shrink grout must be placed at

even density beneath the entire masonry plate surface such that no voids are created. Grout shall reach a minimum compressive strength of 31 MPa before bearing loads shall be applied.

The mating surface with the superstructure shall be a plane surface to within a slope of 1:200.

Following alignment of the bearing components, top plate and auxiliary plate shall be field welded in position as shown on the plans. Welding procedures shall be established by the Contractor to restrict the maximum temperature of the bonded PTFE surfaces to 149 ^{o}C and maximum temperature of the elastomer (Polyether-urethane, Neoprene or Natural Rubber) to 121^{o}C. Temperatures shall be determined by temperature indicating wax pencils or other suitable means.

Welding current shall at no time be permitted to pass through the piston/pot assembly.

Particular care should be exercised to mask and protect the PTFE and polished stainless steel surfaces to protect them from blast abrasive and paint application during construction.

The Contractor shall repair any damage to bearing finishes following installation at no cost to the State as directed by the Engineer.

Bearings shall receive touch-up painting after installation as in accordance with other Contract special provision items addressing the painting of structural steel.

A continuous bead of silicone, 7 mm thick, shall be applied along the interface between auxiliary plate and the bearing proper following completion of painting where the bearing proper is retained by a recessed opening in the auxiliary plate.

Method of Measurement: This work will be measured for payment by the number of each pot, spherical or disc bearing of the load capacity indicated, fabricated, installed, and accepted.

Basis of Payment: This work will be paid for at the contract unit price for "Pot, Spherical or Disc Bearings (600 Kips)" of the load capacity indicated, complete in place, which price shall include the design, all materials, fabrication, testing (including extra bearings if required for testing), equipment and labor incidental thereto. It also shall include the installation, including the masonry plate, grout or pad, and all materials, tools and labor incidental thereto.

Anchor rods and hardware are included in the lump sum price for the applicable “Structural Steel (Site No.)” item.

ITEM #0601091A – SIMULATED STONE MASONRY

Description: This item shall consist of furnishing and installing textured, formed concrete surfaces using form liners designed to duplicate closely the appearance of natural stone as described herein of the type and size called for on the plans, including all accessories or hardware and color staining required in accordance with these specifications.

Materials:

1. Design and Pattern of Form Lined Concrete Surfaces: The design and pattern of form lined concrete surfaces shall follow the layout shown on the contract plans and as described herein. Final texture of cast stone concrete surfaces shall accurately simulate the appearance of real stone.

   The design pattern shall be as shown in the design plans.

2. Form Liner:

   a. Form liners shall be reusable elastomeric form liners, made of high-strength urethane and cutable form liners, made of lower grade urethane, easily attachable to forms. The form liners shall leave crisp, sharp definition of the architectural surface. The form liners shall not compress more than 1/4 inch when concrete is poured at a rate of ten vertical feet per hour. The form liners shall be removable without causing deterioration of surface or underlying concrete. The form liner shall conform to the pattern shown on the plans; no substitutions will be permitted.

   b. The form liner shall be designed to permit 180 degree rotation and interconnection with itself or another pattern liner of differing horizontal dimension. Maximum relief of pattern and the average relief shall be as shown on the contract plans. The simulated stone pattern shall vary in a random manner in the coursing parameters to prevent noticeable multiple duplicate pattern repetition and avoid stacked joints.

   c. In addition to orthogonal surfaces, the form liner shall be capable of forming curved and/or battered surfaces, if shown on the plans, while maintaining the dimensioned coursing and plumb vertical joints without distortion.

3. Release Agent: If a form release agent is used, it must be of a non-staining type. The release agent shall be compatible with the stone masonry architectural treated surface as recommended by the manufacturer.

4. Form Ties: Form ties shall be designed to separate at least one inch back from finished surface, leaving only a neat hole that can be plugged with patching material. The patching material shall be Tamms Speed-crete or equal mixed with latex or acrylic bonder, as approved by the manufacturer and Engineer.

5. Color Stain: Color stain shall replicate the color of the existing brownstone abutments at Bridge No. 08012R, Metro-North Railroad over Atlantic Street. Stain product shall be a penetrant capable of creating a surface finish that is breathable (allowing water vapor transmission), and that resists deterioration from water, alkali, fungi, sunlight and weathering. The stain shall be a waterborne, low V.O.C. material less than 180 grams/liter. In addition, the stain shall meet the following durability requirements:

   a. Weathering resistance - 2000 hours accelerated exposure in accordance with the 3-bulb test of ASTM G23

   b. Scrub test - 100 revolutions

   c. Abrasion resistance (Tabor CF-10) - 500 cycles

   d. Adhesion - 1.00 mm cross cuts on glass pass 3 or higher on a scale of 1 to 5 in accordance with ASTM D3359

   e. Chemical resistance - ASTM D1308.

Construction Methods:

1. Quality of Work: The process of form lining and texturing shall be performed in strict accordance with the manufacturer's written recommendations and as approved by the Engineer.

2. Quality Assurance:

   a. Manufacturer of the form liners shall have five years experience making custom simulated stone molds.

   b. Contractor/Subcontractor (installer) shall have five years experience pouring vertically formed architectural concrete. The installer shall be trained in the manufacturer's special techniques in order to achieve realistic surfaces.

   c. A Pre-installation Meeting shall be scheduled with the manufacturer's representative, installer, designer, and Department inspection personnel to assure understanding of simulated stone masonry use, requirements for construction of mockup, and to coordinate the work.

   d. It is the Contractor’s responsibility to assure that the texture of all finished, form lined cast-in-place and precast concrete surfaces meets the requirements of the plans and special provisions.

3. Shop Drawings and Submittals: Before fabricating any materials, the contractor shall submit shop drawings, product data sheets, samples and mock-ups to the Engineer for approval in accordance with Article 1.05.02 for the materials listed below. These drawings

and submittals shall include, but not be limited to, the following information: manufacturer's name, listing of product compliance with referenced specification standards, complete details of the assemblies, material designations, nominal hardness of appropriate materials, design loads, quantities and locations. The Engineer's drawings shall not be reproduced, traced or used for shop drawings or erection purposes.

4. Submittals:

   a. Catalog cuts, manufacturer's literature, and technical data for the materials specified herein, including but not limited to simulated stone mold pattern, form liner, release agent, concrete patching material and color stain.

   b. Photographs: Color photographs of three (3) similar past projects performed by the manufacturer. Include project names, locations and a telephone number of the previous project Owners' representatives.

   c. Samples: Form ties, sample and description, showing method of separation when forms are removed.

   d. Plan, elevation and details to show overall pattern, joint locations, form tie locations, and edge, end, corner and other special conditions.

5. Form Lined Concrete Mockup: The mockup shall be built on site at least four weeks before cast-in-place concrete work to be textured starts, using same materials, methods and work force that will be used for the project. Location on site for construction of mockup shall be as approved by Engineer. Concrete shall be placed in the mockup, texture constructed and construction procedure adjusted until a final texture is achieved that is acceptable to the Engineer.

   The mockup shall satisfy the following requirements:

   a. The size shall be 50 square feet, or larger if needed to adequately illustrate the pattern and texture selected.

   b. Include an area to demonstrate each of the following conditions:
      - a form liner butt joint,
      - inside and outside mitered corners,
      - continuation of the pattern through an expansion joint, and
      - a location where a form lined surface meets a smooth concrete surface.

   c. If the design includes stone texture across top of wall it shall be included in mockup.

   d. The mockup should demonstrate how the rectangular cut stone surface interfaces with an abutment pilaster and the bottom of the parapet. The workmanship shall include all required chamfers, rustications and expansion/butt joints as applicable.

e. After concrete work on the mockup is completed and cured, and after the surface is determined by the Engineer to be acceptable for forming and pouring, the contractor shall proceed using the mockup as a quality standard.

f. Color staining shall be demonstrated on the mockup. After the color and staining process are determined by the Engineer to be acceptable, the contractor shall proceed with color staining the form lined surfaces using the mockup as a reference and quality standard.

g. The contractor shall remove the mockup as directed by the Engineer.

6. Protection: The contractor is solely responsible for construction methods, means, techniques, and for construction site safety precautions. The contractor shall conduct all construction operations in conformance with all applicable local, state and federal safety laws, rules, regulations and codes. All Material Safety Data Sheets (MSDS) shall be available for inspection.

7. Liner to Form Attachment System: The form liners shall be securely attached to forms with wood or sheet metal screws; threaded inserts added to the back of the form liner for bolts to fasten the form liner through the forms, or bolted through the face of the form liner with flat head bolts inserted in a pattern joint and through the form liner and forming system. Construction adhesives may be used, but not on reusable forms. Place adjacent form liners with less than ¼-inch separation between form liners. The Contractor shall take care to minimize the differential thickness of adjacent form liner panels. It is required that the finished surface of the simulated 'grout joints' between adjacent panels be smooth and true as the 'joints' within a single panel. Differences in the finished surface at 'grout joints' between adjacent panels after the forms are removed shall be finished by the Contractor to the satisfaction of the Engineer. For additional requirements see 'Wall Patching and Preparation' below.

8. Release of Form Liners from Hardened Concrete: Only manufacturer recommended form release agents shall be utilized and shall be applied to the form liners before the concrete is poured. Release agents shall be applied in strict accordance with release agent manufacturer recommendations. Hand-charged sprayers will only be allowed if a thin uniform coating of release agent is obtained on the form liner.

9. Removal of Form Liners: The form liner shall be removed from the wall within 24 hours of pouring the concrete. The form liners may be detached from the forms and then removed from the concrete, or they may remain attached to the forms and the entire forming system removed from the concrete. Remove the form liners from the top, down. Curing of concrete may be accomplished with form liners and forms placed back against the wall after the initial detachment. Curing shall be performed in accordance with Article 6.01.03-19. Curing compounds shall not be used.

10. Care and Cleaning of Form Liner: Form liners shall be cleaned the same day they are removed from the wall with a power wash and mild detergent. Synthetic brushes with stiff

bristles may be used on stubborn areas. Mild acid washes may also be used. Solvents shall not be used. Cuts and tears in form liners shall be sealed and repaired before each use of the liners. If necessary, patching of holes shall be performed with 100% clear silicone caulk. Joints between form liners shall be cleaned before each use to remove any mortar in the joints. Form liners shall be stored inside or under a protective cover, in a vertical, upside-down position.

11. Wall Patching and Preparation: The Contractor is directed to the "Table of Finishes" in the Special Provision "Section 6.01 – Concrete for Structures" for specific requirements related to the type of finish that each of the concrete components shall receive. After form liners are removed from the hardened concrete, the textured surface shall be prepared. All holes larger than 3/4 inch in greatest principal dimension shall be filled with concrete patching material. All honeycombed areas shall be filled and textured to match surrounding areas. Seam lines and other unnatural protrusions shall be ground down to match adjacent areas with a hand-held power grinder using discs made for concrete. Grinding of seams shall be performed immediately after removal of the form liners. Perform final bush hammering to blend defects and ground areas into the final rock texture. In particular, the process of wall patching and preparation shall be subject to approval of the manufacturer and Engineer.

12. Simulated Stone Mold Preparation: The contractor shall clean and make free of buildup the form liners prior to each pour. He shall inspect for blemishes and tears and repair them if needed following manufacturer's recommendations.

13. Color Staining: Only form-lined surfaces shall be color stained. Surfaces to be stained shall be a minimum of 30 days old before color staining is applied. The Contractor shall power wash the concrete to free it from laitance, dirt, oil and other objectionable materials. Once the concrete has dried, the color staining process shall be applied using colors approved by the Engineer. Water-based stains shall be used in air temperatures ranging from 50 degrees F to 100 degrees F.

    All staining work shall be scheduled after significant adjacent earthwork has been completed to avoid contamination or damaging the surface.

Method of Measurement: This work shall be measured for payment by the actual number of square yards of the face area of accepted form lined concrete completed within the neat lines as shown on the plans, or as ordered by the Engineer.

Basis of Payment: All work under this item will be paid for at the contract unit price per square yard for "Simulated Stone Masonry", complete in place, which price shall include all equipment, formwork, molds, liners, caulk, patching material, color stains, tools and labor incidental thereto.

Pay Item	Pay Unit
Simulated Stone Masonry	s.y.

ITEM #0601980A – PRECAST CONCRETE PLATFORM-TYPE 1 (10’ WIDE)

6.01.01 Description: Work under this item shall consist of furnishing and erecting precast concrete platforms as shown on the plans, including all materials, tactile warning strips, plates, keeper plates, neoprene elastomeric pads, fasteners, anchors, guardrail anchors, rub rails, equipment, tools, and labor incidental thereto.

6.01.02 Materials: All materials for new platforms shall meet MTA Metro-North Railroad Station Standards including but not limited to the following:

1. Design shall conform to applicable state codes, ACI, ADA, ASTM and PCI and applicable industry standards.

2. Design live load shall be at least 150 psf (pounds per square foot).

3. A minimum compressive strength for all cast-in-place concrete shall be of 4,500 psi (pounds per square inch) at an age of 28 days. A minimum compressive strength for all precast concrete shall be 5,500 psi at an age of 28 days.

4. Cement shall conform to the requirements for either type II or Type IIA Portland Cement in accordance with ASTM C150. C3A content to be 8% maximum. Alkali content Na20+0.658 K20 less than 0.60%. Minimum cement content shall be 7.5 sacks/cubic yard.

5. Cast-in place for platform slabs and all precast concrete shall have 45 lbs./cy of microsilica added to the mix, for a total cementitious content of 720 lbs./cy. Microsilica admixture shall be Force 10,000, as manufactured by W.R. Grace & Co., or approved equal.

6. Concrete shall also contain DCI Corrosion inhibitor, as manufactured by W.R. Grace & Co., or approved equal. The dosage rate for the corrosion inhibitor shall be 3 gal./cy.

7. For cold weather applications, refer to the latest version of the State of Connecticut Department of Transportation’s Standards and Specifications.

8. Air-entraining admixtures shall be in accordance with ASTM 260 and ASTM C138.

9. Accelerating admixtures shall be in accordance with ASTM C494.

10. The tactile warning strip shall be a prefabricated detectable warning surface tile chosen from the Department’s Qualified Products List. The tile shall conform to the dimensions shown on the plans and have a solid homogeneous color throughout in compliance with MNR Standards or approved equal.

6.01.03 Construction Methods: All new concrete platforms shall be constructed to MTA Metro-North Railroad Station Standards including but not limited to the following:

The members shall be manufactured in accordance with the plans. Concrete shall be finished as follows: -Rough form finish in areas not exposed to view (backfilled areas) -Smooth finish in areas exposed to view (such as pier surfaces) -Broom finish shall be utilized on all walking surfaces and finished perpendicular to the normal walking

path to provide a wet-slip coefficient of 0.5 or greater. -All exposed edges of concrete elements shall have a 1 inch chamber, unless otherwise provided. -A 1 inch x 1 inch quarter round continuous parallel drip void shall be case into the underside edge of all platforms.

Concrete shall be reinforced as follows: -Reinforcing steel: ASTM A615, grade60, Hot-Dip Galvanized ASTM 767 (with supplementary requirements S1, S2, and S3, including Class 1 coating). -Welded wire fabric: ASTM A185, 4 x 4-7/7, Hot-Dip Galvanized ASTM 767 (with supplementary requirements S1, S2, and S3, including Class 1 coating).

New platform surfaces including the front vertical edge and the return to the drip notch under the platform edge shall be coated with a Silane sealer. After applying the Silane sealer, when the tactile warning strip is placed, the second coat shall also be applied over the front vertical edge, and to the drip notch under the platform edge. This product shall be a latex vinyl copolymer emulsion, and a factory apportioned catalyst with abrasion resistant aggregates and a Corrogard MCI.

The detectable warning strip shall be installed 4” from the edge of concrete platform along the full length of the platform as shown on the plans.

Shop Drawings: Before fabrication, the Contractor shall submit shop drawings to the Engineer for approval in accordance with Subarticle 1.05.02-3. These drawings shall include complete details of the methods, materials and equipment he proposes to use for the fabrication precast concrete.

Fabricator Qualifications: The precast concrete members shall be manufactured by a fabricator participating in the Prestressed Concrete Institute’s (PCI) Plant Certification Program and be designated a PCI Certified Plant.

Erection Drawings: The Contractor shall prepare and submit erection drawings, signed and sealed by a Connecticut registered Professional Engineer for the erection of the precast concrete platforms. The drawings shall describe all necessary temporary supports, including the sequence of installation. In addition, a description of the work methods, materials, and/or special equipment needed to complete the work of the section shall be provided.

6.01.04 Method of Measurement: This work will be measured for payment by the actual number of linear feet of precast concrete platform installed and accepted. Measurement will be made along the centerline of each member.

6.01.05 Basis of Payment: Payment for this work will be made at the contract unit price per linear foot for “Precast Concrete Platform-Type 1 (10’ Wide)”, as shown on the plans, completed and accepted, including all materials, plates, keeper plates, neoprene elastomeric pads, fasteners, anchors, guardrail anchors, rub rails, equipment, tools, and labor incidental thereto.

0601980A

ITEM #601919A - POLYMER MORTAR TOPPING

Description:

Work under this item shall consist of furnishing and applying a 2-component polymer mortar topping to surfaces of the platform extensions as shown on the plans.

Materials:

The polymer mortar topping shall be one of the following:

SIKATOP 122 manufactured by Sika Corporation
P.O. Box 297, Lynhurst, New Jersey 07071

TAPECRETTE manufactured by FRC Composites, Limited 1993 Leslie Street, Don Mils, Ontario, Canada and 419 Park Avenue South, New York, New York 10016

RENDEROCS manufactured by Fosroc- Preco
55 Skyline Drive, Plainview, New York 11803

or other approved equal polymer mortar produced by a manufacturer specializing for at least five (5) years in production of this material and who is able to submit a proof of at least ten (10) successful topping applications that have been subject to traffic and deicing chemicals for at least five (5) years and are performing satisfactory.

The polymer mortar topping shall not produce a vapor barrier and shall be thermally compatible with concrete.

Construction Methods:

Surface preparation, need of primer, mixing, applying and curing of the polymer concrete topping shall be done in strict accordance with the instructions supplied by the manufacturer of the polymer mortar.

The topping shall be applied no sooner than 7 days after casting of platforms.

The thickness of the topping shall be in accordance with the plans.

The polymer concrete topping shall have broom finish in the transverse direction. Sample of broom finish shall be submitted to the Engineer for approval.

The Contractor shall obtain the services of a Technical Advisor who is employed by the manufacturer of the polymer mortar to assist the Engineer and the Contractor during the work in connection with this Contract. This Advisor shall be a qualified representative, approved by the Engineer, and shall be at the work site prior to any mixing of components. The Advisor shall provide instructions in the proper mixing components, need of primer, and application of mortar. He shall remain at the job site until the Engineer is satisfied that the work crew has mastered the technique of applying the system successfully.

CAUTION: This material may cause skin irritation and should be used with caution in a manner recommended by the manufacturer.

Any damages sustained by the topping during shipment and openings or cavities needed for lifting devices shall be repaired in accordance with the Technical Advisor's instructions and to the satisfaction of the Engineer.

A Materials Certificate and a Certificate of Compliance shall be submitted in accordance with Article 1.06.07 for polymer mortar.

Method of Measurement:

The quantity to be paid for under this item shall be the number of square feet of topped surface in the completed and accepted work.

Basis of Payment:

This work will be paid for at the contract unit price per square foot for "Polymer Mortar Topping", complete in place, which price shall include surface preparation of the topped areas, services of the Technical Advisor, and all materials, equipment, tools, and all labor incidental thereto.

ITEM #601919A

ITEM #0602903A – DRILLING HOLES

DESCRIPTION: This work shall consist of core drilling through a concrete bridge parapet, wingwall or retaining wall at the locations as shown on the plans, and in accordance with this specification. The drilled hole shall be used to allow the passage of rigid metal conduit into an existing junction box.

MATERIALS: Mortar shall conform to the requirements of Article M.11.04.

CONSTRUCTION METHOD: The Contractor shall core drill through a concrete bridge parapet, wingwall or retaining wall at the locations as shown on the plans. The drilled hole shall have a diameter no larger than the minimum diameter required to accept the size conduit as specified on the plans. The Contractor shall avoid damaging existing reinforcing bars when drilling through the structure wall. The location of the existing re-bar shall be determined using a pachometer. Where a hole is drilled into the back of an existing junction box, the hole shall be cleaned and all loose dust removed prior to installation of the conduit. Once the conduit has been inserted through the drilled hole, the Contractor shall seal around the conduit using a silicon type sealant rated for outdoor use. Conduit shall be secured to the junction box using lock nuts, and shall be terminated with an insulated bonding bushing.

The drilling method used shall not cause spalling or other damage to the concrete. Concrete spalled or otherwise damaged by the Contractor's operations shall be repaired with mortar and finished flush to match the existing outside face of the parapet or wingwall.

METHOD OF MEASUREMENT: This work will be measured for payment by the actual number of holes drilled, complete and accepted.

BASIS OF PAYMENT: This work shall be paid for at the contract unit price each for "Drilling Holes" of the diameter and depth required, complete and accepted in place, which price shall include locating re-bar, drilling, sealing around conduit, mortar, and all material, tools, equipment, labor, and work incidental thereto.

Pay Item	Pay Unit
Drilling Holes	Each

ITEM #0603062A - STRUCTURAL STEEL (SITE NO. 2)

ITEM #0603063A - STRUCTURAL STEEL (SITE NO. 3)

Section 6.03 *is supplemented and amended as follows:*

6.03.01 - Description: *Append with the following:*
"Work under this item shall also include metallizing the structural steel, including surface preparation, the shop application of a thermal spray (metallizing) coating, the shop application of a sealer coat of urethane, and the field touch-up as shown on the plans, or as directed by the Engineer and in accordance with these provisions. All surfaces of fabricated structural steel are to be metallized prior to shipment for erection. All work shall be done in the shop unless otherwise noted."

6.03.02 – Materials: *Append with the following:*
"Metallizing materials for this work shall conform to the following:

1. The feedstock material used for metallizing must be one of the following: aluminum, zinc, 85/15 (Zn/Al) or 90/10 MMC.

2. The sealer coat to be applied over the metallizing is an acrylic urethane coating.

Abrasives:

1. Provide abrasives that are clean, dry, and sized properly to provide the surface profile required by this section.

2. Use abrasives that are acceptable to CDOT. Abrasives shall be hard and sharp in order to produce an angular surface profile. Acceptable abrasives include, but are not limited to, angular aluminum oxide, angular steel grit and angular crushed slag. Silica sand shall not be used. Steel shot and other abrasives that produce a rounded surface profile shall not be used.

3. Abrasives shall conform to the following:

- SSPC AB 1 for mineral slag abrasives
- SSPC AB 2 for recycled ferrous metal abrasives
- SSPC AB 3 for new steel abrasives

Coating Materials:

1. Thermal Spray Feedstock - Provide the type and quantity of thermal spray feedstock needed to metallize all carbon steel surfaces in the field and then seal those surfaces.

2. The zinc, aluminum, alloy or metal matrix composite (MMC) shall be manufactured for thermal arc spraying and shall have a chemical composition that meets the requirements that meets

ANSI/AWS A5.33, "Specification for Solid and Ceramic Wires and Ceramic Rods for Thermal Spraying".

3. The Contractor shall provide a certificate of the chemical composition of the feedstock from the feedstock supplier.

Urethane Sealer:

Provide the type and quantity of urethane sealer needed to seal all surfaces of the metallizing.

1. The seal coat shall be a urethane applied over all metallizing in accordance with the manufacturer's requirements. The products of Carboline Company and Sherwin Williams Company listed below are examples of the standard of quality to be achieved. Equivalent products of other manufacturers may be submitted to CDOT for consideration:

a) Carboline: Carbothane 134 HG,

b) Sherwin Williams: High Solid Polyurethane B65,

c) Or Approved Equal

2. Use a single manufacturer to supply all thermal spray feedstock, and a single manufacturer to supply the coating materials and including thinners, additives, and touch-up coatings. Do not co-mix coating products or components produced by different manufacturers under any circumstances.

3. Only use materials that are packaged and sealed, original, labeled containers bearing manufacturer's name, type of material, brand name, shelf life, batch number, and instruction for mixing and thinning.

Caulking Materials:

When caulking is required, provide 100% solids material that is recommended by the coating manufacturer."

6.03.03 – Construction Methods: *Append with the following:*
"Construction methods for metallizing shall conform to the following:

Workmanship Requirements: The General Contractor is responsible for coordinating the work to assure that the products of only one metallizing supplier and one sealer/paint manufacturer are utilized on the entire structure.

The Contractor(s) are required to implement and maintain programs and procedures which comply with the requirements of the specifications and all applicable Federal, state, and local OSHA and EPA standards and regulations. The Contractor is cautioned that it must comply with all applicable regulations even if the regulation is not specifically referenced herein. If a state or

local regulation is more restrictive than the requirements of this specification, the more restrictive requirements prevail.

Pre-Metallizing Meeting: A mandatory pre-metallizing meeting will be held prior to the beginning of any metallizing work. This meeting will be held separately from other general construction meetings for the overall project.

The following parties are required to attend this meeting: General Contractor, Metallizing Contractor, Coating Contractor, Thermal Spray Feedstock and Paint Manufacturer, Metallizing Equipment Manufacturer, Project Engineer, Paint Inspector, Test Laboratory, CDOT Personnel and other parties as deemed appropriate by the Engineer.

Reference Standards: The latest edition of the following standards and regulations form a part of this specification:

American Society for Testing and Materials (ASTM):

ASTM D1400, Standard Test Method for Non-Destructive Measurement of Dry Film Thickness of Non-Conductive Coatings Applied to a Non-ferrous Metal Base

ASTM D3359, Standard Test Methods for Measuring Adhesion by Tape Test

ASTM D4138, Standard Test Method for Measurement of Dry Paint Thickness of Protective Coating Systems by Destructive Means

ASTM D4285, Standard Test Method for Indicating Oil or Water in Compressed Air

ASTM D4414, Standard Practice for Measurement of Wet Film Thickness by Notch Gages

ASTM D4417, Standard Test Methods for field Measurement of Surface Profile of Blast Cleaned Steel

ASTM D4541, Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers

ASTM D 4940, Standard Test Method for Conductmetric Analysis of Water-Soluble Ionic Contamination of Blasting Abrasive

American Welding Society:

ANSI/AWS C2.18-93, Guide for the Protection of Steel with Thermal Sprayed Coatings of Aluminum and Zinc and Their Alloys and Composites

ANSI/AWS A5.33, “Specification for Solid and Ceramic Wires and Ceramic Rods for Thermal Spraying.”

Code of Federal Regulations (CFR):

29 CFR 1926, Occupational Safety and Health Regulations for the Construction Industry

29 CFR 1926.104, Safety Belts, Lifelines, and Lanyards

29 CFR 1926.105, Safety Nets

29 CFR 1926.451, Scaffolding

Society for Protective Coatings (SSPC):

SSPC-SP 1, Solvent Cleaning SSPC-SP 2, Hand Tool Cleaning SSPC-SP 3, Power Tool Cleaning
SSPC-SP 10, Near White Metal Blast Cleaning

SSPC-PA 2, Measurement of Dry Film Thickness with Magnetic Gages

SSPC-VIS 1, Visual Standard for Abrasive Blast Cleaned Steel

SSPC-VIS 3, Visual Standard for Hand and Power Tool Cleaned Steel

SSPC-AB1, Abrasive Specification No. 1

SSPC-AB2, Specification for Cleanliness of Recycled Ferrous Metal Abrasives

SSPC-AB4, Newly Manufactured or Re-Manufactured Steel Abrasives

SSPC-QP1, Standard Procedure for Evaluating Qualifications of Painting Contractors: Shop Applicators

SSPC-CS 23.00, Guide for Thermal Spray Metallic Coating Systems

Equipment and Metallizing Material and Coating Manufacturers' Published Instructions

Submittals: Submit the following plans and programs to CDOT for review and acceptance a minimum of fifteen (15) days prior to metallizing:

Surface Preparation/Metallizing and Sealing/Painting Plan: Provide written procedures for the preparation of surfaces and the application of the metallizing and the urethane sealer. Also include a procedure for the repair and touch up of any damage that occurs to the newly applied metallizing or coatings.

Provide a written QA/QC plan. Include quality control checkpoints for surface preparation, metallizing application, adhesion testing of metallizing application and coating thickness measurements.

Identify the metallizing and coating materials to be applied. Include manufacturer's name, product names, and product numbers. Provide Product Data Sheets, VOC levels for liquid coatings, MSD sheets, and written application instructions including mixing requirements, specified thinners, and thinner amounts for liquid coatings.

Identify the type and brand name of the abrasive proposed for use.

In the event of a conflict between the manufacturer's technical data and this section, this section will govern unless the manufacturer's requirements are more restrictive.

Identify the thermal spray equipment to be used to apply the feedstock.

Work Schedule: Provide a schedule for surface preparation, metallizing and sealing/painting. CDOT shall be notified a minimum of one week prior to starting work.

CDOT review and acceptance of Contractor submittals shall not be construed to imply approval of any particular method or sequence for conducting the work, or for addressing health and safety. Acceptance of the programs does not relieve the Contractor from the responsibility to conduct the work in strict accordance with the requirements of this section, or to adequately protect the health and safety of all workers involved in the project including any members of the public who may be affected by the project. The Contractor remains solely responsible for the adequacy and completeness of the programs and work practices and adherence to them.

Superintendence by the Metallizing and Painting Contractors: The Metallizing and Painting Contractors are responsible for supervising and directing the coating work efficiently using the best skills and attention, and are solely responsible for the means, methods, techniques, sequences, and procedures of construction.

Keep an experienced, competent, resident superintendent acceptable to CDOT on the project at all times. Do not replace the superintendent except under extraordinary circumstances, and only upon approval of the CDOT.

The superintendent is the Metallizing and Painting Contractors' representative and must have the authority to act on behalf of the Contractor. All communications given to the superintendents are binding upon the Contractor.

Contractor/Worker Qualifications:

1. The Metallizing Contractor/Painting Contractor shall be certified by the SSPC Painting Contractor Certification Program QP-3, entitled "Standard Procedure for Evaluating Qualifications of Shop Painting Contractors" in the enclosed shop category or hold an AISC Quality Certificate with a "Sophisticated Paint Endorsement." The

Metallizing Contractor/Painting Contractor shall be fully certified, including endorsements, for the duration of the time they are doing surface preparation and coating application.

2. The complete coating system shall be applied in an enclosed shop except for field touch-up painting which shall be applied after all bolts are fully tensioned and deck form work removed. The enclosed shop shall be a permanent facility with outside walls to grade and a roof where surface preparation and coating activities are normally conducted in an environment not subject to outdoor weather conditions and/or blowing dust.

3. All metallizing and coating work shall be performed by a Contractor with at least two years of experience performing metallizing of structural steel. Prior to the pre-metallizing meeting as per 1.02 A., the Contractor shall submit written documentation of at least three successful metallizing projects in the last three years. Information shall include the name of owner of each metallizing project, number and location of each job and year each job was completed. The Contractor shall possess knowledge and experience in all areas of the surface preparation and metallizing work. This documentation will be reviewed and verified by CDOT prior to beginning work on this project.

4. Each spray operator shall be qualified to metallize according to ANSI/AWS C2.18-93. Any operator who does not show evidence of qualification shall not be allowed to spray.

5. Technical Advisors: It is mandatory that the Contractor obtains the services of qualified technical advisors that represent the coating manufacturer, the thermal spray feedstock manufacturer, and the metallizing application equipment manufacturer. The Contractor shall make all necessary arrangements for technical advisor site visits. The technical advisors shall assist the Engineer and the Contractor in establishing the correct application methods for the metallizing and painting.

Surface Preparation, Thermal Spraying, and Painting Equipment:

1. Provide thermal spray metallizing, and surface preparation and painting equipment in accordance with the requirements of this section.

2. Use equipment and materials that are clean and sized properly to accomplish the work, including the required surface profile and finish as required by this section.

3. The thermal spray equipment shall be gas or electric arc equipment set up, calibrated, and operated in accordance with the manufacturer’s written instructions. Proper set up and functioning of equipment shall be verified by performing a bend test in accordance with "Pre-Production Test Sections", included under "Surface Preparation" below.

Personal Protective Equipment:

1. Provide all of the necessary personal protective equipment (PPE) for the project to assure that workers are protected from hazards during surface preparation, metallizing, coating application, and clean-up activities.

2. Furnish and have available to the Engineer, two new NIOSH/MESA approved thermal sprayair respirators and other safety equipment needed to permit the inspection of ongoing metallizing/coating work.
3. Repair or replace PPE as required to assure that it continues to provide its' intended purpose.

Surface Preparation:

1. Weld Spatter, Sharp Edges, and Holes:

Remove slag, flux deposits, and weld spatter and steel irregularities such as fins, tears and slivers. Grind any resulting burrs smooth, including burrs around holes.

All corners and edges shall be rounded to a 1/16-inch radius or chamfered to a 1/16-inch chamfer.

Flame cut edges shall be ground over their entire surface such that any hardened surface layer is removed, and subsequent abrasive blast cleaning produces the specified surface profile depth.

2. Pre-Surface Preparation Cleaning of Steel:

a) Prior to surface preparation, remove visible grease and oil, etc. from bridge surfaces in accordance with SSPC-SP 1 using only solvents or detergents acceptable to the coating manufacturer and CDOT. The use of pressurized water for this cleaning is also acceptable.

b) Use clean cloths for the final wiping.

3. Compressed Air Cleanliness:

a) Provide compressed air that is free from moisture and oil contamination.

b) Verify the cleanliness of the compressed air by the white blotter test in accordance with ASTM D4285 at least once per shift for each compressor system. Sufficient freedom from oil and moisture is confirmed if soiling or discoloration are not visible on the paper.

c) If air contamination is evident, change filters, clean traps, add moisture separators or filters, or make adjustments as necessary to achieve clean, dry air.

4. Ambient Conditions:

a) Do not conduct final surface preparation which exposes bare steel under damp environmental conditions or when the surface temperature is less than 5° F greater than the dew point temperature of the surrounding air.

5. Abrasives/Profile:

a) Use clean, dry, uniformly graded recyclable steel or disposable abrasives for blast cleaning that are free of oil, soluble salts and other similar substances that could contaminate the blast cleaned surface.

b) Provide abrasive that is sized to produce a sharp, angular, uniform surface profile height of 3.0 to 4.0 mils, unless the requirements of the metallizing products are otherwise. Measure the profile using the Keane-Tator Surface Profile Comparator or Testex Replica Tape in accordance with ASTM D4417.

6. Pre-Production Test Sections:

a) Prior to proceeding with production surface preparation operations, blast clean and metallize at least 9 square feet of steel surface.

b) Use the same metallizing equipment, set up, materials, and calibration and operating procedures in the test section(s) that will be used for the production operations.

c) Spray parameters should be set for spraying the submitted feedstock and at a minimum, be validated by passing a bend test as follows:

(1) Spray five carbon steel coupons with approximate dimensions of 2 x 4 to 8 x 0.050 inches. The surface of the coupons should be prepared to the same degree as specified for the project. Bolt, bracket or otherwise fasten the coupons to larger pieces of stock during the blast cleaning and metallizing operations.

(2) Spray metallizing 8 to 10 mils thick in a right angle cross hatch spray passes laying down approximately 3 to 4 mils per pass.

(3) Bend coupons 180 degrees around a 0.5 inch diameter mandrel.

(a) Bend test passes if there is no cracking or only minor cracking visually observed on the bend-radius.

(b) Bend test fails if the coating cracks and lifts from the substrate.

d) Metalographic analysis of additional coupons may be required by CDOT to establish the suitability of the surface preparation and the thermal spray coating. Supply, prepare, and thermal spray coat these panels using the same materials, equipment and process parameters for the contract work at no additional cost to CDOT.

e) Provide safe access for close visual inspection and testing.

f) Do not proceed with production surface preparation activities until CDOT agrees that the surfaces of the test section has been prepared to conform with the requirements.

Sealer/Paint and Metallizing Material Storage, Mixing, and Handling:

1. Sealer/Paint and Metallizing Material Storage:

a) Keep all containers unopened until required for use.

b) Store all sealer/paint, metallizing materials (i.e. feedstock wire), thinners, and solvents in accordance with OSHA regulations and the requirements of the manufacturer. Store the materials under cover, out of direct sunlight. Maintain the temperature between 40°F and
90°F, unless the requirements of the manufacturer are more restrictive.

c) Provide the size and number of fire extinguishers in proper proportion to the quantity of sealer/paint stored.

d) Do not permit smoking in sealer/paint storage, mixing, and application areas.

e) Do not open or mix sealer/paint in the storage area.

f) Do not return mixed sealer/paint to the storage area.

g) Bulk containers for solvents and thinners must be equipped with spring-loaded, self- closing, dispensing nozzles. Use Underwriter's Laboratories approved containers for transporting paint to mixing areas.

h) Use explosion-proof lighting fixtures.

i) Do not permit the accumulation of empty sealer/paint cans, combustibles, and other debris.

j) Maintain MSDS for all materials.

2. Mixing and Thinning of Sealer/Paint Materials:

a) Verify that the sealer/paint to be mixed has not exceeded its' shelf life. When required by the manufacturer, warm paints stored at less than 40°F to above 50°F prior to mixing.

b) Utilize proper ventilation in the mixing area to prevent injury to workmen or the accumulation of volatile gases.

c) Mix all sealer/paint coatings in accordance with the requirements of the coating manufacturer.

d) Mix only complete kits of material. Mixing of partial kits is not allowed.

e) Do not use two component materials beyond the pot life established by the manufacturer's written instructions.

f) Thin sealer/paint in strict accordance with the coating manufacturer's written instructions. Use only those types, brands, and amounts of thinner recommended by the coating manufacturer. Limit the thinning to the minimum amount necessary to facilitate application except for the mist coat of urethane sealer applied over metallizing. Unless directed otherwise by the coating manufacturer, thin the sealer coating approximately 25% and first apply as a mist coat to seal the surface. When the mist coat has penetrated the metallizing, follow with the full coat with proper thinning.

Coating Application:

1. Quality of Surface Preparation:

a) Verify that the surface exhibits the specified SSPC-SP10 degree of cleaning immediately prior to metallizing.

b) Apply the metallizing on the same work shift that cleaned the steel to bare metal. If bare steel is allowed to remain uncoated for more than six hours, or re-rusting is evident, reclean the surface prior to metallizing.

2. Surface Cleanliness – Thoroughly clean the surface of each coat prior to the application of the next to remove overspray, spent abrasive, dirt, dust, and other interference material.

3. Grease/Oil – If grease or oil have become deposited on the bare steel or on the surface of any of the applied coats, remove by solvent cleaning in accordance with SSPC-SP1 prior to the application of the next coat.

4. Ambient Conditions – Apply metallizing and sealer/paint under the following conditions unless the requirements of the coating manufacturer are more restrictive:

a) Surface and Air Temperatures – between 40°F and 110°F

b) Relative Humidity – Less than 85%.

c) Dew Point – Surface temperature at least 5°F above the dew point temperature of the sur- rounding air.

d) Frost/Rain – Do not apply coatings to surfaces containing frost or during rain, fog, or similar conditions.

e) Remove and replace any paint that is exposed to unacceptable conditions (e.g. rain or dew) prior to adequate curing.

5. Metallizing Application:

a) The coating shall be applied in a neat and workmanlike manner, shall be applied uniformly, and shall be free of ridges or other defects. The coating shall be applied by thermal spray employing multiple passes to achieve a thickness of 0.008 to 0.010 inches (8-10 mils). No single pass shall deposit more than 0.004 inches. Proper spray equipment set up, calibration, and operating procedures shall be verified by passing a bend test at the beginning of each work shift that metallizing is to be applied. Perform this bend test in accordance with Part 3.02 F.3 of this section.

b) In addition to the bend test, a cut test shall be performed once per every two hours that metallizing is being applied. The cut test consists of a single cut 1.5 inches long through the thermal spray coating to the substrate without severely cutting the substrate. A cut shall be made with a hammer and sharp chisel. The chisel cut should be made at a shallow angle. The bond of the metallizing is considered unsatisfactory if any part of the metallizing lifts from the substrate along the cut.

c) Spraying shall be performed in a block pattern, typically 2 square feet or as per the equipment manufacturer's written recommendation. Overlapping spray passes to ensure uniform coverage, and produce the required thickness and uniformity. A minimum of two passes are required, overlapping and at right angles to each other. The gun shall be held at such a distance from the work surfaces so that the metal is still plastic on impact, typically 5 to 8 inches from the surface. The coating shall be firmly adherent and free from uncoated spots, lumps or blisters, and have a fine-sprayed texture.

d) Special care shall be exercised to avoid contamination of surrounding areas or property by over spraying. Containment tarps should be used when spray application is performed.

e) The work area shall be properly ventilated to assure proper worker protection.

6. Metallizing Adhesion – Adhesion strength of the metallizing shall be 700 psi minimum as measured with approved equipment as per ASTM D4541 using apparatus under Annex A4. All adhesion test locations shall be re-metallized in accordance with this specification at no additional cost. Measurements shall be taken every 500 square feet. If adhesion is less than

700 psi but greater than 560 psi, four additional adhesion tests shall be made. If any of the additional adhesion tests are less than 700 psi, the coating shall be removed and re-applied at the Contractor's expense. Any adhesion test result less than 560 psi, will be grounds for the Contractor to remove the entire coating at their expense.

7. Sealer/Paint Application:

   a) Apply all sealer/paint by the methods shown below unless the methods recommended by the sealer/paint manufacturer are more restrictive. Apply the sealer/paint to all previously metallized surfaces. Do not allow the metallized surface to stand for longer than 8 hours before application of the seal coat, and in no cases shall the seal coat be applied over visible oxidation of the metallizing.

   b) Apply the sealer/paint in a two-coat operation, a mist coat and a full coat. Thin the mist coat up to the manufacturers written maximum amount using the recommended thinner in order to penetrate the metallizing layer. Apply the full finish sealer/paint coat without thinning.

   c) Airless or conventional spray application – If conventional spray is used, verify that the compressed air supply is clean and dry as determined by the blotter test. When spraying, use extreme care to avoid contamination of surrounding areas or property by overspray.

   d) Brush or roller application – Brushes or rollers may be used to control overspray, or for localized application such as touch-up, in areas of limited accessibility for spraying, or for stripe coating.

8. Recoat Times For Liquid Coatings:

   a) Apply each coat only after the previous coat has been allowed to dry as required by the manufacturer's written instructions, but as soon as possible to minimize the length of time that the coating is exposed to dust and contamination.

   b) Do not allow any coat to remain exposed for longer than fourteen (14) calendar days prior to overcoating.

9. Coverage and Continuity:

   a) Apply each coat to assure thorough wetting of the substrate or underlying coat, and to achieve a smooth, streamline surface relatively free of dryspray, overspray, and orange peel. Shadow-through, pinholes, bubbles, skips, misses, lap marks between applications, or other visible discontinuities in any coat are unacceptable. Runs or sags in liquid coatings may be brushed out while the material remains wet. If the discontinuities remain in the film after drying, remove and replace the defective coating as described later in the "Repair" section of this specification.

b) Thoroughly coat all surfaces with special attention to hard-to-reach areas, and irregular surfaces. Some configurations may require spraying from multiple directions to assure complete coverage.

10. Tint – Tint successive coats (if approved by the manufacturer), or use materials of sufficiently different color to facilitate proper coverage and to provide a visual distinction between coats.

11. Sealer/Paint Adhesion:

a) Apply sealer/paint in such a manner to assure that they are well-adherent to each other and to the underlying surface. If the application of any coat causes lifting of an underlying coat, or there is poor adhesion between coats or to the substrate, remove the coating in the affected area to adjacent sound, adherent, coating, and reapply the material.

b) If sealer/paint adhesion is suspect, conduct adhesion tests in accordance with ASTM D3359 or ASTM D4541 as directed by CDOT and repair all test areas. The acceptance criteria for the testing will be established by CDOT and the coating manufacturer. Replace all defective coating that is revealed by the testing.

12. Wet Film Thickness – Use wet film thickness gages in accordance with ASTM D4414 to verify the thickness of each liquid coat at the time of application.

13. Dry Film Thickness:

a) Apply each coat to the thicknesses specified below:

(1) Metallizing 8 to 10 mils

(2) Urethane Sealer 2 to 4 mils

Total System = 10 to 14 mils

b) Measure the thickness of each coat using nondestructive magnetic dry film thickness gages. Comply with SSPC-PA2 for the calibration and use of the gages, and the frequency of thickness measurements. Spot readings both 20% above and 20% below the thicknesses shown above are permitted, provided the average thicknesses are within the specified tolerances.

c) If there are questions regarding the non-destructive measurements of coating thickness, a Tooke Gage (destructive scratch gage) may be used when authorized by CDOT. Conduct measurements in accordance with ASTM D4138, but limit its

use to a minimum of locations. Mark and repair all damage caused by the destructive testing, whether created by CDOT or the Contractor.

d) Apply additional coating to areas of insufficient thickness with care to assure that all repairs blend in with the surrounding material.

e) Unless directed otherwise by CDOT, remove excessive coating thickness and reapply the affected coat(s).

Repair of Film Discontinuities and Damage to Coating System after Erection:

1. Surface Preparation of Film Discontinuities or Damage:

   a) Remove localized film discontinuities (e.g., runs, sags, shadow-through, etc.) or damage and corrosion by solvent cleaning in accordance with SSPC-SP 1 followed by sanding or power tool cleaning.

   b) In damaged metallized areas, if the repair operation exposes the substrate, remove all loose material, prepare the steel in accordance with SSPC-SP 5, and achieve a uniform and dense surface profile of 2 to 4 mils.

   c) If the substrate is not exposed, remove all loose material and prepare the surface in accordance with SSPC-SP 3.

2. Feathering of Repair Areas:

   a) Feather the existing material surrounding each repair location. Feather for a distance of 1 to 2 inches to provide a smooth, tapered transition into the existing intact coating.

   b) Verify that the edges of coating around the periphery of the prepared areas are tight and intact by probing with a putty knife in accordance with the requirements of SSPC-SP3. Roughen the existing coating in the feathered area to assure proper adhesion of the repair coats.

3. Coating Application:

   a) When the bare substrate is exposed in the repaired area, apply the metallizing and urethane sealer/paint.

   b) When the repair does not extend to the bare substrate, apply only the seal coats.

   c) Maintain the thickness of the system in overlap areas within the specified total thickness tolerances.

Inspection:

1. CDOT may inspect any or all phases of the Work to verify that it is in accordance with the requirements of this section. Facilitate this inspection as required, including allowing ample time for the inspections and access to the work. Inspections may include, but are not limited to, surface preparation, pre-painting cleanliness, paint application, dry film thickness, film appearance and continuity, and adhesion.

2. The presence or activity of CDOT inspections in no way relieves the Contractor of the responsibility to comply with all requirements of this Section and to provide adequate inspections of its' own.

3. Furnish, until final acceptance of the coating system, all equipment and instrumentation needed to inspect all phases of the work.

One-Year Anniversary Inspection:

1. A one-year anniversary inspection will be conducted approximately twelve months after the structure has been erected. Provide for all aspects of this inspection (i.e. access, rigging, safety traffic control, etc.) and participate in this inspection with CDOT. All at no additional cost to CDOT.

2. Repair, at no cost to CDOT, all locations where the coating exhibits disbonding, cracking, rusting, or other such defects. Perform all repairs in accordance with this Section and the coating manufacturer's written instructions.

6.03.05 – Basis of Payment: *Add the following at the end of the second paragraph:*

"Payment for new structural steel, complete in place, shall also include shop metallizing, all field touch-up and corrective or repair field metallizing, QC Inspector(s), QC Log Book(s) and testing equipment, technical advisor, equipment, tools and labor incidental thereto."

ITEM #0603064A - STRUCTURAL STEEL (SITE NO. 4)

Section 6.03 *is supplemented and amended as follows:*

6.03.01 - Description: *After the third paragraph, add the following:*
"This special provision provides additional requirements for the surface preparation, shop painting, and field touch-up painting of new structural steel."

6.03.02 – Materials: *After the second paragraph, add the following:*
"Painting materials for this work shall conform to the following:

- The Contractor shall select a three-coat system from the qualified product List A or B, issued by the Northeast Protective Coating Committee (NEPCOAT). The approved NEPCOAT listings may be found at the NEPCOAT website at http://www.nepcoat.org/
- Note: The List B Carboline Company system that specifies Carboguard 888 is not eligible for use under this special provision at this time.
- The system chosen shall have a prime coat that has achieved a Class 'B' slip coefficient for faying surfaces. Top coat paint color shall be as noted on the plans.
- Both the shop painted and field touchup applied coating systems shall be of the same three-coat system. A compatible organic zinc rich primer shall be used for any necessary field touch up.
- The same coating material manufacturer shall furnish all materials for the complete coating system. Intermixing of materials within and between coating systems will not be permitted.
- Thinning of paint shall conform to the manufacturer's written instructions."

6.03.03 – Construction Methods: *Revise* Subarticle 4(f) "Field Erection - High Strength Bolted Connections" *as follows:*

Replace the first sentence of the fourth paragraph "Surface Conditions: At the time of assembly … other foreign material." *with the following:*
"Connection faying surfaces within portions of structural steel designated to be painted shall receive a single coat of primer in accordance with requirements stipulated elsewhere in this special provision."

Delete the fifth paragraph of Subarticle 4(f) *and the three bulleted paragraphs after it:* "Paint is permitted on … wire brushing is not permitted."

After the last paragraph of Article 6.03.03, *before* Tables A through C, *add the following:*
"The painting application shall be done in compliance with the following requirements:

Qualifications of Shop Painting Firm: All shop painting of structural steel must be performed by and in an enclosed shop that is certified by the SSPC Painting Contractor Certification Program QP-3, entitled "Standard Procedure for Evaluating Qualifications of Shop Painting Contractors" in the enclosed shop category or by a shop that holds an AISC Quality Certificate with a "Sophisticated Paint Endorsement" in the enclosed shop category. The firm shall be fully

certified, including endorsements, for the duration of the surface preparation and coating application. A copy of the subject certification shall be provided to the Engineer prior to commencing any surface preparation or coating application.

The shop painting firm is required to have at least one (1) **Coating Application Specialist (CAS) (SSPC ACS/NACE No. 13)**-certified (Level II-Interim Status-Minimal) craft-worker. CAS-certified (Level II-Interim Status-Minimal) craft-worker(s) are required for all crews/craft-workers up to four (4) crew members. For each crew larger than four (4), an additional CAS-certified (Level II-Interim Status-Minimal) craft-worker shall be present on each painting/blasting crew during blast cleaning and spray application (Atmospheric and Immersion Service) operations. A crew-member is a person who is on the job performing hand-held nozzle blast cleaning and/or spray application of protective coatings on a steel structure. The certification(s) must be kept current for the duration of the Project work.

The complete coating system shall be applied in an enclosed shop except for field touch-up painting which shall be applied after all bolts are fully tensioned and deck formwork removed. The enclosed shop shall be a permanent facility with outside walls to grade and a roof where surface preparation and coating activities are normally conducted in an environment not subject to outdoor weather conditions or blowing dust.

Quality Control Inspection of Shop Painting: The firm performing shop painting of the structural steel shall have a written quality control (QC) program. A copy of the QC program and record keeping procedures shall be provided to the Engineer prior to commencing any surface preparation or coating application. The program shall contain, but not be limited to, the following:

1. Qualifications of QC staff.
2. Authority of QC staff. QC staff must have the authority to stop non-conforming work.
3. Procedure for QC staff to advise operation supervisor, in writing, of non-conforming work.
4. Sample copy of QC inspection reports that will document compliance with specifications.
5. Procedure for calibrating inspection equipment and recording calibration.
6. Procedure for repairing defective coating applications.

The Contractor or Shop shall provide at least one Quality Control Inspector for the duration of the shop application to provide Quality Control. The QC Inspector must be a National Association of Corrosion Engineers (NACE) Certified Coating Inspector Level 3 with Peer Review. The QC Inspector shall verbally inform the Engineer on a daily basis, of the progress and any corrective actions performed on the coating work. The QC Inspector shall be present during all cleaning and coating operations.

The Contractor or Shop shall be responsible for purchasing and providing the latest version of the NACE Coating Inspector Log Book(s) and all necessary inspection tools. The Contractor's QC Inspector shall stamp the front page of each inspector's log book used during painting operations. The stamped book(s) shall indicate the inspector's NACE certification number, certification expiration date and shall also be signed. All daily coating activity shall be recorded in the Log Book. Copies of the log entries shall be provided on a daily basis to the Department's Quality

Assurance (QA) shop representative. Upon completion of the coating, the log book(s) shall then be furnished to the Department's QA shop representative.

Technical Advisor: The Contractor or Shop shall obtain the services of a technical advisor who is employed by the coating manufacturer to assist the Engineer and shop painting firm during this work. The technical advisor shall be a qualified representative and shall be made available at the Shop upon request by the QC Inspector or the Engineer.

Surface Preparation: The following steps shall be performed prior to abrasive blast cleaning of steel members:

1. All corners and edges shall be rounded to a 1/16-inch radius or chamfered to a 1/16-inch chamfer.
2. All fins, slivers and tears shall be removed and ground smooth.
3. All rough surfaces shall be ground smooth.
4. Flame cut edges shall be ground over their entire surface such that any hardened surface layer is removed, and subsequent abrasive blast cleaning produces the specified surface profile depth.

Immediately before abrasive blast cleaning all steel members shall be solvent cleaned in accordance with SSPC-SP1 - "Solvent Cleaning."

Abrasive blast cleaning shall be performed in accordance with SSPC-SP 10 - "Near White Blast Cleaning" using a production line shot and grit blast machine or by air blast. The abrasive working mix shall be maintained such that the final **surface profile** is within the range described herein.

The QC Inspector shall test the abrasive for oil, grease or dirt contamination in accordance with the requirements of ASTM D7393 and document the test results. Contaminated abrasive shall not be used to blast clean steel surfaces. The blast machine shall be cleared of all contaminated abrasive and then solvent cleaned thoroughly in accordance with SSPC-SP 1 "Solvent Cleaning." New uncontaminated abrasive shall be added. Abrasive shall be tested for contaminants in accordance with the requirements of ASTM D7393 prior to the start of blast cleaning operations and at least every four hours during the blast cleaning operations.

All compressed air sources shall have properly sized and designed oil and moisture separators, attached and functional, to allow air at the nozzle, either for blast cleaning, blow-off, painting or breathing, to be oil-free, and moisture-free. The equipment shall have sufficient pressure to accomplish the associated work efficiently and effectively.

The QC Inspector shall perform the blotter test and document the results at the start of each blasting shift and at least every four hours during the blasting operation to ensure that the compressed air is free of oil and moisture. The blotter test shall be performed in accordance with the procedure outlined in ASTM D4285. For contaminated air sources, the oil and moisture separators shall be drained and the air retested.

No surface preparation or coating shall be done when the relative humidity is at or above 80 percent or when the surface temperature of the steel is less than five (5) degrees Fahrenheit

above the dewpoint temperature as determined by a surface thermometer and an electric or sling psychrometer.

Surface Profile: The steel surface profile shall be 1 to 3 mils. Each girder or beam shall have the surface profile measured at a minimum of three locations in accordance with the test requirements of ASTM D4417, Method C. Smaller pieces such as diaphragms shall have the surface profile measured at a minimum of three locations on one piece at the beginning of abrasive blast operations and at least every four hours and at the end of abrasive blast cleaning operations. This measurement shall be performed with both coarse (0.8-2.0 mils) and extra coarse (1.5-4.5 mils) replica tape. During this measurement, special attention shall be given to areas that may have been shielded from the blast wheels, such as the corners of stiffeners and connection plates. The impressed tapes shall be filed in the NACE Coating Inspector's Log Book.

Application Methods: The coating system shall be applied by spray equipment of a type and size capable of applying each coat within the required thickness range. The applicator shall strictly adhere to the manufacturer's written recommendations for application methods, cure times, temperature and humidity restrictions and recoat times for each individual coat of the specified system. However, in no case shall coatings be applied in ambient conditions that exceed the relative humidity and dewpoint temperature control limits specified herein. Brushes shall be used in areas where spray application will not achieve acceptable results. Brushing technique shall be performed in a manner that will provide a uniform, blended finish.

Conventional spray equipment with mechanical agitators shall be used for prime coat application.

All storage, mixing, thinning, application and curing techniques and methods shall be accomplished in strict accordance with the printed material data sheets and application instructions published by the respective coating material manufacturer.

Surfaces shall be painted with the specified prime coat material before the end of the same work shift that they were blast cleaned and before any visible rust back occurs. Applied coatings shall not have runs, sags, holidays, pinholes or discontinuities.

The dry film thickness shall be within the range specified in the manufacturer's printed literature for the specified coating system. Dry film thickness shall be measured in accordance with SSPC-PA 2. The prime, intermediate and top coats shall be of contrasting colors as determined by the Engineer. There shall be no color variation in the topcoat as determined by comparison with Federal Standard 595.

Areas Requiring Special Treatment: All steel surfaces shall receive the three-coat shop applied system as specified except the following particular area types which shall be treated as follows:

1. Faying surfaces of connections shall receive a single application of primer. The dry film thickness shall be no greater than the thickness tested on the coating manufacturer's Certified Test Report for slip coefficient.
2. All steel surfaces within four (4) inches of field welds shall receive a single mist coating of primer at 0.5 - 1.5 mils dry film thickness.

3. Top surfaces of top flanges that will be in contact with concrete shall receive a single mist coating of primer at 0.5 - 1.5 mils dry film thickness.
4. Edges and shop welds shall be locally hand-striped with a brush in the longitudinal direction with an additional coat of an appropriate zinc-rich primer prior to application of the full intermediate coat. The application of the striping materials shall be in accordance with the coatings manufacturer's written instructions. The striping material shall be a contrasting color to distinguish it from the primer and intermediate coats.
5. The interior surfaces of box girders, including bracing, shall be prepared in accordance with these specifications then coated with the first two coats of the three-coat system. The intermediate coat in these areas shall be white and match Federal Standard 595 Color Number 27925.

Adhesion: Adhesion strength of the fully coated assemblies shall be the more restrictive of the manufacturer's specified adhesion strength or at least 600 psi for systems with organic zinc primers and at least 250 psi for systems with inorganic zinc rich primers measured as per ASTM D4541 using apparatus under Annex A4. All adhesion test locations shall be recoated in accordance with this specification at no additional cost. The QC Inspector shall perform adhesion strength tests every 500 sf and shall document the adhesion strength test results.

If adhesion test results are less than the specified value, but equal to or greater than 80% of the specified value, four (4) additional adhesion tests shall be taken within the 500 sf area of the failed test. If any of the additional adhesion tests are less than the specified value, the coating shall be removed from the entire piece and re-applied at the Contractor's expense. If any adhesion tests are less than 80% of the specified value, the entire coating system shall be removed from the piece and re-applied at the Contractor's expense.

Smaller pieces such as diaphragms shall be analyzed in lots that have an overall coated surface area of approximately 500 sf.

Protection of Coated Structural Steel: All fully coated and cured assemblies shall be protected from handling and shipping damage with the prudent use of padded slings, dunnage, separators and tie downs. Loading procedures and sequences shall be designed to protect all coated surfaces. Erection marks for field identification of members and weight marks shall be affixed in such a manner as to facilitate removal upon final assembly without damage to the coating system.

Field Touch-Up Painting of Shop Applied Coating: Field touch-up painting shall be undertaken by the Contractor for the purpose of completing coating applications of masked-off areas at splices, connections, and for the repair of coated surfaces damaged during shipment or construction, as directed by the Engineer. The Aesthetics of any field painting is very important. Every effort must be made to perform any field painting in a professional manner that does not affect the appearance or aesthetic value of the structural steel in any way. Significant color variations or texture changes between the shop painting and field painting will not be allowed. The Contractor will be required to perform any additional field painting work required to provide consistent color and texture throughout the structural steel. This is especially true for all Fascia surfaces and areas exposed to public view. The Engineer will be the sole judge on color variations and textures variations of the field painting.

The Painting Contractor shall submit for approval by the Engineer a complete coating application procedure for all touch-up painting and corrective work.

The field applied coating for touch-up painting shall be the same system used in the shop applied application. The intermediate and topcoat material for field touch-up painting shall be from the same lot and batch used in the shop provided its shelf life has not expired. If the shelf life has expired, the same material of the same color from a different lot and batch shall be used.

Field application of coatings shall be in accordance with the manufacturer's written application guidelines and these specifications. All areas cleaned to bare metal must be coated with zinc-rich primer before any visible rusting occurs.

After all concrete is placed and the forms are removed, all rust, scale, dirt, grease, concrete splatter and other foreign material shall be completely removed from all painted surfaces. All surfaces to be field painted shall also be cleaned by solvent cleaning in accordance with SSPC-SP 1, hand tool cleaning SSPC-SP 2, and power tool cleaning SSPC-SP 3 and SSPC-SP 11. Areas cleaned to SSPC-SP 11 must have a 1-3 mil profile and must be primed prior to rusting. All debris generated from cleaning operations must be contained and properly disposed of by the Contractor.

Bolts, nuts, washers and surrounding areas shall receive brush applications of intermediate and topcoat after final tensioning. Careful attention shall be given to bolted connections to insure that all bolts, nuts and washers are fully coated and that no gaps are left unfilled and uncoated.

Damage to the coating system that extends to the steel surface (such as scratches, gouges or nicks), shall have the entire three-coat system locally reapplied after power tool cleaning to bare metal in **accordance with SSPC-SP 11. The coating system adjacent to the damage shall be feathered back to increase** the surface area for touch up painting. The area cleaned to SSPC-SP 11 shall be primed with a zinc-rich primer before rusting occurs.

Damage to the coating system that extends back only to the prime or intermediate coat, shall only have the topcoat applied. Application of the touch-up materials in these damaged areas shall be performed by brush only.

During any field painting the Contractor shall protect property, pedestrians, vehicular and other traffic upon, underneath, or in the vicinity of the bridge, and also all portions of the bridge superstructure and substructure against damage or disfigurement from errant coating materials.

Tarps shall be used to collect all surface preparation debris. The Contractor shall be responsible for disposing of all removed materials, including tarps.

Contractor – Subcontractor Qualifications: Contractors and subcontractors doing field touchup painting work are required to be certified by the SSPC Painting Contractor Certification Program (PCCP) to QP-1, entitled "Standard Procedure for Evaluating Qualifications of Painting Contractors (Field Application to Complex Structures)" at the time of field touchup coating application.

Contractors and subcontractors are required to have at least one (1) **Coating Application Specialist (CAS) (SSPC ACS/NACE No. 13)**-certified (Level II-Interim Status-Minimal) craft-worker. CAS-certified (Level II-Interim Status-Minimal) craft-worker(s) are required for all crews/craft-workers up to four (4) crew members. For each crew larger than four (4), an additional CAS-certified (Level II-Interim Status-Minimal) craft-worker shall be present on each painting/blasting crew during blast cleaning and spray application (Atmospheric and Immersion Service) operations. A crew member is a person who is on the job performing hand-held nozzle blast cleaning and/or spray application of protective coatings on a steel structure. The certification(s) must be full, not interim, and must be kept current for the duration of the Project work. If a Contractor's, subcontractor's or any craft-worker's certification expires, the firm will not be allowed to do any work on this item until the certification is reissued.

Requests for extension of time for any delay to the completion of the Project due to an inactive certification will not be considered and liquidated damages will apply. At the option of the Engineer, if such a delay will adversely impact the successful and timely completion of the Project, the Department may require the Contractor to engage another SSPC certified contractor to do the painting work at the prime contractor's expense.

Quality Control Inspection of Field Touchup Painting: The Contractor performing field touchup painting of the structural steel shall have a written quality control (QC) program. A copy of the QC program and record keeping procedures shall be provided to the Engineer prior to commencing any surface preparation or coating application. The program shall contain, but not be limited to, the following:

1. Qualifications of QC staff.
2. Authority of QC staff. QC staff must have the authority to stop non-conforming work.
3. Procedure for QC staff to advise operation supervisor, in writing, of non-conforming work.
4. Sample copy of QC inspection reports that will document compliance with specifications.
5. Procedure for calibrating inspection equipment and recording calibration.
6. Procedure for repairing defective coating applications.

The Contractor shall provide at least one (1) Coating Inspector who is a National Association of Corrosion Engineers (NACE) Certified Coating Inspector Level 3 with Peer Review for the duration of the field application to provide Quality Control. The QC Inspector shall verbally inform the Engineer on a daily basis, of the progress and any corrective actions performed on the coating work. The QC Inspector shall be present during all cleaning and coating operations.

The Contractor shall be responsible for purchasing and providing the latest version of the NACE Coating Inspector Log Book(s) and all necessary inspection tools. The Contractor's QC Inspector shall stamp the front page of each inspector's log book used during painting operations. The stamped book(s) shall indicate the inspector's NACE certification number, certification expiration date and shall also be signed. All daily coating activity shall be recorded in the Log Book. Copies of the log entries shall be provided on a daily basis to the Department's Quality Assurance (QA) field representative. Upon completion of the coating, the log book(s) shall then be furnished to the Department's QA field representative.

General: The word "PAINTED" followed by the month and year the painting of the structure is completed along with the ConnDOT Project Number and the manufacturer's abbreviations for each of the three coats, shall be stenciled on the inside of a fascia girder at mid-depth of the girder in three (3) inch high block letters located near the abutment, so as to be clearly visible from the ground below. Paint for stenciling information shall be of a contrasting color and be compatible with the topcoat."

6.03.05 – Basis of Payment: *Add the following at the end of the second paragraph:*

"Payment for either method for new structural steel, complete in place, shall also include shop painting, all field touch-up painting and corrective or repair field painting, QC Inspector(s), QC Log Book(s) and testing equipment, technical advisor, "Painted" stencil, equipment, tools and labor incidental thereto."

ITEM #0603253A - DISPOSAL OF LEAD DEBRIS

Description: Under this item, the Contractor shall dispose of all debris that has been classified or identified as hazardous by the Department. This debris is the collected by-product of the removal of paint containing lead, removal of lead based products, and chemical solvents used to remove paint. The Department will sample and test the debris in accordance with the criteria required by the Department's Division of Environmental Compliance.

The Contractor shall conform to the latest requirements of the Hazardous Waste Management Regulations prepared by the D.E.P.'s Hazardous Waste Management Section, subject to regulations of Section 22a-449(c) of the Connecticut General Statutes.

Disposal of the debris after testing shall be in strict conformance with all Federal E.P.A. and D.E.P. regulations for hazardous materials.

Materials: The debris must be offered for transportation and transported in compliance with the Code of Federal Regulations, Title 49, Chapter 1, Part 173, Subparts A, B, C and D and Paragraph 178.118. Transport vehicles (hopper or dump type) must be free from leaks and discharge openings must be securely closed during transportation, All storage containers (roll offs or drums) shall have a protective liner and removable lid. These containers shall not have any indentations or damage that would allow seepage of the contained material.

Construction Methods: Prior to generation, a temporary E.P.A. ID number shall be obtained from the Department's Division of Environmental Compliance,(telephone number 860-594-2067 or 860-594-3344) by the Department's Project Engineer (Construction).

The disposal of the debris classified as hazardous shall be completed within 90 calendar days on the date on which it began to be accumulated in the lined containers. Storage of containers shall be in accordance with current Department procedures.

A licensed hazardous waste transporter and a licensed hazardous waste treatment/disposal facility must be secured from lists available from D.E.P. and approved by the Department's Division of Environmental Compliance.

The disposal containers shall be labeled with a 6-inch square, yellow, weatherproof, Hazardous waste sticker in accordance with U.S. DOT regulations, by the Contractor. Stickers are available through the Department's Project Engineer (Construction). Additional labels or stenciling shall indicate "Abrasive Blast and/or Construction Paint Residue."

All necessary forms, including the "Uniform Hazardous Waste Manifest" obtained from the Hazardous Waste Management Section of the D.E.P., must be filled out, approved and signed by

the Department's Project Engineer (Construction), and appropriate copies returned to the Department's Division of Environmental Compliance.

When all necessary procedures have been completed, then the hazardous waste shall be shipped to the hazardous waste disposal facility.

Any spillage of debris during disposal operation i.e. loading, transport and unloading shall be cleaned up in accordance with the Code of Federal Regulations, Title 40, Chapter 1, Part 265, Subparts C and D, at the Contractor's expense.

The Contractor is liable for any fines, costs or remediation costs incurred as a result of their failure to be in compliance with the special provision and all Federal, State and Local laws.

Method of Measurement: This item will be measured for payment by the contract unit price per 55-gallon barrel of hazardous lead waste. Barrels that have been partially filled because of weight limitations will be measured as a partial unit dependent upon actual volume in barrel. Material may be disposed of in larger containers, with a conversion factor of 0.273 CY to 55-gallon barrel. Materials incidental to the construction, which become contaminated due to the lead debris removal, such as, but not limited to, gloves, coveralls, tarps and filters shall be disposed of in accordance with this specification. These incidental materials shall be kept separate from the blast debris. These materials will not be measured for payment, but will be included in the general cost of the work.

Basis of Payment: This work will be paid for at the contract unit price per 55-gallon barrel, of hazardous lead waste for "Disposal of Lead Debris." The price shall include materials, transportation, storage containers, disposal, equipment, tools, labor and work incidental thereto.

Pay Item	**Pay Unit**
DISPOSAL OF LEAD DEBRIS	BBL

ITEM #0603801A - STRUCTURAL STEEL

ITEM #0603431A - STEEL (MISCELLANEOUS)

Description: Work under this item consists of fabrication, delivery and erection of structural steel for catenary structures, including poles, trusses and pole extensions.

Work under this item also consists of furnishing, fabrication, delivery and erection of steel (miscellaneous) for support of catenary and feeder systems. Steel (miscellaneous) includes, but is not limited to, drop tubes, drop tube supports, tail and catenary dead end supports, catenary supports (CSD), anchor bridge assembly (ABAS), cross arms, span bracket assemblies, supports for guide tubes, midpoint anchor assemblies, pole extension truss connection, jumper wire support, jumper wire dead-end, messenger bracket assemblies, buss bar supports and aerial innerduct supports and dead-ends.

The Contractor shall be responsible for coordinating the installation of poles, pole extensions, truss mounted pole extensions and trusses with the Railroad and the requirements set forth in the Special Provisions, obtaining necessary outages for conducting work, as well as coordinating necessary transmission line outages with utility companies.

Materials: Structural shapes, plates and rods shall conform to Form 816, Section M.06.02. The material for rolled sections, plates and rods shall be ASTM A36 and ASTM A500 Grade B for structural tubes.

Size of bolt holes shall be 1/16" larger than bolt diameter unless specified otherwise.

All field connections shall be bolted.
All connection bolts shall be 7/8" diameter except as noted.
All bolts to have hex heads and nuts and washers.

High strength bolts, nuts and washers shall conform to Form 816, Section M.06.02.5 and shall meet ASTM A325 Type 1. Other connectors, where noted, shall be ASTM A307.

Wire mesh fabric shall conform to Form 816 Article M.10.05.1(b) with #10ga wire and 1” x 1” mesh.

All material provided under this Section shall be galvanized after fabrication in conformance with Form 816, Section M.06.03. Fabricator to provide adequate vent holes to all enclosed areas prior to galvanizing.

Filler material for welding shall conform to form 816, Section M.06.04.

Polyurethane Sealant shall conform to Federal Specifications TT-S00227E, Type I or II (Class A or B).

Base plates may be fabricated from material conforming to ASTM A537 or A633 in addition to the steel material listed above. Miscellaneous bolts, nuts and washers shall conform to ASTM A325.

Submittals for Catenary Support Structures and Steel (Miscellaneous): Shop drawings.

Mill certificates for structural steel and proof of U.S. origin.

Charpy V-notch test certificates.

Certificate for high strength bolts (See Section M.06 in the Special Conditions).

Proposed erection procedure to demonstrate compliance with "Requirements for Erection, Demolition, or other Rigging operations over or Adjacent to Railroad Right-of-Way" See Special Conditions.

Construction Methods: The installation of new poles, trusses, pole extensions, truss-mounted pole extensions, cross arms and other steel assemblies will occur in the vicinity of electrical energized facilities. De-energizing of the Railroad's, and the utility company's electric lines will be required to perform the work. The Contractor shall perform the work in accordance with the following:

1. During the installation of structural and miscellaneous steel, all equipment and persons will at all times, remain at least 20 feet clear of the utility company's existing 115 kV overhead transmission lines, installed on catenary or pole structures along the railroad's mainline right-of-way. When approach closer that the specified distance is required, the Contractor will request in writing, with six months advance notice, the de-energizing of the utility lines or equipment. De-energizing of the utility power line is contingent on power demand and economic dispatch and shall be coordinated with the utility. The Contractor will assume any risk involved in the reasonable denial of a request to de-energize the utility's transmission line and the last minute cancellation of an approved request to de-energize the transmission lines. If so ordered by the Engineer, the Contractor will immediately cease all activity in the areas where the utility's transmission lines are to be re-energized.

2. The Contractor and the utility must cooperate fully in order to avoid damage to the conductors, and to insure that no delays will occur in the progress of the work. Therefore, the Contractor shall furnish the utility with a schedule for this work, which is to include starting and completion dates and, shall notify the utility six months in advance of the commencement of construction work.

All applicable portions of Form 816, Section 6.03.03 shall apply.

The Contractor shall not complete the fabrication of all sections of the trusses until he has verified in the field, the distance between the north and south foundations or anchor bolts. The end sections of the trusses may be fabricated prior to the completion of the foundations.

The Contractor shall not erect trusses until he has verified in the field that there will be adequate clearance between truss and catenary messenger wires.

The Contractor shall not fabricate miscellaneous steel attachments intended for to existing structures until he has verified in the field the pertinent dimensions of the structures.

Poles shall not be set until foundation concrete has reached a strength of 3,000 psi. Posts or poles shall not be loaded until foundation concrete has reached a strength of 4,000 psi.

All shop connections shall be welded but subject to the Engineer's approval the Contractor may modify the truss and truss splice details or splice locations to suite his fabrication and erection procedure and equipment. All splices shall be full strength bolted splices as defined in AISC Manual of Steel Construction. Gusset plates may be required.

A minimum of 25% of bolts in a group (but not less than two) connecting a truss to a post must be in place before end of track outage.

Field welding of galvanized members will not be permitted.

Voids in the base plate anchor bolt holes shall be completely filled with polyurethane sealant.

The Railroad's safety procedures require that, as soon as structural steel has been set in place and before power is restored, temporary grounding must be connected to the aerial ground wire system.

Temporary grounds must be at least equal to one 4/0 cable placed in a position protected from damage and vandalism. Permanent grounding (aerial and ground rod) shall be connected as soon as possible following steel erection.

Before erecting a catenary post, truss, post extension or stringing a ground or feeder wire the Contractor shall ascertain that no energized wires will come into contact with or within 3 ft. of a new post, truss, post extension feeder or ground wire. Should energized feeders or catenaries of the existing system be 3 ft. of a structure or ground wire, then the Contractor shall consult the Engineer about protective measures before proceeding with erection. The Contractor shall ascertain that no 115kV utility conductors come within 20 ft.

In certain locations there are signal cables, signal boxes and/or ladders attached to the structures. Should the Contractor have to temporarily relocate these in order to proceed with the installation of steel, the Contractor must obtain prior permission from the Railroad to do so.

Methods of Measurement: Steel (Miscellaneous) shall be measured for payment based on its weight to be calculated in accordance with Form 816, Section 6.03.04.

Structural Steel shall be measured for payment based on its weight to be calculated in accordance with Form 816, Section 6.03.04, except that the material costs for structural steel shall be paid for under Item #0603999A MATERIALS FOR CATENARY STRUCTURAL STEEL. Only costs associated with the fabrication, delivery and installation of structural steel shall be paid for as STRUCTURAL STEEL.

There shall be no separate or additional payment for the design of tubular steel poles, their base plates, anchor bolt system, cross arms and/or appurtenances, but the cost thereof shall be included in the unit cost of STRUCTURAL STEEL.

No direct payment will be made for galvanizing, but the cost thereof shall be included in the unit prices of STRUCTURAL STEEL or STEEL (MISCELLANEOUS).

No direct payment will be made for temporary grounds but the cost thereof shall be included in the unit price of STRUCTURAL STEEL.

STRUCTURAL STEEL shall include, for payment purposes, all catenary support structures (poles, trusses, pole extensions & tubular steel poles).

STEEL (MISCELLANEOUS) shall include, for payment purposes, drop tubes, drop tube support assemblies, cross arms for feeders, catenary and tail wire dead end assemblies, catenary supports (CSD), anchor bridge assemblies (ABAS), guy assembly support (GAS), span wire bracket assemblies, supports for guide tubes, cable messenger supports, midpoint anchor assemblies, dead end supports, pole extension detail (PE-P), jumper wire supports (JWS-1 & JDD-1), pole extension truss connection, buss bar supports, aerial innerduct support and platform extensions. Other small steel parts and assemblies shall be considered as parts of Catenary Assemblies or for suspension of C&S, fiber optic or control cable messengers.

STEEL (MISCELLANEOUS) shall include, for payment purposes, attachment brackets and deadend brackets associated with the installation of the new fiber optic cable and innerduct, including, lattice angle attachment, pull-off pole attachment, built up channel attachment, lattice channel attachment, built up wide flange attachment, anchor bridge attachment, wide flange attachment, one and two-sided dead-ends, attachment bracket, dead-end bracket assembly, down guy bracket assembly, and guyed attachment bracket.

Guy Bracket Assemblies (GBA, GBA-1 and GBA-2) and Swivel Bracket Assemblies (GC-1 and GC-2), where installed in conjunction with Down Guys, are not paid for as STEEL (MISCELLANEOUS), but shall be included for payment in the item for DOWN GUYS.

No separate payment will be made for the temporary support, relocation or removal of existing communication, signal, or ground wire that may interfere with the installation of new steel, but the cost thereof shall be included in the items contained in this section.

The temporary removal and restoration, if any, of a member of the structure or of signal cables, signal cases, ladders, platforms or other impediment attached to the structure, in order to facilitate the installation of steel shall not be paid for separately, but the cost thereof shall be included in the items covered under this section.

Basis for Payment: This work will be paid for at the contract unit price for the following pay items, which prices shall include all transportation, materials, equipment, tools and labor incidental thereto:

Pay Item	**Pay Unit**
STRUCTURAL STEEL	CWT
STEEL (MISCELLANEOUS)	CWT

ITEM # 0603851A – STRUCTURAL STEEL (LOW ALLOY)

Work under this item shall conform to the requirements of Section 6.03 amended as follows:

Article 6.03.01 - Description: is supplemented as follows:

This special provision applies to the structural steel used in retaining wall construction. Where the term "structural steel" is used within the contract plans for the construction of retaining walls, said steel shall be paid for under the item "Structural Steel (Low Alloy)."

Article 6.03.03 – Construction Methods: In Subarticle 4 "Field Erection" - part (e) "Welded Connections," following the last paragraph of the article, add the following:

Galvanized surfaces shall be prepared for welding based on the recommendations of the American Galvanizers Association. These recommendations are available online at:
http://www.galvanizeit.org/design-and-fabrication/fabrication-considerations

Article 6.03.05 – Basis of Payment: Delete in its entirety and replace with the following:

The structural steel, incorporated in the completed and accepted structure, will be paid for at the Contract unit price per hundredweight for "Structural Steel (Low Alloy)." Payment shall be for structural steel, complete in place, which price shall include quality control, furnishing, fabricating, transporting, storing, erecting, welding, surface preparation and all materials including fastener assemblies, equipment, tools and labor incidental thereto.

No direct payment will be made for preparing galvanized surfaces for welding. No direct payment will be made for field touch-up of galvanized surfaces that may be required for any reason including, but not limited to, field or shop preparation for welding. No direct payment will be made for non-destructive testing as may be required.

Pay Item	Pay Unit
Structural Steel (Low Alloy)	CWT

ITEM #0603881A – TEMPORARY SUPPORT SYSTEM (SITE NO. 1)
ITEM #0603882A – TEMPORARY SUPPORT SYSTEM (SITE NO. 2)
ITEM #0603883A – TEMPORARY SUPPORT SYSTEM (SITE NO. 3)

Description: Work under this item shall consist of designing, furnishing, and subsequently removing any type of adequately designed temporary support system which the Contractor elects to build that adequately supports the proposed bridges during their off-line construction, and that also supports the existing bridges after they have been removed from their original location, as shown on the plans and accordance with these specifications or as otherwise approved by the Engineer.

Materials: Any combination of materials may be used, provided that they are properly designed for the purpose intended. Proprietary systems shall conform to the manufacturer's specifications and project specifications. The parts list shall be furnished for the proprietary system and the Contractor shall provide the material certificates for the parts.

Construction Methods: Temporary support systems shall be designed, constructed, and maintained as necessary for proper performance of the work. Construction shall be such as to facilitate the lifting, movement, and setting of the proposed and existing bridges using Self Propelled Modular Transporters (SPMT). The Contractor is responsible for evaluating existing site conditions and determining applicable soil design parameters based on all evaluation criteria the Contractor deems necessary to determine such parameters.

The temporary support systems shall be designed in accordance with the AASHTO Guide Design Specifications for Bridge Temporary Works, 1st Edition, 2008 Interim Revisions. The support systems shall be designed to safely support all dead loads as well as any imposed loadings under all possible construction conditions.

Working drawings and design calculations for temporary support systems shall be submitted in accordance with the requirements of Article 1.05.02(2). The working drawings and design calculations shall be prepared, sealed, and signed by a Professional Engineer, licensed in the State of Connecticut. The furnishing of such plans shall not serve to relieve the Contractor of any part of his responsibility for the safety of the work or for the successful completion of the project.

The elevations of the temporary bridge bearings relative to one another shall be at the same relative elevations of the final structure bridge bearings to ensure proper detailing of final condition bridge geometry.

A periodic inspection of all temporary support systems shall be maintained by the Contractor as directed by the Engineer. The Contractor shall correct any deficiencies noted or otherwise present as directed by the Engineer.

Unless otherwise ordered by the Engineer, all parts of the temporary support systems shall be removed upon completion of the work.

Method of Measurement: This work, being paid for on a lump sum basis, will not be measured for payment.

Basis of Payment: This work will be paid for at the contract lump sum price for "Temporary Support System (Site No.)", which price shall include of designing, furnishing, maintaining, and removing temporary support systems, and all equipment, tools, and labor incidental thereto.

Pay Item	Pay Unit
Temporary Support System (Site No. 1)	LS
Temporary Support System (Site No. 2)	LS
Temporary Support System (Site No. 3)	LS

ITEM #0604398A - ERECTION EQUIPMENT - COMPLETE

Description: This work shall consist of designing, furnishing and utilizing Self Propelled Modular Transporter (SPMT) systems to relocate the new bridge superstructure segments from their locations constructed on temporary support systems onto the proposed abutments.

Work associated with the temporary support systems shall not be included in this item, and shall be included in the item "Temporary Support System (Site No.)", found elsewhere in these specifications.

Work associated with the erection of new structural steel onto the temporary support systems, shall not be included in this item, and shall be included in the item "Structural Steel (Site No.)", found elsewhere in these specifications.

Construction Methods:

Submittals

The Contractor shall submit a schedule addressing the timing and sequence of fabrication and erection of the permanent superstructure, removal or demolition of the old superstructure, construction of temporary abutments, connections with the roadway, road closures, and the transportation of the superstructure.

The Contractor shall submit working drawings and calculations as follows, for both existing superstructure removal and new superstructure installation operations:

1. Bridge Staging Area (BSA) and Travel Path (TP)

    a. A staging sequence, BSA, and TP are indicated on the plans.

    b. Provide detailed plans of the proposed TP including plans and profiles of the path and grading details beyond the path.

    c. Indicate all ground improvements, soft soil mitigation, and utility protection.

    d. Verify all clearances, vertical and lateral, along the TP from the BSA to the final bridge locations. Clearances shall be shown for all potential obstacles, with indication of plans for mitigation.

2. Selected Movement System

    a. Design the movement system to lift the bridge at the pick points indicated in the project plans. The system shall have the ability to actively monitor and adjust the relative deflections of the superstructure during the lifting, moving and setting of the superstructure.

    b. Demonstrate that any new pick points support the structure within the stress limits indicated on the project plans when lifting the bridge at pick points other than those indicated on the design. Submit signed and sealed calculations for review and

approval.

c. Design the lifting system to provide wheel loads that do not exceed allowable ground pressures, as determined by the Contractor's geotechnical engineer.

d. Indicate that the selected lifting system will possess adequate stroke to negotiate the TP as designed.

e. Indicate any additional systems required to move the structure, for example such items may include skid shoes, climbing jacks, and strand jacks.

1) Demonstrate that stresses provided in the project plans are not exceeded.

f. Indicate how the lifting system will prevent twisting, racking, longitudinal and transverse slope changes, or other deflections and movements during the moving operations that could result in out-of-tolerance deflections.

g. Indicate that the selected lifting system will possess electronic capability allowing for all necessary movements for the system to negotiate the TP between the BSA and final superstructure locations.

h. Indicate that the selected movement system will provide equal support to all girders.

i. Provide documentation of all preparatory work necessary for moving personnel, SPMT equipment, supplies, additional equipment necessary, and incidentals to the project site before beginning work.

j. Provide pre-operations checklist, and proposed schedule of meetings with the Engineer for review and approval of the pre-operations checklist.

k. Documentation that the moving system is sufficiently redundant to avoid damage to the structure during fabrication, transport, and placement.

3. SPMT Support Apparatus

a. Design SPMT Supports to meet AASHTO Guide Design Specifications for Bridge Temporary Works, 1st Edition, 2008 Interim Revisions and 2nd edition 2004 AASHTO LRFD Bridge Construction Specifications, 2008 interim revisions.

b. Calculate the anticipated lateral forces due to braking, turning, and vertical grades and provide a system to transfer loads to SPMTs.

4. Monitoring Plans

a. The Contractor shall prepare and submit a monitoring plan prior to the start of fabrication of the bridge superstructure and temporary abutments to measure performance of:

1) Superstructure geometry during fabrication on temporary supports for the purpose of ensuring distortion resulting from settlement of temporary foundations or other out-of-tolerance construction is limited;

2) Superstructure geometry during SPMT movement to ensure that distortion during transport is limited to within specified values;

3) Superstructure geometry after erection at its final location to ensure specified geometric requirements have been satisfied;

4) Concrete deck during lifting, moving, and setting operations to identify damage resulting from lifting, moving, and setting operations.

5. Mitigation Plans

a. The Contractor shall prepare and submit a mitigation plan prior to the start of fabrication of the bridge superstructure and temporary abutments to account for remediation in case movements are found to be greater than allowable tolerances.

b. The mitigation plan shall include at a minimum:

1) Threshold and limiting values for instrumentation readings, alerting the Engineer of potential out-of-tolerance construction.

2) A schedule for reading and reporting instrumentation readings. At a minimum, the Contractor shall provide a report of instrumentation values and interpretation at least once per week. If threshold values are met or exceeded, readings shall be taken more frequently, as directed by the Engineer.

3) Measures to correct out of tolerance movement.

4) Measures proposed to repair structural elements in the event damage occurs.

5) An analytical model of the bridge superstructure that shall be used to evaluate out-of-tolerance construction. This model shall include a three-dimensional representation of the bridge superstructure for the purpose of evaluating stresses imposed on the structure due to deflection/distortion during construction and erection.

6. QA/QC procedures

a. The Contractor shall have a Technical Representative present on site during the entire lifting and placement of the existing and new bridges, and who will oversee, monitor and implement the entire procedure including QA/QC, Mitigation and Contingency plans as necessary.

7. Contingency Plans

a. The Contractor shall prepare a contingency plan which accounts for potential unforeseen events during or as a result of transportation.

b. The contingency plan shall address at a minimum:

1) Mechanical failure of SPMT and moving equipment

2) Potential damage to the proposed abutments

3) Extended track outages due to out-of-tolerance construction or other procedures not in accordance with the contract documents.

Working drawings and calculations shall be submitted in accordance with Article 1.05.02(2). The working drawings and design calculations shall be prepared, sealed, and signed by a Professional Engineer, licensed in the State of Connecticut. The furnishing of such plans shall not serve to relieve the Contractor of any part of his responsibility for the safety of the work or for the successful completion of the project.

Lift,Transport,and Placementof Superstructure Segments

During lift, transport, and placement operations of the proposed superstructure segments, the Contractor shall follow the established and submitted QC/QA procedures and Pre-operations checklist. The Contractor shall:

1. General

   a. Check elevations of bearing seats and tops of bearings prior to lifting bridge. Contractor will submit all as-built measurements with the Working Drawings for the Engineer's review.

   b. Notify the Engineer of differences between as-built and as-planned bearing elevation and submit proposals for corrective adjustments.

   c. Lift and transport structure in accordance with the lifting points established in the drawings.

   d. Deliver the structure to its final location with no damage or loss of strength, performance, or long-term durability.

2. Monitoring

   a. Monitor the span for stability and integrity of the SPMT system during lifting, transport, and placement following the plans for the equipment and methods of monitoring.

   b. Monitor deflection and twist control during transportation.

   c. Obtain deflection and twist tolerances from the Engineer.

   d. Provide measurements to the Engineer for actual deflection and twist during lift, transport, and setting.

   e. Halt operations immediately if deflection or twist exceeds allowable limits as designed by the Engineer, returning bridge to temporary supports if necessary.

3. Tolerances

a. Plan alignment, location, and clearances for the final condition of the span after placement.

b. Do not exceed 2 inches for spans under 100 ft, and 3 inches for spans over 100 ft at each end of the span for maximum deviation from overall longitudinal alignment of an individual span after setting.

c. Do not exceed 2 inches for spans under 100 ft, and 3 inches for spans over 100 ft for maximum deviation from the overall transverse location at each line of bearing.

d. Do not exceed 2 inches for spans under 100 ft, and 3 inches for spans over 100 ft for maximum yaw.

e. Maintain individual elements or surfaces within 2 inches for spans under 100 ft, and 3 inches for spans over 100 ft of location with respect to similar matching surfaces at expansion joints (plane of web parapet) of adjacent spans, pier or abutment features in the absence of other constraints.

f. Provide the maximum allowable change in longitudinal gradient along the girders.

1) Calculate change from differences between the elevations taken just before lifting and the elevations taken at any time during transport.

g. Provide the maximum allowable change in transverse gradient across the girder span.

1) Calculate change from differences between the elevations taken just before lifting and the elevations taken at any time during transport.

j. Do not exceed the SPMT ground pressures for the supporting capacity of the soil, roadway construction, or any structures over which the load will travel.

k. Follow specified allowable limits for loss of support by any pair of wheels or axle lines.

m. Implement contingency plans in the event of a major breakdown of equipment to complete the installation with minimal disruption or delay to traffic.

Method of Measurement: This work, being paid for on a lump sum basis, will not be measured for payment.

Basis of Payment: This work will be paid for at the contract lump sum price for "Erection Equipment - Complete", which price shall include design, furnishing, monitoring, oversignt, and utilization of SPMT's to install new superstructure segments, and all equipment, tools, and labor incidental thereto.

PayItem	PayUnit
Erection Equipment – Complete	LS

ITEM #0609030A – REPOINT MORTAR JOINTS

Description: This item shall consist of repointing existing stone retaining walls where mortar is loose or missing at the locations of new wall foundations or as directed, in accordance with these specifications. This work shall be performed before the installation of new wall foundations.

Materials: The mortar for this work shall conform to the pointing mortar specified in Form 816, Article M.11.04.

Construction Methods:

1 – Joint Preparation: Loose and deteriorated mortar shall be removed to a minimum depth of about 2 inches or as directed by the Engineer. Any loose or deteriorated mortar beyond this depth shall be removed. Mortar joints, which are sound but exhibit a separation of one quarter inch (¼") or more between the stone and mortar shall be repointed. Removal of mortar shall be by hand tools. No power tools will be allowed. Pointing which is in good condition shall not be removed. Removed mortar shall be disposed of properly.

2 – Repointing:

A. Mixing Mortar: Dry ingredients shall be measured by volume and thoroughly mixed before addition of any water. Half the necessary water may then be added, followed by mixing for approximately 5 minutes. Water should then be added in small portions until a mortar of the proper consistency is reached. The total volume of water necessary may vary from batch to batch, depending on weather conditions. Mortar shall be used within 30 minutes of final mixing, and "re-tempering", or adding additional water after the final mix is prepared, will not be permitted. The use of admixtures such as, but not limited to, antifreeze compounds or air entraining additives will not be permitted. Bonding agents are also prohibited.

B. Mortar Placement: Repointing shall only be performed when the temperature of the stone is between 40 degrees (F) and 95 degrees (F). If the ambient temperature is likely to fall below 40 degrees (F) at any time within 24 hours after placement, the following procedures shall be followed:

1. Heat mixing water to a temperature of 70 degrees (F) to 110 Degrees (F).
2. Cover and insulate the recently placed work so as to maintain 50 degrees (F) or more for 72 hours.
3. Do not use chemicals, antifreeze or salts to lower the freezing point of water or mortar, or to accelerate hardening.

Prior to placing mortar in a joint, the joint shall be rinsed with a jet of water to remove dust or loose materials. At the time of filling, the joints should be damp with no standing water present.

Where the joint is greater than one (1) inch in depth, the deeper areas should be filled first, compacting the new mortar in several layers.

The back of the joint shall be filled successively by applying mortar in ¼" lifts, packing it in well. This application may extend for several feet in either direction. As soon as the mortar has reached thumb print hardness, another ¼" layer of mortar may be applied.

The procedure shall be repeated until the joint is flush with the face of the stones. When the final layer is thumb print hard, the joint shall be tooled. Tooling of the mortar shall be done at the proper time to avoid discoloration of the mortar and to assure proper bonding. The joints shall be tooled to match the appearance of the adjacent existing mortar joints.

If necessary, immediately after tooling, excess mortar shall be removed with a bristle brush. Within 2 hours after mortar is tooled, excess mortar around the joint shall be removed with a stiff bristle brush. If the mortar has hardened, cleaning may be accomplished by using a wooden handle or chisel, if necessary. Power tools will not be allowed.

C. Curing: Keep mortar damp for at least 72 hours after pointing to prevent quick setting shrinkage. Do not direct a stream of water at any mortar for at least 48 hours after it has been placed.

D. Cleaning: After mortar has fully hardened (30 days), thoroughly clean exposed stone surfaces of excess mortar and foreign matter using natural bristle brushes and clean water. Sand blasting or acid cleaning is not permitted.

Method of Measurement: The quantity of repointed masonry shall be the actual linear feet completed and accepted within the neat lines as shown on the plans or as directed by the Engineer. Joints not accepted by the Engineer shall be cleaned and repointed at the Contractor's expense.

Basis of Payment: This work shall be paid for at the contract unit price per linear feet for REPOINTED MORTAR JOINTS which price shall include all materials, equipment, tools and labor incidental thereto.

Pay Item	**Pay Unit**
REPOINTED MORTAR JOINTS	LF

ITEM #0651011A – 12” R.C. PIPE

Work under this item shall conform to Section 6.51 supplemented as follows:

Article 2.02.01 – Description:

Add the following: Capping the pipe as shown on the plans or as ordered by the Engineer shall be included in the work.

Article 2.02.04 – Method of Measurement:

Add the following: No measurement shall be made for capping the pipe but this work shall be measured as part of the item 12” R.C. Pipe.

Article 2.02.01 – Basis of Payment:

Add the following: Add the following: No payment shall be made for capping the pipe but this work shall be paid for as part of the item 12” R.C. Pipe.

Pay Item	**Pay Unit**
12” R.C. Pipe	Linear Foot

ITEM #0651013A – 18” R.C. PIPE

Work under this item shall conform to Section 6.51 supplemented as follows:

Article 2.02.01 – Description:

Add the following: Capping the pipe as shown on the plans or as ordered by the Engineer shall be included in the work.

Article 2.02.04 – Method of Measurement:

Add the following: No measurement shall be made for capping the pipe but this work shall be measured as part of the item 18” R.C. Pipe.

Article 2.02.01 – Basis of Payment:

Add the following: Add the following: No payment shall be made for capping the pipe but this work shall be paid for as part of the item 18” R.C. Pipe.

Pay Item	**Pay Unit**
18” R.C. Pipe	Linear Foot

ITEM #0661106A – SAFETY WALK

Description: This item shall consist of furnishing and installing fiberglass grating, metal handrail mounted on structural steel framing, anchored to the steel fascia girder, including structural steel shapes, anchor bolts, hardware, fasteners fully galvanized in accordance with the dimensioned details given, and erected where shown on the plans in accordance with these specifications.

Materials: The materials for this work shall conform to the requirements of Article M.06.

Steel for fabrication shall be in conformance with ASTM A 36.

High strength bolts shall conform to ASTM A325, Type 1. Nuts shall conform to either ASTM A563, Grade DH or ASTM A194, Grade 2H. Flat hardened washers shall conform to ASTM F436. Bolts, nuts and washers shall be galvanized in conformance with ASTM B695, Class 50.

The anchorage system shall conform to the details shown on the plans. Anchor bolts and washers shall be stainless steel conforming to ASTM A193, GradeB6 and ASTM A194, Grade 6, respectively.

Fiberglass grating shall be a Fiberglass reinforced Pultruded Fiberglass Grating System and shall possess the following material properties:

a. Corrosion Resistant
b. Elecrically Non-Conductive
c. Impact Resistant
d. Low Thermal Conductivity

Fiberglass grating shall be capable of withstanding a minimum uniform load of 150 lbs. per sq. ft. and a minimum concentrated load of 300 lbs with a maximum deflection of 3/8 inch.

Fiberglass grating shall have a gritted skid resistant top. Grit shall be embedded in the resin layer. Glue on grit shall not be acceptable. Fiberglass grating shall be 1.5 inch thick grating with standard panel sizes 3 feet wide minimum. Color shall be permanent and part of the molded grating. Color shall be a safety yellow or as directed by the Engineer. All hardware used to fasten grating shall be of similar corrosion resistance and shall be designed to avoid the creation of tripping hazards.

Fiberglass reinforced Grating shall be as manufactured by the following, or approved equal for specified application:

> "McNichols – MS I-6015 1-1/2" Pultruded I-Bar Grating", McNichols Co., Tampa FL
> "Century Composites - Pultruded Fiberglass Grating", Century Composites LLC, Tyrone, GA

Construction Methods: Fabricate, galvanize and install all items as shown on the plans and approved shop drawings.

All welding procedures shall conform to the current standards of the AWS. Care shall be taken to minimize distortion due to heat. Metal shall not be galvanized before welding.

Installation of fiberglass reinforced grating shall be per manufacturers requirements. A minimum of 8 fasteners shall be used on a 3 foot by 10 foot panel. Small pieces of grating shall be fastened with no fewer than four fasteners.

The Contractor shall be responsible for scheduling the delivery of all items so as to minimize on-site storage time prior to installation. All stored materials and items shall be protected from weather, careless handling and vandalism.

Shop Drawings: Before fabricating any materials, the Contractor shall submit shop drawings to the Engineer for approval, in accordance with article 1.05.02 (b). These drawings shall include, but not be limited to, the following information: the layout plan showing all safety wall steel, fiberglass reinforced grating, railing post spacing, all railing post base plate grades, expansion joint locations, dimensions, all details, material lists and material designations.

Methods of Measurements: This work will be measured for payment by the number of square feet of completed and accepted "Safety Walk" measured from outside of end posts.

Basis of Payment: This work will be paid for at the contract unit price per square feet for a "Safety Walk" complete in place, which price shall include all material, equipment, tools and labor incidental thereto.

Pay Item	Pay Unit
Safety Walk	S.F.

ITEM #702026A - MICROPILES

ITEM #702027A - VERIFICATION TEST FOR MICROPILES

ITEM #702028A - PROOF TEST FOR MICROPILES

ITEM #702029A – MICROPILE LENGTH ADJUSTMENT

Description: This work shall consist of constructing micropiles as shown on the contract plans and approved working drawings and as specified herein. The Contractor is responsible for furnishing all design, materials, products, accessories, tools, equipment, services, transportation, labor and supervision, and manufacturing techniques required for design, installation and testing of micropiles and micropile top attachments for this project.

The Contractor shall select the micropile type, size, pile top attachment, installation means and methods, estimate the ground-grout bond value and determine the required grout bond length and final micropile diameter. The Contractor shall design and install micropile that will develop the load capacities indicated on the plans. The micropile load capacities shall be confirmed by verification and proof load testing as required and must meet the test acceptance criteria specified herein.

Materials: Furnish materials new and without defects. Materials for micropiles shall consist of the following:

Admixtures for Grout: Admixtures shall conform to Article M.03.01 of the Form 816. Accelerators are not permitted. Expansive admixtures and admixtures containing chlorides are not permitted.

Cement: All cement shall be Portland cement conforming to ASTM C 150/AASHTO M85, Types II, III or V.

Centralizers and Spacers: Centralizers and spacers shall be fabricated from schedule 40 PVC pipe or tube, steel, or material non-detrimental to the reinforcing steel. Wood shall not be used. Centralizers and spacers shall be securely attached to the reinforcement; sized to position the reinforcement within ½ inch of plan location from center of pile; sized to allow grout tremie pipe insertion to the bottom of the drillhole; and sized to allow grout to freely flow up the drillhole and casing and between adjacent reinforcing bars.

Grout: Neat cement or fine aggregate/cement mixture. The designer is responsible for indicating the 3 day and 28 day compressive strengths. The grout shall conform to the specification AASHTO T106/ASTM C109 and to any minimum and/or maximum properties shown on the plans. The grout shall conform to Article M.03.01 of the Form 816.

Permanent Casing Pipe: Permanent steel casing/pipe shall conform to required minimum and/or maximum properties shown on the plans. The permanent steel casing/pipe shall be designed to withstand the design service loadings shown on the plans and the proof/verification

tests loading described in this specification. The steel casing/pipe shall conform to one or more of the following specifications ASTM 252, ASTM 106, or API (N-80). The designer will be responsible for indicating the applicable material specification(s) and any welding or fabrication conditions that apply.

Reinforcing Bars: Reinforcing steel shall be deformed bars in accordance with ASTM A615/AASHTO M31. The grade, thickness and number of bars shall be indicated by the designer and shall conform to any minimum and/or maximum properties shown on the plans. Continuous spiral deformations (i.e. continuous threadbars) shall be used. Bar tendon couplers, if required, shall develop the ultimate tensile strength of the bars without evidence of any failure.

Construction Methods:

1 - Contractor's Experience Requirements:

The micropile Contractor shall be experienced in the construction and load testing of micropiles and have successfully constructed at least 5 projects in the last 5 years involving construction totaling at least 100 micropiles of similar capacity to those required in these plans and specifications.

The Contractor shall have previous micropile drilling and grouting experience in soil/rock similar to project conditions. The Contractor shall submit construction details, structural details and load test results for at least three previous successful micropile load tests from different projects of similar scope to this project.

The Contractor shall assign a professional engineer, licensed in the State of Connecticut, to supervise the work. This engineer shall have experience on at least 10 projects of similar scope to this project completed over the past 5 years. The Contractor shall not use manufacturers' representatives to satisfy the supervising engineer requirements of this section. The contractor may use a single independent consultant for this purpose, provided the consultant has specific experience as listed above, and operates their business specifically for the purpose of transferring technology and skills in micropiling to contractors. The on-site foremen and drill rig operators shall also have experience on at least 10 projects over the past 5 years installing micropiles of equal or greater capacity than required in these plans and specifications.

The Contractor shall assign a professional engineer, licensed in the State of Connecticut, to design the micropiles. This engineer shall have experience in the design of at least 3 successfully completed micropile projects over the past 5 years, with micropiles of similar capacity to those required in these plans and specifications. This engineer shall also be responsible for design, supervision and reporting of the verification and proof test(s).

At least 45 calendar days before the planned start of micropile construction, the Contractor shall submit 5 copies of the completed project reference list and a personnel list. The project reference list shall include a brief project description with the owner's name and current phone number and load test reports. The personnel list shall identify the supervising project engineer, drill rig operators, and on-site foremen to be assigned to the project. The personnel list shall contain a summary of each individual's experience and be complete enough for the Engineer to determine

whether each individual satisfies the required qualifications.

Work shall not start, nor materials ordered, until the Engineer's written approval of the Contractor's experience qualification is given. The Engineer may suspend work if the Contractor uses non-approved personnel. If work is suspended, the Contractor shall be fully liable for all resulting cost and no adjustment in contract time will result from the suspension.

2-Micropile Design Requirements and Submittals

The micropiles shall be designed to meet the specific loading conditions, as shown on the plans and approved working drawings. Design the micropiles and pile top to footing connections using the Service Load Design (SLD) procedures contained in the FHWA "Micropile Design and Construction Guidelines Manual", Report No. FHWA-SA-97-070 and the "Connecticut Department of Transportation Bridge Design Manual".

The required geotechnical safety factors/strengths factors (for SLD Design) shall be 2.0, unless specified otherwise. Estimated applied foundation loading, easements, rights-of-way and other applicable design criteria will be as shown on the plans or specified herein. Structural design of any individual micropile structure elements not covered in the FHWA manual shall be by the SLD method in conformance with appropriate articles of the most current Edition of the AASHTO Standard Specification for Highway Bridges, including current interim specifications.

Steel pipe used for micropile permanent casing shall incorporate an additional 1/16" thickness for sacrificial steel corrosion protection.

Where required as shown on the plans, corrosion protection of the internal steel reinforcing bars, consisting of either encapsulation, epoxy coating, or grout, shall be provided in accordance with the Material portion of this specification. Where the permanent casing is used for a portion of the micropile, encapsulation shall extend at least 5ft into the casing.

The Contractor shall prepare and submit to the Engineer working drawings. Working drawings shall be submitted in accordance with Article 1.05 of the Form 816. The working drawings shall include all information required for the design, plans, construction and quality control of the piling. This information should include the following, but not necessarily be limited to;

1. Design Computations

    a. A written summary report which describes the overall micropile design.

    b. Applicable code requirements and design references.

    c. Micropile structure critical design cross-section(s) geometry including soil/rock strata and piezometric levels and location, magnitude and direction of applied loadings, including slope or external surcharge loads.

    d. Design criteria including, soil/rock shear strengths (friction angle and cohesion), unit weights, and grout-to-ground bond values and micropile drillhole diameter assumptions for each soil/rock strata.

e. Safety factors/strength factors used in the design of the ground-grout bond values, surcharges, soil/rock and material unit weights, steel, grout and concrete materials.

f. Design calculation sheets with the project number, micropile structure location, designation, date of preparation, initials of designer and checker, and page number at the top of each page. Provide an index page with the design calculations.

g. Design notes including an explanation of any symbols and computer program used in the design.

h. Pile to footing connection calculations.

2. Plans

a. A plan view of the micropile structures identifying;

i. A reference baseline and elevation datum.

ii. The offset from the construction centerline or baseline to the face of the micropile structure at all changes in horizontal alignment.

iii. Beginning and end of micropile structure stations.

iv. Right-of-way and permanent or temporary construction easement limits, location of all known active and abandoned utilities, adjacent structures or other potential interference. The centerline of any drainage structure or drainage pipe behind, passing through or passing under the micropile structure.

v. Subsurface exploration locations shown on the plan view of the proposed micropile structure alignment with appropriate reference baselines to fix the locations of the exploration relative to the micropile structure.

b. An elevation view of the micropile structure(s) identifying;

i. Elevation view showing micropile locations and elevations; vertical and horizontal spacing; batter and alignment and the location of drainage elements (if applicable).

ii. Existing and finish grade profiles both behind and in front of the micropile structure.

c. Design parameters and applicable codes.

d. General notes for constructing the micropile structure including construction sequencing or other special construction requirements.

e. Horizontal and vertical curve data affecting the micropile structure and micropile structure control points. Match lines or other details to relate micropile structure stationing to centerline stationing.

f. A listing of the summary of quantities on the elevation drawing of each micropile structure showing pay item estimated quantities.

g. Micropile typical sections including micropile spacing and inclination; minimum

drillhole diameter; pipe casing and reinforcing bar size and details; splice type and locations; centralizers and spacers; grout bond zone and casing plunge length (if used); corrosion protection details; and connection details to the substructure footing, anchorage, plates, etc.

h. A typical detail of verification and production proof test micropiles defining the micropile length, minimum drillhole diameter, inclination, and load test bonded and unbonded test lengths.

i. Details, dimensions and schedules for all micropiles, casing and reinforcing steel, including reinforcing bar bending details.

j. Details for constructing micropile structures around drainage facilities (if applicable).

3. Construction Procedures

a. Detailed step-by-step description of the proposed micropile construction procedure, including personnel, testing and equipment to assure quality control. This step-by-step procedure shall be shown in sufficient detail to allow the Engineer to monitor the construction and quality of the micropiles.

b. Proposed start date and time schedule and micropile installation schedule providing the following:

i. Micropile number.

ii. Micropile design load.

iii. Type and size of rebar.

iv. Minimum total bond length.

v. Total micropile length.

vi. Micropile top footing attachment.

c. If welding of casing is proposed, submit the welding procedure. All welding shall be done in accordance with the current AWS Structural Welding Code.

d. Information on space requirements for installation equipment that verify the proposed equipment can perform at the site.

e. Plan describing how surface water, drill flush, and excess waste grout will be controlled and disposed.

f. Certified mill test reports for the reinforcing steel and for permanent casing. The ultimate strength, yield strength, elongation, and material properties composition shall be included. For API N-80 pipe casing, coupon test results may be submitted in lieu of mill certification.

g. Proposed Grouting Plan. The grouting plan shall include complete descriptions, and details for the following:

i. Grout mix design and type of materials to be used in the grout including certified test data and trial batch reports. The Contractor shall also provide specific gravity of the wet mix design.

ii. Methods and equipment for accurately monitoring and recording the grout depth and grout volume as the grout is being placed.

iii. Estimated curing time for grout to achieve specified strength. Previous test results for the proposed grout mix completed within one year of the start of grouting may be submitted for initial verification and acceptance and start of production work. During production, grout shall be tested in accordance with Article M.03.01 of the Form 816.

iv. Procedure and equipment for Contractor monitoring of grout quality. At a minimum, the Contractor shall be required to use a Baroid Mud Balance (per API RP-13B-1) to check the specific gravity of the mixed grout prior to placement of the grout into each drilled micropile.

4. Detailed plans for the proposed micropile load testing method. This shall include all drawings, details, and structural design calculations necessary to clearly describe the proposed test method, reaction load system capacity and equipment setup, types and accuracy of apparatus to be used for applying and measuring the test loads and pile top movements in accordance with this specification.

5. Calibration reports and data for each test jack, pressure gauge and master pressure gauge and electronic load cell to be used. The calibration tests shall have been performed by an independent testing laboratory, and tests shall have been performed within 90 calendar days of the date submitted. Testing shall not commence until the Engineer has reviewed and accepted the jack, pressure gauge, master pressure gauge and electronic load cell calibration data.

Work shall not begin until the construction submittals have been received, reviewed, and accepted in writing by the Engineer. Any submittals that are found to be unacceptable by the engineer shall be revised, resubmitted and accepted prior to commencing work.

3 - Pre-construction Meeting.

A pre-construction meeting will be scheduled by the Engineer and held prior to the start of micropile construction. The design Engineer, supervising Engineer, prime Contractor, and micropile specialty Contractor, shall attend the meeting. Attendance is mandatory. The pre-construction meeting will be conducted to clarify the construction requirements for the work, to coordinate the construction schedule and activities, and to identify contractual relationships and delineation of responsibilities amongst the prime Contractor and the various Subcontractors – specifically those pertaining to excavation for micropile structures, installation of temporary sheeting, anticipated subsurface conditions, micropile installation and testing, micropile structure survey control and site drainage control.

4 - Site Drainage Control.

The Contractor shall control and properly dispose of drill flush and construction related waste, including excess grout, in accordance with Section 1.10 of the Form 816, any related specifications within the contract documents and all applicable codes and regulations. Drill flush shall be conveyed by pipe, hose or conduit a minimum 20ft away from the location where the micropile is being drilled and away from any adjacent structure or facility. Provide positive control and discharge of all surface water that will affect construction of the micropile installation. Maintain all pipes or conduits used to control surface water during construction. Repair damage caused by surface water at no additional cost. Upon substantial completion of the work, remove surface water control pipes or conduits from the site. Alternatively, with the approval of the Engineer, pipes or conduits that are left in place may be fully grouted and abandoned or left in a way that protects the structure and all adjacent facilities from migration of fines through the pipe or conduit and potential ground loss.

Immediately contact the Engineer if unanticipated existing subsurface drainage structures or other utilities are discovered during excavation or drilling. Suspend work in these areas until remedial measures meeting the Engineer's approval are implemented.

5 - Excavation

Coordinate the work and the excavation so the micropile structures are safely constructed. Perform the micropile construction and related excavation in accordance with the Plans and approved submittals.

6 - Micropile Allowable Construction Tolerances

1. Centerline of piling shall not be more than 3 inches from indicated plan location.
2. Pile shall be plumb or battered within 2 percent of total-length plan alignment.
3. Top elevation of pile shall be plus 1 inch or minus 1 inch maximum from vertical elevation indicated.
4. Centerline of reinforcing steel shall not be more than 0.5 inches from indicated location.

7 - Micropile Installation

The micropile Contractor shall select the drilling method, the grouting procedure and the grouting pressure used for installation of the micropiles. The micropile Contractor shall also determine the micropile casing size, final drillhole diameter and bond length, and central tendon reinforcement steel sizing necessary to develop the specified load capacities and load testing requirements. The micropile Contractor is also responsible for estimating the grout take. There will be no extra payment for grout overruns.

Should the plans require uncased drilling of the micropile into bedrock, the permanent and/or temporary casing shall be drilled a minimum 6 inches into ledge or to a depth within the ledge so as to prevent subsidence of over burden into the uncased and/or bond zone portion of the drill hole (i.e. the rock socket). The plans show estimated permanent casing lengths for each

substructure unit. Any difference in the required length of permanent casing installed and accepted by the Engineer from the estimated lengths shown on the plans shall be measured for payment and/or credit. There will be no payment for differences in required length of temporary casing.

The drilling equipment and methods shall be suitable for drilling through the conditions to be encountered, without causing damage to the overburden above rock head, any overlying or adjacent structures, buried structures or utilities, or services. If called for in the drilling method description, or by the nature of the stratum to be drilled through, the micropile Contractor shall furnish an overburden casing of the type and thickness, which can be installed without distortion. Casings that fail, fracture, or otherwise distort during drilling or after drilling shall, unless otherwise directed, be withdrawn or replaced at the micropile Contractor's expense. The drillhole must be open along its full length to at least the design minimum drillhole diameter prior to placing grout and reinforcement.

Temporary casing or other approved method of pile drillhole support will be required in caving or unstable ground to permit the pile shaft to be formed the minimum design drillhole diameter. The Contractor's proposed method(s) to provide drillhole support and to prevent detrimental ground movements shall be reviewed by the Engineer. Detrimental ground movement is defined as movement which requires remedial repair measures, in order to maintain site conditions as determined by the Engineer. Use of drilling fluid containing bentonite or any other non-reverting drilling fluid is not allowed.

During construction, the Contractor shall observe the ground conditions in the vicinity of the micropile construction site on a daily basis for signs of ground heave or subsidence. Immediately notify the Engineer if signs of movements are observed. The micropile Contractor shall immediately suspend or modify drilling or grouting operations if ground heave or subsidence is observed, if the micropile structure is adversely affected, or if adjacent structures are damaged from the drilling or grouting. If the Engineer determines that the movements require corrective action, the micropile Contractor shall take corrective actions necessary to stop the movement or perform repairs.

Reinforcement may be placed prior to grouting the drillhole. Reinforcement surface shall be free of deleterious substances such as soil, mud, grease or oil that might contaminate the grout or coat the reinforcement and impair bond. Pile reinforcement groups, if used, shall be sufficiently strong to withstand the installation and grouting process without damage or disturbance.

The micropile Contractor shall check pile top elevations and adjust all installed micropiles to the planned elevations.

Centralizers and spacers shall be provided at 10ft centers maximum spacing. The upper and lower most centralizer shall be located a maximum of 3ft from the top and bottom of the micropile. Centralizers and spacers shall permit the free flow of grout without misalignment of the reinforcing bar(s) and permanent casing. The reinforcing steel shall be inserted into the drill hole to the desired depth without difficulty. Partially inserted reinforcing bars shall not be driven or forced into the hole. The micropile Contractor shall re-drill and reinsert reinforcing steel when necessary to facilitate insertion.

Lengths of casing and reinforcing bars to be spliced shall be secured in proper alignment and in a manner to avoid eccentricity or angle between the axes of the two lengths to be spliced. Splices and threaded joints shall meet the requirements of the rebar material. Threaded pipe casing joints shall be located at least two casing diameters (OD) from a splice in any reinforcing bar. When multiple bars are used, bar splices shall be staggered at least 1 foot.

Micropiles shall be grouted the same day the load transfer bond length is drilled. The grouting equipment used shall be a colloidal grout plant, and shall produce a grout free of lumps and undispersed cement. Paddle type mixers are not acceptable. The micropile Contractor shall have means and methods of measuring the grout quantity and pumping pressures during the grouting operations. The grout pump shall be equipped with a pressure gauge to monitor grout pressure. A second pressure gauge shall be placed at the point of injection into the pile top. The pressure gauge shall be capable of measuring pressures of at least 145 psi or twice the actual grout pressure used, whichever is greater. The grout shall be kept in agitation prior to mixing. Grout shall be placed within one hour of mixing. The grouting equipment shall be sized to enable each pile to be grouted in one continuous operation. The grout shall be injected from the lowest point of the drill hole and injection shall continue until uncontaminated grout flows from the top of the pile. The grout may be pumped through grout tubes, casing, hollow stem augers or drill rods. Temporary casing, if used, shall be extracted in stages ensuring that, after each length of casing is removed the grout level is brought back up to the ground level before the next length is removed. The tremie pipe or casing shall always extend below the level of the existing grout in the drillhole. The grout takes shall be controlled to prevent excessive heave or fracturing of rock or soil formations. Upon completion of grouting, the grout tube may remain in the hole, but must be filled with grout.

If the Contractor elects to use a post-grouting system, Working Drawings and details shall be submitted to the Engineer for review in accordance with Article 1.05 of the Form 816.

Grout within the micropile verification and proof test piles shall attain the minimum required 3-day compressive strength prior to load testing. During production, micropile grout shall be tested by the Contractor for compressive strength in accordance with AASHTO T106/ASTM C109 at a frequency of no less than one set of three 2 inch grout cubes, or 3” cylinders, from each grout plant each day of operation or per every 10 piles, whichever occurs more frequently. The compressive strength shall be the average of the 3 cubes tested.

Grout consistency as measured by grout density shall be determined by the micropile Contractor per API RP-13B-1 at a frequency of at least one test per pile, conducted just prior to start of pile grouting. The Baroid Mud Balance used in accordance with API RP-13B-1 is an approved device for determining the grout density of neat cement grout.

Provide grout cube/cylinder compressive strength and grout density test results to the Engineer within 24 hours of testing.

8 - Micropile Installation Records.

The micropile Contractor shall prepare and submit to the Engineer full-length installation records for each micropile installed. The records shall be submitted within one work shift after that pile installation is completed. The data shall be recorded on a micropile installation log. A separate log shall be provided for each micropile.

9 – Verification and Proof Tests

Perform verification and proof testing of piles at the locations specified on the plans. Perform compression load testing in accord with ASTM D1143 and tension load testing in accord with ASTM D3689, except as modified herein.

Perform pre-production verification pile load test(s) to verify the design of the pile system and the construction methods proposed prior to installing any production piles. Sacrificial verification test pile(s) shall be constructed in conformance with the approved Working Drawings. Verification test pile(s) shall be installed at the location(s) shown on the plans or at a location(s) approved by the Engineer.

Verification load test(s) shall be performed to verify that the Contractor installed micropiles will meet the compression and/or tensile load capacities and load test acceptance criteria and to verify the length of the micropile load transfer bond zone is adequate. The micropile verification load test results must verify the Contractor's design and installation methods.

The drilling method, grouting method, casing length, micropile diameter (cased and uncased), reinforcing bar length and length of embedment for the verification test pile shall be identical to those specified for the production piles at the given locations. The verification test micropile structural steel sections shall be sized to safely resist the maximum test load.

The maximum verification and proof test loads applied to the micropile shall not exceed 80 percent of the structural capacity of the micropile structural elements; include steel yield in tension, steel yield or buckling in compression, or grout crushing in compression. Any required increase in strength of the verification and proof test pile elements above the strength required for the production piles shall be provided for in the Contractor's bid price.

Testing equipment shall include dial gauges, dial gauge independent reference frame, jack and pressure gauge, electronic load cell (with readout device), and a reaction frame. The load cell is required only for the creep test portion of the verification test. The contractor shall provide a description of test setup and jack, pressure gauge and load cell calibration curves in accordance with the Submittals Section.

Design the testing reaction frame to be sufficiently rigid and of adequate dimensions such that excessive deformation of the testing equipment does not occur. Align the jack, bearing plates, and stressing anchorage such that unloading and repositioning of the equipment will not be required during the test.

Apply and measure the test load with a hydraulic jack and pressure gauge. The pressure gauge

shall be graduated in 100psi increments or less. The jack and pressure gauge shall have a pressure range not exceeding twice the anticipated maximum test pressure. Jack ram travel shall be sufficient to allow the test to be done without resetting the equipment. Monitor the creep test load hold during verification tests with both the pressure gauge and the electronic load cell. Use the load cell to accurately maintain a constant load hold during the creep test load hold increment of the verification test.

Measure the pile top movement with a dial gauge capable of measuring to 0.001 inches. The dial gauge shall have a travel sufficient to allow the test to be done without having to reset the gauge. Visually align the gauge to be parallel with the axis of the micropile and support the gauge independently from the jack, pile or reaction frame. Use a minimum of two dial gauges when the test setup requires reaction against the ground or single reaction piles on each side of the test pile.

Test verification piles to a maximum test load of 2.0 times the maximum allowable compressive load, hereafter termed, "Design Load" shown on the Plans. The verification pile load tests shall be made by incrementally loading the micropile in accordance with the following cyclic load schedule for both compression and tension loading (test the compression prior to tension):

Verification Test Loading Schedule		
AL = Alignment Load DL = Design Load		
	LOAD	HOLD TIME
1	AL (.05 DL)	1 minute
2	0.25 DL	1 minute
3	0.50 DL	1 minute
4	AL	1 minute
5	0.25 DL	1 minute
6	0.50 DL	1 minute
7	0.75 DL	1 minute
8	AL	1 minute
9	0.25 DL	1 minute
10	0.50 DL	1 minute
11	0.75 DL	1 minute
12	1.00 DL	1 minute
13	AL	1 minute
14	0.25 DL	1 minute
15	0.50 DL	1 minute
16	0.75 DL	1 minute
17	1.00 DL	1 minute
18	1.33 DL	60 minutes
19	1.75 DL	1 minute
20	2.00 DL (Maximum Test Load)	10 minutes
23	AL	1 minute

The test load shall be applied in increments of 25 percent of the DL load. Each load increment shall be held for a minimum of 1 minute. Pile top movement shall be measured at each load increment. The load-hold period shall start as soon as each test load increment is applied. The verification test pile shall be monitored for creep at the 1.33 Design Load (DL). Pile movement during the creep test shall be measured and recorded at 1, 2, 3, 4, 5, 6, 10, 20, 30, 50, and 60 minutes. The alignment load shall not exceed 5 percent of the DL load. Dial gauges shall be reset to zero after the initial AL is applied.

The acceptance criteria for micropile verification load test are:

1. The Engineer shall determine the criteria for tolerable movement during the load test at the top of the micropile.

2. At the end of the 1.33 DL creep test load increment, test piles shall have a creep rate not exceeding 0.05 inch/log cycle time (1 to 10 minutes) or 0.1 inch/log cycle time (6 to 60 minutes or the last log cycle if held longer). The creep rate shall be linear or decreasing throughout the creep load hold period.
3. Failure does not occur at any load increment up to and including the 2.0 D.L. max test load. Failure is defined as load at which attempts to further increase the test load simply result in continued pile movement.

Upon completion of the test, the Contractor shall submit a report stamped by a qualified Professional Engineer licensed in the State of Connecticut of the test results for review and acceptance by the Engineer prior to beginning installation of production micropiles. This report shall include written confirmation of the verification micropile's capacity.

If a verification tested micropile fails to meet the acceptance criteria, the Contractor shall modify the design, the construction procedure, or both. These modifications may include modifying the installation methods, increasing the bond length, or changing the micropile type. Any modification that necessitates changes to the structure shall be submitted as a revision to the working drawings and require the Engineer's review and acceptance. Any modifications of design or construction procedures or cost of additional verification test piles and load testing shall be at the Contractor's expense. At the completion of verification testing, test piles shall be removed down to the elevation specified by the Engineer.

Perform proof load tests at the micropile locations as shown on the plans. Perform proof load tests on the first set of production piles installed at each designated substructure unit prior to the installation of the remaining production piles in that unit. The initial proof test piles shall be installed at the locations shown on the plans. Upon completion of each test, the Contractor shall submit a report stamped by a qualified Professional Engineer licensed in the State of Connecticut of the test results for review and acceptance by the Engineer

Proof test piles to a maximum test load of 1.67 times the micropile Design Load shown on the Plans or Working Drawings. Proof tests shall be made by incrementally loading the micropile in accordance with the following schedule, to be used for both compression and tension loading:

Proof Test Loading Schedule		
AL = Alignment Load DL = Design Load		
	LOAD	HOLD TIME
1	AL	1 minute
2	0.25 DL	1 minute
3	0.50 DL	1 minute
4	0.75 DL	1 minute
5	1.00 DL	1 minute
6	1.33 DL	60 minutes Creep Test
7	1.67 DL (Maximum Test Load)	1 minute
8	AL	1 minute

Depending on performance, either a 10 minute or 60 minute creep test shall be performed at the 1.33 DL Test Load. Where the pile top movement between 1 and 10 minutes exceeds 1 mm, the Maximum Test Load shall be maintained an additional 50 minutes. Movements shall be recorded at 1, 2, 3, 5, 6, 10, 20, 30, 50 and 60 minutes. The alignment load shall not exceed 5 percent of DL. Dial gauges shall be reset to zero after the initial AL is applied.

The acceptance criteria for micropile proof load tests are:

1. The Engineer shall determine the criteria for tolerable movement during the load test at the top of the micropile.

2. At the end of the 1.33 DL creep test load increment, test piles shall have a creep rate not exceeding 0.05 inch/log cycle time (1 to 10 minutes) or 0.1 inch/log cycle time (6 to 60 minutes).The creep rate shall be linear or decreasing throughout the creep load hold period.

3. Failure does not occur at the 1.67 DL maximum test load. Failure is defined as the load at which attempts to further increase the test load simply result in continued pile movement.

If a proof-tested micropile fails to meet the acceptance criteria, the Contractor shall immediately proof test another micropile within that footing. For failed piles and further construction of other piles, the Contractor shall modify the design, the construction procedure, or both. These modifications may include installing replacement micropiles, incorporating piles at not more than 50% of the maximum load attained, post-grouting the tested pile and re-proof testing the pile, modifying installation methods, increasing the bond length, or changing the micropile type. Any modification that necessitates changes to the structure design shall require the Engineer's prior review and acceptance. Any modifications of design or construction procedures, or cost of additional verification test piles and verification and/or proof load testing, or replacement production micropiles, shall be at the Contractor's expense.

Method of Measurement: Measurement will be made as follows for the quantity, as specified or directed by the Engineer. Micropiles will be measured as each installed, and accepted. There will be no separate measurement for mobilization and demobilization associated with this item. Verification Tests (performed on sacrificial micropiles) and Proof Tests (performed on production piles) for Micropiles will be measured as each. Micropile Length Adjustment will be measured in feet as the difference between the estimated length of permanent casing, as shown on the plans, and the actual length of permanent casing installed and accepted by the Engineer. Note that the permanent casing length is measured from the bottom of the pile cap to the permanent casing tip, including the required embedment into rock. Embedment into the pile cap will not be measured for payment because it is considered incidental to micropile construction. Any increase in casing length will be measured for payment to the Contractor, and any decrease in casing length will be measured for credit to the State.

Basis of Payment: The quantities accepted for payment will be paid for at the contract unit prices for the for the items listed below, complete in place and accepted, which price shall include all materials, equipment, tools, proper disposal of drilling spoil, and labor incidental thereto.

Pay Item	Pay Unit
Micropiles	EA.
Verification Test for Micropiles	EA.
Proof Test for Micropiles	EA.
Micropile Length Adjustment	L.F.

ITEM #0707013A – RAILROAD DECK WATERPROOFING

Description: This work shall consist of furnishing and installing an acrylic-based, cold spray applied seamless, elastomeric waterproofing system on the top surface and sides of the deck before the installation of ballast mat as shown on the plans, in conformance with either of the two systems described herein.

Materials: Delete this article and add the following:

The products and materials for this work shall conform to the following requirements:

A. The primer shall be a 100% reactive, acrylic-based, spray applied resin capable of a full cure in 40 minutes at 68^{o} F (20^{o} C) and equal to Stirling Lloyd Products, Inc. PAR1 for use on concrete.

B. The elastomeric waterproofing membrane shall meet the following requirements:

1. The membrane shall be 100% reactive, acrylic-based, two-component, spray applied material, and equal to Stirling Lloyd Products, Inc. ELIMINATOR.

2. The membrane shall meet or exceed the following properties as related to laboratory prepared samples tested at 68^{o} F (20^{o} C) and 24-hour cure where applicable.

Property	**Test Method**	**Units**
Gel Time	Stirling Lloyd 001	6-11 minutes
Cure Time	Stirling Lloyd 001	30 minutes
Water Vapor Transmission	ASTM E96-80	6.6 g/m^2/day
Adhesion to Concrete	ASTM D4541	100 psi (0.7 MPa) or failure in concrete
Adhesion to Steel	ASTM D4541	290 psi (2.0 MPa)
Minimum Tensile Strength	ASTM D638, Method A, Die C	940 psi (6.4 N/mm^2)
Minimum Elongation at Break	ASTM D638, Method A, Die C	80%
Low Temperature Flexibility	CAN CGSB 37.50 M89	Pass ¼" (6 mm) made at -13^{o} F (-25^{o} C)
Crack Bridging	ASTM C836-89a	Pass @ 25 cycles, 0.0625 in. (1.59 mm), -15^{o} F (-26^{o} C)
Ballast Impact	SNCF Test Method	No damage

3. The cured membrane shall be capable of carrying the direct load of a Cooper E-80 vehicle load distributed over a 7" deep layer of ballast, without the need for any protective cover.

C. Related materials determined in consultation with the Manufacturer on the basis of feasibility of application and recommended preparation.

Construction Methods: Delete this article and add the following:

Construction methods and procedures shall conform to the following requirements:

A. SUBMITTALS:
The following material shall be submitted prior to any waterproofing installation.

1. The latest edition of the Manufacturer's literature including performance data and installation procedures, In accordance with Article 1.06.07 (Certified Test Reports and Materials Certificates).

2. List of references for similar projects completed during the last five years. In accordance with Article 1.06.07 (Certified Test Reports and Materials Certificates).

3. An 8 in. (200 mm) square sample of the proposed membrane; Color, texture, and thickness shall be representative of overall appearance, In accordance with Article 1.06.02 (Samples and Test).

B. QUALITY ASSURANCE:

1. The Manufacturer shall have a minimum of 10 years experience in the production, sales, and technical support of waterproofing membranes and related materials.

2. Proposed suppliers of "or equal" products shall be required to meet all provisions of this specification as well as provide evidence for compatibility between components to the satisfaction of the Engineer.

3. The Applicator shall be fully licensed by the Manufacturer.

4. A Certificate of Conformance shall be issued by the Manufacturer with each delivery of materials to the site.

5. The materials shall be manufactured by or equal to:

Stirling Lloyd Products, Inc.
152 Rockwell Road
Building A
Newington, CT 06111
Phone: 860-666-5008; Fax: 860-666-5106

C. WARRANTY: The Manufacture shall warrant the materials used on the project as evidenced by the Certificate of Conformance. Liability shall be limited to replacement of materials used.

D. SYSTEM DESCRIPTION:

1. A nominal 120 mils (3.0 mm) acrylic-based, cold liquid-applied, elastomeric waterproofing membrane to provide protection against corrosion of concrete or steel. Protection board shall not be required, as the membrane shall withstand the direct loading of ballast.

2. The system shall be applied to the prepared area(s) as defined in the plans strictly in accordance with the Manufacturer's recommendations.

E. SEQUENCING AND SCHEDULING: The Contractor and Engineer shall agree upon a schedule for coordinating activities in the area, which is to receive the system.

F. DELIVERY, STORAGE AND HANDLING:

1. All components of the system shall be delivered to the site in the Manufacturer's packaging, clearly identified with the product type and batch number.

2. The Applicator shall be provided with a storage area for all components. The area shall be cool, dry, out of direct sunlight and in accordance with the Manufacturer's recommendations and relevant health and safety regulations.

3. Copies of Material Safety Data Sheets (MSDS) for all components shall be kept on site for review by the Engineer or other personnel.

G. PROJECT CONDITIONS:

1. Application can proceed while air and substrate temperature is between 32^{o} F (0^{o} C) and 104^{o} F (40^{o} C) providing the substrate is above the dew point. Outside of this range, the Manufacturer shall be consulted.

2. The Applicator shall be provided with adequate disposal facilities for non-hazardous waste generated during installation of the system.

3. All open flames and spark-producing equipment shall be removed from the work area prior to commencement of application.

4. "No-Smoking" signs shall be posted at the entrances to the work area.

5. Non-related personnel in the work area shall be kept to a minimum.

H. INSPECTION:

1. Prior to the priming of the surface the Engineer and the Applicator shall

inspect and approve the prepared substrate.

a. Random tests for adequate tensile strength shall be conducted on the substrate by the Applicator at the job site using an Elcometer Adhesion Tester Model 106 or similar at a minimum frequency per 5,000 ft^2 ($500m^2$). Smaller areas shall receive a minimum of three tests.

b. Adequate surface preparation will be indicated by tensile bond strengths of primer to the substrate greater than or equal to 100 psi (0.7 MPa) for concrete decks.

c. Should the tensile bond strengths be lower than the minimum specified, the Engineer may request additional substrate preparation.

d. Cracks and joints shall be treated in accordance with the Manufacturer's recommendations as approved or directed by the Engineer.

I. APPLICATION: The system shall be applied in three distinct steps as listed below:

* Substrate Preparation
* Priming
* Membrane Application

1. Where the area to be treated is bound by a vertical surface (e.g., curb or wall), the system may be continued up the vertical as necessary using the appropriate grade of membrane as agreed with by the Manufacturer.

2. The handling, mixing and addition of components shall be performed in a safe manner to achieve the desired results in accordance with the Manufacturer's recommendations as approved or directed by the Engineer.

3. A neat finish with well-defined boundaries and straight edges shall be provided by the Applicator.

4. Surface Preparation:

a. Concrete surfaces shall be free of oil, grease, curing compounds, loose particles, moss, algae, rust, growth, friable matter, dirt, bituminous products and previous waterproofing materials. If required, degreasing shall be performed via detergent washing in accordance with ASTM D4258.

b. There shall be no visible moisture present on the surface at the time of the application of the System. Compressed oil-free air and/or a light passing of a propane torch may be used to dry the substrate.

c. Removal of contaminants and surface preparation shall be performed by means approved by the Engineer to an agreed standard.

d. Within four hours of cleaning, all detritus shall be removed from the

substrate and the primer coat applied.

e. The surface shall be abrasively cleaned, in accordance with ASTM D4259, to provide substrate free from laitance.

f. The substrate shall be sounded and all spalls repaired prior to placement of primer coat. Spalls shall be repaired with rapid-cure concrete patch materials as per the Engineer's and the Manufacturer's recommendations.

g. Voids and blow holes on vertical surfaces shall be repaired in the same manner.

h. The surface profile of the concrete is not to exceed ¼ inch peak-to-valley, and areas of minor surface deterioration of ½ inch and greater shall also be repaired to prevent excessive product usage. The extent and location of thin surface patches shall require the approval of the Engineer before the system is applied.

5. Primer

a. The primer shall consist of one coat with an overall coverage rate of 125-175 ft^2/gal (3.0 – 4.3 m^2/1).

b. All components shall be measured and mixed in accordance with the Manufacturer's recommendations.

c. The primer shall be spray-applied using a single component spray system approved for use by the Manufacturer. If required by site conditions, brush or roller application shall be allowed.

d. Porous concrete may require a second coat of primer should the first coat be absorbed.

e. The primer shall cure tack-free before application of the waterproofing membrane.

6. Membrane

a. The waterproofing membrane shall consist of two coats with a total film thickness of 60 mils (1.5 mm) per coat and a total of 120 mils (3.0 mm) to achieve an overall coverage rate of 13.4 ft^2/gal (0.33 m^2/l).

b. The membrane shall be comprised of two liquid Components A and B and a hardener powder which is to be added to Components B in accordance with the Manufacturer's recommendations.

c. If required by site conditions, the membrane shall be applied by brush, gauge rake or trowel.

d. The substrate shall be coated in a methodical manner. Checks for wet film thickness shall be carried out typically once every 100 ft^2 (9m^2).

e. The membrane shall cure tack-free before opening to service.

7. Repairs

a. If an area is left untreated or the membrane becomes damaged, a patch repair shall be carried out to restore the integrity of the System. The damaged area shall be cut back to sound material and wiped with solvent (e.g., acetone) up to a width of at least 4 in. (100 mm) on the periphery. The substrate shall be primed if necessary, followed by the application of membrane. A continuous layer shall be obtained over the substrate with a 4 in. (100 mm) overlap onto the existing membrane.

b. Where the membrane is to be joined to existing cured material and at day joints the new application shall overlap the existing one by at least 4 in. (100 mm). No preparation shall be necessary unless the existing materials are contaminated with dirt in which case the repair/overlap area shall first be wiped with solvent (e.g., acetone).

J. FIELD QUALITY CONTROL: The following sampling, tests, and inspections shall be conducted by the Applicator or Manufacturer's representative and recorded on a form to be submitted to the Engineer.

1. Air, substrate temperatures, and dew point. Dew point shall be calculated from temperature and humidity using standard tables.

2. Adhesion tests of the cured membrane shall be checked in accordance with Section H.1.a. above.

3. Wet film thickness shall be checked every 100 ft^2 (9 mm^2) using a gauge pin or standard comb type thickness gauge.

4. Coverage Rates for all layers shall be monitored by checking quantity of material used against the area covered.

5. When deemed necessary by the Engineer, samples shall be provided for each day's production or every 5,000 ft^2 (500 m^2), whichever is greater. Membrane samples shall be of a minimum size of 8 in (200 mm) square.

K. FINAL REVIEW: The Engineer and Applicator shall jointly review the area(s) in which the completed system has been installed. Any irregularities or other items, which do not meet the requirements of the Engineer, shall be addressed at this time.

Method of Measurement: This Work will be measured for payment by the number of square yards of membrane waterproofing completed and accepted within neat lines as shown on the plans. Metal sheeting, metal flashing, sealer, and any other materials

necessary to make a complete and proper waterproofing system will not be measured and are considered incidental to this work.

Basis of Payment: This Work will be paid for at the Contract Unit Price per square yard for "Railroad Deck Waterproofing" complete in place, which price shall be full compensation for furnishing all material, including protective course, technical representatives, equipment, tools, labor and incidentals necessary to satisfactorily complete the Work.

Pay Item	Pay Unit
Railroad Deck Waterproofing	S.Y.

ITEM #0714016A – LAGGING

Description: Work under this item shall consist of furnishing all labor, materials, tools, equipment, transportation, and installation of permanent lagging along the front and side faces of the proposed Bridge 08012R abutments as specified herein and shown on the Contract Drawings.

Material: The material for lagging shall be precast reinforced concrete and structural steel as shown on the Contract Drawings.

Method of Measurement: Lagging will be measured for payment by the number of square feet completed and accepted. This area will be measured or computed from the horizontal and vertical payment limits shown on the plans or as ordered. If no payment limits are shown on the plans, the limits used for payment will be the actual horizontal and vertical limit of lagging installed and accepted.

Basis of Payment: Payment for this work will be made at the contract unit price per square foot for "Lagging" measured as described above. The price shall include all design, materials, equipment and labor incidental to the construction of the lagging required at the locations specified on the plans; including removal of obstructions, repair and correction, adjustments or reconstruction required.

Pay Item	Pay Unit
Lagging	S.F.

ITEM #0714026A - TEMPORARY SHEET PILING (RAILROAD)
ITEM #0714045A - TEMPORARY SOLDIER PILE AND LAGGING (RAILROAD)

Work under this item shall conform to the requirements of Section 7.14, supplemented and amended as follows:

7.14.01-Description: Add the following:

The system(s) shall be designed for lateral earth pressure, piezometric forces, construction loads and Cooper E80 live loads as applicable.

It is required that temporary excavation support system(s) be properly designed soldier pile and lagging or alternative properly braced systems. Cantilevered, unbraced steel sheet piling systems are not acceptable for railroad sheet piling applications.

The Contractor shall monitor the temporary excavation support system and the Railroad facilities being supported for movement in accordance with applicable monitoring items.

7.14.02-Materials: Add the following:

Steel: Steel soldier piles, walers and fabrications shall conform to the requirements of AASHTO M 183 (ASTM A 36) or AASHTO M 223 (ASTM A 572).

Lagging: Timber lagging shall be construction grade, rough cut and shall be a minimum of 3" thick, and shall conform to Specification for Structural Timber, Lumber and Piling, AASHTO M168. Where necessary, the Contractor shall provide certification that the timber conforms to the grade, species, and other specified requirements. If timber is to be treated with a preservative, a certificate of compliance shall be furnished.

Precast concrete lagging shall conform to Section 8.13 "Precast Concrete Members" of AASHTO "Standard Specifications for Highway Bridges." Concrete for the precast elements shall have a minimum 28-day compressive strength of 5000 psi.

7.14.03-Construction Methods: Add the following:

Installation of any tieback anchor system, soldier piles and other miscellaneous components of temporary excavation support systems shall not interfere with stage construction requirements or existing facilities.

The Contractor shall perform all work required for the design, installation, maintenance, and removal of temporary excavation support systems in a manner that satisfies the operational requirements of the railroad as noted in the Contract documents.

Construction staking shall be performed in accordance with applicable "Construction Staking"

item.

7.14.04-Method of Measurement: Add the following:

No separate measurement will be made for maintenance (including replacement, if necessary) of the temporary excavation support systems if required to provide adequate support to the protected facilities.

7.14.05-Basis of Payment: Delete the first sentence of this section and replace with the following:

Payment for this work will be made at the contract unit price per square foot for "Temporary Sheet Piling (Railroad)" or "Temporary Soldier Pile and Lagging (Railroad)," as applicable, measured as described in Section 7.14.04, as modified above. The unit price shall include all materials, tools, equipment, and labor incidental to the design, construction, maintenance and removal of the temporary excavation support systems required at the locations specified on the plans.

Monitoring of the rail facilities and the excavation support systems for movement during construction will be performed and paid under the applicable monitoring item.

Pay Item	Pay Unit
Temporary Sheet Piling (Railroad)	S.F.
Temporary Soldier Pile and Lagging (Railroad)	S.F.

ITEM #0714046A - SOLDIER PILE AND LAGGING LEFT IN PLACE (RAILROAD)

Description: This specification covers only that portion of the Temporary Soldier Pile and Lagging (Railroad) that may be ordered left in place by the Engineer or designated in the plans to be left in place.

Materials: Vacant

Construction Methods: The Contractor shall submit to the Engineer for approval, plans showing the proposed method of construction prior to the start of such construction.

Method of Measurement: Temporary Soldier Pile and Lagging (Railroad) material left in place will be measured for payment by the square foot. This area will be measured or computed from the horizontal and vertical payment limits shown on the plans or as ordered. If no payment limits are shown on the plans, the limits used for payment will be the actual horizontal limit of Temporary Soldier Pile and Lagging (Railroad) ordered or designated in the plans to be left in place, and the vertical limit will correspond to the method of measurement of the Temporary Soldier Pile and Lagging (Railroad).

Temporary Soldier Pile and Lagging (Railroad) left in place solely at the Contractor's option, and with the Engineer's permission, will not be measured for payment.

Basis of Payment: Payment for this work will be made as follows:

That portion of the Temporary Soldier Pile and Lagging (Railroad) ordered or designated in the plans to be left in place will be paid for at the contract unit price per square foot for "Soldier Pile and Lagging Left in Place (Railroad)," applying to one or more structures or portions of structures, which price shall include only the cost of material left in place. All other expenses shall be paid for under the item for "Temporary Soldier Pile and Lagging (Railroad)."

Pay Item	Pay Unit
Soldier Pile and Lagging Left in Place (Railroad)	s.f.

ITEM #0714050A - TEMPORARY EARTH RETAINING SYSTEM

Description: Temporary earth retaining system shall be any type of adequately braced temporary retaining wall such as temporary sheet piling which the Contractor elects to build to satisfy, and which does satisfy, the condition that existing facilities be properly retained during excavation or fill for the placement of substructure or other facilities. Temporary earth retaining system shall be designed by the Contractor and constructed where shown on the plans. This system shall be removed upon completion of the permanent work, except that some sections may be left in place when so ordered by the Engineer.

Materials: Materials of steel sheet piling shall conform to the requirement of ASTM A 328. Timber sheet piling shall conform to the requirements of Subarticle M.09.01-1. Materials other than steel or timber, or a combination of these may be used provided they are properly designed for the purpose intended. Systems utilizing other material(s) shall conform to the manufacturer's specifications and project specifications. The parts list shall be furnished for the proprietary system and the Contractor shall provide the material certificates for the parts.

Construction Methods: Temporary earth retaining system shall be safely designed and shall be carried to adequate depths and braced as necessary for proper performance of the work. Construction shall be such as to permit excavation or fill as required. Interior dimensions shall be such as to give sufficient clearance for construction of forms and their inspection and for battered pile clearance when necessary. Movements of the system or bracing which prevent the proper completion of the substructure shall be corrected at the sole expense of the Contractor. No part of the temporary earth retaining system or bracing shall be allowed to extend into the substructure without written permission of the Engineer.

Working drawings and design calculations for temporary earth retaining system shall be submitted in accordance with the requirements of Article 1.05.02(2). The working drawings and design calculations shall be prepared, sealed, and signed by a Professional Engineer, licensed in the State of Connecticut. The furnishing of such plans shall not serve to relieve the Contractor of any part of his responsibility for the safety of the work or for the successful completion of the project.

Unless otherwise ordered by the Engineer, all parts of the temporary earth retaining system shall be removed upon completion of the work for which it was provided. The excavation shall be backfilled and properly compacted, prior to removal of the system unless otherwise permitted by the Engineer. Temporary earth retaining system may be left in place at the option of the Contractor if so permitted by the Engineer, provided that it is cut off at an elevation as directed by the Engineer and the cutoffs removed from the site.

Method of Measurement: Temporary earth retaining system will be measured for payment by the number of square feet of temporary retaining wall completed and accepted, as computed from the horizontal and vertical payment lines shown on the plans or as ordered. If no payment limits are shown on the plans, the limits used for payment will be the actual horizontal limit of temporary earth retaining system installed and accepted, and the vertical limit as measured from

the bottom of the exposed face of the wall system to the top of the retained earth behind the system. The measurement for temporary earth retaining system which is used as a common wall for staged construction will be the horizontal payment limit shown on the plans and the greater vertical dimension of the common wall face.

No measurement will be made of end extensions or returns necessary for the safety of the retained facility. Earth retaining system ordered left in place by the Engineer shall be measured in accordance with "Earth Retaining System Left in Place."

Earth retaining systems left in place solely at the Contractor's option, and with the Engineer's permission, will not have an additional payment at the contract unit price per square foot for "Earth Retaining System Left in Place."

Basis of Payment: Payment for this work will be made at the contract unit price per square foot for "Temporary Earth Retaining System" measured as described above, which price shall include all design, materials, equipment and labor incidental to the construction and removal of the temporary earth retaining system required at the locations specified on the plans; including removal of obstructions, repair and correction, adjustments or reconstruction required by the plans. Any common earth retaining system required for staged construction will be measured for payment only once.

Pay Item	Pay Unit
Temporary Earth Retaining System	s.f.

ITEM #0715050A - EARTH RETAINING SYSTEM LEFT IN PLACE

Description: This specification covers only that portion of the temporary earth retaining system that may be ordered left in place by the Engineer or designated in the plans to be left in place.

Materials: Vacant

Construction Methods: The Contractor shall submit to the Engineer for approval, plans showing the proposed method of construction prior to the start of such construction.

Method of Measurement: Earth retaining system material left in place will be measured for payment by the square foot. This area will be measured or computed from the horizontal and vertical payment limits shown on the plans or as ordered. If no payment limits are shown on the plans, the limits used for payment will be the actual horizontal limit of temporary earth retaining system ordered or designated in the plans to be left in place, and the vertical limit will correspond to the method of measurement of the temporary earth retaining system.

Temporary earth retaining system left in place solely at the Contractor's option, and with the Engineer's permission, will not be measured for payment.

Basis of Payment: Payment for this work will be made as follows:

That portion of the temporary earth retaining system ordered or designated in the plans to be left in place will be paid for at the contract unit price per square foot for "Earth Retaining System Left in Place," applying to one or more structures or portions of structures, which price shall include only the cost of material left in place. All other expenses shall be paid for under the item for "Temporary Earth Retaining System."

Pay Item	Pay Unit
Earth Retaining System Left in Place	s.f.

ITEM # 0751996A - GEOCOMPOSITE SHEET DRAIN

This Special Provision provides additional requirements for Underdrains and Outlets.

Work under this item shall conform to the requirements of Section 7.51, supplemented and amended as follows:

Article 7.51.02: Materials: Delete Section 7.51.02 (2) and replace it with the following:

(2) Geocomposite Sheet Drain:

The geocomposite drain shall be of composite construction consisting of a drainage core material connecting to a structure underdrain surrounded by crushed stone (M.01.01) and filter fabric. The filter fabric shall encapsulate the crushed stone and structure underdrain. The drainage core material shall consist of a three dimensional double or single cuspated high impact polystyrene or high density polyethylene material with a structure that permits flow along the core vertically and horizontally. The core structure shall also be constructed to permit flow regardless of the water inlet surface. Geotextile shall cover the full length of the core. The core and geotextile shall meet the minimum property requirements listed in Table 1.

Table 1

Property	Test Method	Criteria
Composite Core		
Compressive Strength	ASTM D-1621	15,000 psf (min)
Flow Capacity	ASTM D-4716	15 gal per min/ft width
Geotextile		
AOS	ASTM D-4751	1 mm (max.)
Tensile Strength	ASTM D-4632	100 lbs
Permittivity	ASTM D-4491	1.8 sec -1
Puncture	ASTM D-4833	60 lbs (min.)

A geotextile flap shall be provided along all drainage core edges. This flap shall be of sufficient width for sealing the geotextile to the adjacent drainage structure edge.

The geocomposite core shall be furnished with an approved method of constructing and connecting with structure underdrains as shown on the plans. Any fittings shall allow entry of water from the core but prevent intrusion of backfill material into the core material.

The Contractor shall submit a certified test report demonstrating that the geocomposite supplied meets the design properties and respective index criteria measured in full accordance with all test methods and standards specified, and in conformance with Article 1.06.07. Minimum average roll values, per ASTM D-4759, shall be used for conformance.

In addition to criteria outlined in this specification, the Geotextile shall also conform to Subarticle M.08.01-26.

Article 7.51.03: Construction Methods: Delete paragraphs 1 and 2 and add the following to the end of the article:

The Contractor shall insure that during all periods of shipment and storage, the geocomposite material is protected from mud, dirt, all deleterious materials that might become affixed to the geocomposite, and temperatures greater than 140^{o}F. Follow manufacturer's recommendations with regards to protection from direct sunlight. At the time of installation, the geocomposite shall be free of any defects, including, but not limited to tears, punctures, flaws, deterioration, or any damage due to manufacture, transportation, and storage.

The geocomposite sheet drain shall be attached to the lagging and installed as shown on the plans and as follows. Edge seams shall be formed by utilizing the flap of the geotextile extending from the geocomposite's edge and lapping over the top of the geotextile of the adjacent course. The geotextile flap shall be securely fastened to the adjacent fabric by means of plastic tape, safety pins or non-water-soluble construction adhesive, as recommended by the supplier. Where vertical splices are necessary at the end of the geocomposite roll or panel, an 8 inch wide continuous strip of geotextile may be placed, centered over the seam and continuously fastened on both sides with plastic tape or non-water soluble construction adhesive. Care should be taken so as not to damage the geocomposite material or separation membrane during all subsequent construction activities.

The geocomposite sheet drain shall be installed as shown on the plans and in accordance with the manufacturer's recommended installation procedure. Should the geocomposite sheet drain allow insertion of the drain pipe between the geotextile and core, the contractor may elect to eliminate the crushed stone at the bottom of the trench.

Article 7.51.04: Method of Measurement: Replace with the following:

This work will be measured for payment by the number of square feet of Geocomposite Sheet Drain completed and accepted.

Article 7.51.05: Basis of Payment: Replace with the following:

This work will be paid for at the contract unit price per square foot of "Geocomposite Sheet Drain" complete in place which price shall include all material and labor incidental thereto.

Item	Pay Unit
Geocomposite Sheet Drain	s.f.

ITEM NO. 0814001A - RESET BRICK PAVERS

This work shall conform to Section 8.14 of Form 816 supplemented as follows:

Description:

Add the following:
The work shall include the removal and resetting of brick pavers at the northwest corner of Station Place and Atlantic Street on new or existing base material to the limits and grades as shown on the plans.

Base materials shall consist of granular fill, concrete and a sand layer as shown on the details.

Materials:

Delete the section and replace with the following:

Brick Pavers shall be existing. Pavers that are not usable shall be replaced with equal material of the same color and texture.

Material for this work shall conform to the following requirements:

Concrete: 3,000 psi Class "C" Concrete in accordance with the provisions of Article 4.01.03 for Concrete Pavement.

Wire Fabric: 6x6 – W2.9xW2.9 sheets in accordance with Article M.06.01.

Brick Pavers: The Contractor shall provide samples of the brick for approval by the Engineer.

Sand: In accordance with Article M.03.01 – 2 for Fine Aggregate

Granular Fill: In accordance with Article M.02.01 for Granular Fill

Construction Methods:
Add the following:
Resetting of brick pavers will consist of removing existing pavers and base material to the limits shown or as directed, storing material, installing the base materials and brick pavers to the proposed limits and grade. Damaged or unusable brick paver material shall be replaced with pavers of the same color and texture. Pavers shall be installed to match the existing pattern and cut as need to match the proposed curb radius and abut the adjacent pieces.

1 – Excavation: Excavation shall be made to required depths below finish grade, as shown necessary to achieve the desire surface drainage for the finish surface. The Contractor shall be careful of the adjacent concrete sidewalks, building and bituminous concrete driveway and curbing. Any damage caused to the surrounding features will be replaced at the Contractor's

expense.

2 –Granular Fill Base Course: The Granular Fill shall be uniformly spread upon the compacted subgrade to the require depth and thoroughly compacted in accordance with Article 9.21.03-2.

3 – Concrete: Place concrete over the prepared granular fill bedding layer in accordance with Article 9.21.03. Wire Fabric to be discontinued at all expansion joints.

4 – Brick Pavers: The brick pavers shall be placed on a sand leveling layer of approximately 1 inch thick to provide a flush joint at the interface with the adjoining curbing and or concrete sidewalk. The brick pavers shall be set to the line and grade to achieve the desired finished surface and grade using the running bond pattern. The brick pavers shall be installed hand tight with a maximum joint not to exceed 1/8". After the brick pavers have been completely laid, sweep joint sand into the joints until full. Lightly fog with water and continue to fill with sand until no further settlement occurs. Paver edge restraints shall be installed around the entire perimeter that is not restrained by the concrete sidewalk. Place the edge restraint on the base material and spike through pre-drilled holes into the compacted base material using 10" x 3/8" diameter steel spikes as per the manufacturer's recommendations. Upon completion, the surface shall be swept clean.

Method of Measurement:

Add the following:
Resetting of brick pavers will be measured for payment by actual number of square yards of brick pavers reset and accepted, complete in place, which shall include the removal of existing pavers, storage of materials, furnishing and installing the base materials, cutting the pavers if needed and resetting the pavers to the new grade.

Basis of Payment:

Add the following:
The work will be paid for at the contract unit price, Square Yard for "Reset Brick Pavers" complete in place, which price shall include the removal of existing pavers, storage of materials, adjusting the base materials, furnishing and installing the base materials, cutting the pavers if needed and resetting the pavers to the new grade.

Pay Item	Pay Unit
Reset Brick Pavers	Square Yard

ITEM #824052A - REMOVE EXISTING CONCRETE BARRIER CURB

DESCRIPTION:
The work under this item shall include the removal of existing concrete barrier curb that is within the project limits when the barrier curb is no longer needed to control traffic operations. Prior to removing any barrier curb the Contractor shall obtain approval from the Engineer. The existing removed barrier curb shall become the property of the Contractor.

METHOD OF MEASUREMENT:
This work will be measured for payment by the actual number of lineal feet of Temporary Concrete Barrier Curb removed, measured along the center of the barrier curb.

BASIS OF PAYMENT:
This work will be paid for at the contract unit price per lineal foot for "Remove Existing Concrete Barrier Curb" as specified, which price shall include removal, materials, tools and equipment incidental thereto.

Pay Item	Pay Unit
Remove Existing Concrete Barrier Curb	LF

ITEM #0913025A - 6’ CHAIN LINK FENCE (BRIDGE)

Description:

Work under this item shall consist of furnishing and installing chain link fencing in accordance with the details as shown on the plans, in conformance with these specifications, and as directed by the Engineer.

Materials:

Materials for this work shall conform to the following:

1. Fabric: The fabric shall be aluminum-coated chain link steel fabric. It shall be No. 9 gage wire woven to form a 2 inch mesh. The chain link fabric shall conform to the requirements of AASHTO M181 and shall have a knuckled finish on both edges.

2. Posts and Rails: Metal posts and rails shall be standard steel pipe conforming to the requirements of ASTM A53 (E or S Grade B) or AASHTO M181, Grade 2, and shall be galvanized in conformance with Subarticle M10.05-2.

3. Fittings: Fittings shall conform to AASHTO M181 and shall be of the fabricator’s standard design. All, except the stretcher bars, shall be galvanized in conformance with ASTM A153. The stretcher bars shall be galvanized in conformance with ASTM A123.

4. Clamps and Wire Ties: All clamps and wire ties shall conform to the requirements of Subarticle M10.05-4.

5. Galvanizing Compound: Galvanizing compound shall conform to the requirements of Federal Specification TT-P-641b or Military Specification MIL-P-21035.

6. Base Plates: Base plates shall conform to ASTM A36M and shall be galvanized in accordance with ASTM A123 after fabrication and shop welding. All burrs and sharp edges shall be removed and smoothed prior to galvanizing.

7. Preset Anchorage: The preset anchorage shall be fabricated as detailed on the contract plans. Preset anchorages configured differently from those detailed on the plans may be used provided they utilize the same materials described below and are approved by the Engineer prior to fabrication.

   The wire struts shall be cold-drawn and conform to ASTM A510, Grade 1030 with a minimum tensile strength of 100 ksi. The wire struts shall be securely welded to the ferrules, with the welds capable of developing the tensile strength of the struts and the ferrules.

The ferrules either open or closed end, shall conform to ASTM A108, Grade 12L14. A plastic cap shall be provided for sealing the bottom of each open-end ferrule before placing concrete. Closed-end ferrules shall provide as minimum full thread length of 2 inches. Removable plastic washers of the same diameter as the ferrules shall be provided for the top of each ferrule and shall be left in place until temporary supporting bolts are removed. Removable plastic caps shall be provided for sealing the top of each ferrule until the erection of fence posts.

After fabrication, the preset anchorage shall be hot-dipped galvanized in accordance with ASTM A123.

A sample anchorage, including bolts and washers, shall be submitted to the Engineer for approval prior to incorporation into the project.

Bolts for the preset anchorage system shall be stainless steel and conform to the requirements of ASTM F593, Group 1 (AISI Type 304). All circular washers shall be stainless steel and shall conform to the requirements of ASTM A167 Type 302-305.

The Contractor shall provide Materials Certificates and Certificates of Compliance in accordance with Article 1.06.07 for all materials conforming to ASTM A53 (E or S Grade B) and AASHTO M181, Class 2.

Construction Methods:

The chain link fence shall be accurately fabricated and installed in accordance with the plans. The posts shall be placed plumb and the top and bottom rails set parallel to the top of the parapet or wall. The fabric shall be stretched tightly between end posts and securely fastened with stretcher bar bands. The fabric shall be attached to the rails and line posts as shown on the plans.

The preset anchorage shall be installed perpendicular to the grade of the wall. The preset anchorage shall be accurately positioned and restrained against movement during the placement of concrete.

Posts, with bottoms cut to the required grade, shall be welded to the base plates. All welding shall conform to the requirements of Subarticle 6.03.03-6.

All baseplates shall provide full contact with the bearing surface when the posts are plumb and shall be caulked all around with a waterproof silicone rubber sealant. Expansion posts, with compression springs and sliding pipe, shall be installed at the locations indicated on the plans. All rails shall be erected to produce a smooth, continuous appearance with posts placed vertically and with all rails parallel to the grade of the wall. The fabric shall be stretched tightly between end posts and securely fastened with stretcher bar bands. The fabric shall be attached to the rails and line posts as shown on the plans. Dome caps shall be installed on top of all posts.

Galvanized areas damaged during shipment, storage and installation, shall be treated with two coats of galvanizing compound.

Shop Drawings:

Before fabricating any materials, the Contractor shall submit shop drawings to the Engineer for approval in accordance with Article 1.05.02(b). These drawings shall include, but not be limited to, the following information: the layout plan showing all rail post locations, post spacings, fence details, material lists and material designations.

Method of Measurement:

This work will be measured for payment by the number of meters of completed and accepted fence, measured horizontally from outside-to-outside of terminal posts, as shown on the plans.

Basis of Payment:

This work will be paid for at the contract unit price per foot for "6' Chain Link Fence (Bridge)", complete in place, which price shall include all materials, equipment, tools and labor, incidental thereto.

ITEM #0921001A CONCRETE SIDEWALK
ITEM #0921005A CONCRETE SIDEWALK RAMP
ITEM #0921039A DETECTABLE WARNING STRIP

Delete Section 9.21 in its entirety and replace it with the following:

9.21.01—Description: This item shall consist of concrete sidewalks and ramps 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. Cutting of existing concrete sidewalk for the installation of new concrete sidewalk or concrete ramps shall be included in the respective items.

9.21.02—Materials: Materials for this work shall conform to the requirements of Article M.03.01 for Class "F" Concrete.

Gravel or reclaimed miscellaneous aggregate for base shall conform to Article M.02.01 for granular fill.

Detectable warning strips shall be a prefabricated detectable warning tile chosen from the Department's Qualified Products List for retrofit and/or cast in place applications.

9.21.03—Construction Methods:

1. Excavation: Excavation, including removal of any existing sidewalk (bituminous or concrete) and curbing, 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.

The Contractor shall establish the limits required to achieve grades for each ramp prior to removal of existing sidewalk and ramps. The Contractor shall document and notify the Engineer of any control points that may conflict with the design grades or configuration of ramps shown on the plans. Control points can be but are not limited to ROW, utility poles, drainage structures, buildings, fences, walls or other features found near the proposed ramp. When control points are encountered within the limits of the ramp, the Engineer will determine if an alternative ramp type is required or the ramp is to be constructed as shown on the plans.

2. Gravel or Reclaimed Miscellaneous Aggregate Base: The gravel or reclaimed miscellaneous aggregate base shall be placed in layers not over 6 inches 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 surfaced plank except that at sharp curves thinner material may be used. If made of metal, they shall be of an approved section and 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 in thickness, of the full depth and width of the walk, shall be spaced at intervals of 12 feet 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 "F" Concrete. Concrete shall be cured in accordance with the provisions of Article 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 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.

7. Detectable Warning Strip: The detectable warning strip for new construction shall be set directly in poured concrete and each tile shall be weighted down to prevent the tile from floating after placement in wet concrete in accordance with curing procedures. Install detectable warning strip, according to the plans and the Manufacturer's specifications, or as directed by the Engineer.

The detectable warning strip for retrofit construction shall be installed according to the plans in the direction of pedestrian route and contained wholly within painted crosswalk when present. Its installation shall conform to all Manufactures requirements.

9.21.04—Method of Measurement: This work will be measured for payment as follows:

1. Concrete Sidewalk or Sidewalk Ramp: This work will be measured by the actual number of square feet of completed and accepted concrete sidewalk or ramp.

2. **Excavation:** Excavation below the finished grade of the sidewalk or ramp, backfilling, and disposal of surplus material will not be measured for payment, but the cost shall be included in the price bid for the sidewalk or ramp. Excavation above the finished grade of the sidewalk or ramp will be measured and paid for in accordance with Section 2.02

3. Gravel or Reclaimed Miscellaneous Aggregate Base: This work will not be measured for payment, but the cost shall be considered as included in the price bid for the sidewalk or ramp.

4. Detectable Warning Strip: For new construction (cast in place), the detectable warning strip will be measured for payment by the actual number of each ramp where a detectable warning strip has been installed and accepted regardless of the number of tiles installed.

5. Retrofit Detectable Warning Strip: For retrofit construction (surface applied), the detectable warning strip will be measured for payment by the actual number of each ramp where a detectable warning strip has been installed and accepted regardless of the number of tiles installed.

6. Construction Staking: The establishment of control points and limits of grading will be measured in accordance with the item Construction Staking.

7. Cut Concrete Sidewalk: This work shall not be measured but shall be included in the measurement for concrete sidewalk or concrete ramp.

9.21.05—Basis of Payment: Construction of a concrete sidewalk or ramp will be paid for at the contract unit price per square foot for "Concrete Sidewalk," or “Concrete Sidewalk Ramp” complete in place, which price shall include all excavation as specified above, backfill, disposal of surplus material, curb removal and any monolithic or separately cast sidewalk curb when required for the sidewalk ramp as shown on the plans, gravel or reclaimed miscellaneous aggregate base, equipment, tools, materials and labor incidental thereto.

Cut Concrete Sidewalk shall not be paid separately but shall be paid in the item - concrete sidewalk or concrete ramp.

A new detectable warning strip will be paid for at the contract unit price for each ramp where the detectable warning strip has been installed complete in place. This price shall include all tiles, materials, equipment, tools and labor incidental thereto.

Retrofitting the existing concrete sidewalk with a detectable warning strip will be paid for at the contract unit price for each ramp where the retrofit detectable warning strip has been installed complete in place. This price will include all tiles, saw cutting concrete, adhesive, drilling holes for fasteners, materials, equipment, tools and labor incidental there to.

The establishment of control points and limits of grading will be paid for in accordance with the item Construction Staking.

Pay Item	Pay Unit
Concrete Sidewalk	s.f.
Concrete Sidewalk Ramp	s.f.
Detectable Warning Strip	Each

ITEM NO. 0921018A – BRICK PAVING

Description:

This item shall consist of furnishing and installing Brick Paving on a sand bed and concrete leveling layer placed over granular fill to the dimensions and details as shown on the plans and in accordance with these specifications. The Brick shall match the existing Brick at the northwest corner of Station Place and Atlantic Street in size, color and texture.

Materials:

Material for this work shall conform to the following requirements:

Concrete: 3,000 psi Class "C" Concrete in accordance with the provisions of Article 4.01.03 for Concrete Pavement.

Wire Fabric: 6x6 – W2.9xW2.9 sheets in accordance with Article M.06.01.

Brick Paving: The Contractor shall provide samples of the Brick for approval by the Engineer.

Sand: In accordance with Article M.03.01 – 2 for Fine Aggregate

Granular Fill: In accordance with Article M.02.01 for Granular Fill

Construction Methods:

The Contractor shall receive approval on the Brick paver prior to the installation. The Paving will be free from excessive chips, cracks, voids, discoloration or other defects that might be visible or cause staining in finished work. The Brick Paving will be mixed from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures. The Brick Paving will be cut with motor-driven masonry saw equipment to provide clean, sharp, un-chipped 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

1 – Excavation: Excavation shall be made to required depths below finish grade, as shown necessary to achieve the desire surface drainage for the finish surface. The Contractor shall be careful of the adjacent concrete sidewalks, building and bituminous concrete driveway and curbing. Any damage caused to the surrounding features will be replaced at the Contractor's expense.

2 –Granular Fill Base Course: The Granular Fill shall be uniformly spread upon the compacted subgrade to the require depth and thoroughly compacted in accordance with Article 9.21.03-2.

3 – Concrete: Place concrete over the prepared granular fill bedding layer in accordance with Article 9.21.03. Wire Fabric to be discontinued at all expansion joints.

4 – Brick Paving: The Brick Paving shall be placed on a sand leveling layer of approximately 1 inch thick to provide a flush joint at the interface with the adjoining curbing and or concrete sidewalk. The Brick Paving shall be set to the line and grade to achieve the desired finished surface and grade using the running bond pattern. The Brick Paving shall be installed hand tight with a maximum joint not to exceed 1/8". After the Brick Paving have been completely laid, sweep joint sand into the joints until full. Lightly fog with water and continue to fill with sand until no further settlement occurs. Paver edge restraints shall be installed around the entire perimeter that is not restrained by the concrete sidewalk. Place the edge restraint on the base material and spike through pre-drilled holes into the compacted base material using 10" x 3/8" diameter steel spikes as per the manufacturer's recommendations. Upon completion, the surface shall be swept clean.

Method of Measurement

1 – Brick Paving: This work will be measured by the actual numbers of square yards of Brick Paving completed and accepted.

2 – Excavation: All excavation required for the installation of the Brick Paving to the lines and grades directed by the plans or as directed by the Engineer, will not be measured for payment. The disposal of surplus material will not be measured for payment, but the cost shall be included in the price bid for the Brick Paving.

3 – Processed Aggregate Base: This work will not be measured for payment but the cost thereof shall be included in the price bid for the Brick Paving.

Basis of Payment:

This work will be paid for at the contract unit price per square yard for "Brick Paving" complete in place, which price shall include all excavation as specified above, backfill, disposal of surplus material, processed aggregate base, edge restraints, and all equipment, tools, labor and materials incidental thereto.

Pay Item	Pay Unit
Brick Paving	Square Yard

ITEM # 0921160A – SIDEWALK SHED

Description: Work under this item shall consist of furnishing, erecting, maintaining and removing structures over public sidewalks to protect pedestrians from falling objects from construction activities where shown on the plans or as directed by the Engineer.

Materials: All materials used for the sidewalk sheds shall be suitable for the intended purpose and shall meet the minimum material requirements identified in the Contractor's Working Drawing submission and shall also meet the requirements of sections M.03, M.06, M.11 and M.15 as applicable. All material proposed for use that has been salvaged shall be subject to inspection by the Engineer. Material deemed to be damaged or otherwise unsuitable for use shall be removed from the site by the Contractor.

Construction Methods: The Contractor shall prepare a Working Drawing submission for the sidewalk sheds in accordance with Section 1.05.02. The submission shall include the details of the sheds, lighting, anchorage, material requirements, and construction and maintenance requirements. The working drawings shall be signed and sealed by an Engineer registered in the State of Connecticut and shall include the supporting design calculations. Sidewalk sheds shall be erected in accordance with the manufacturer's recommendations for prefabricated pedestrian shelters or in accordance with any special construction requirements specified in the working drawing submission for Contractor designed systems.

Shed construction shall be performed in a workmanlike manner with care taken to provide a secure structure that satisfies the need to provide a roofed enclosure without introducing hazards including sharp edges, projections or other potential safety hazards. Sheds shall be in place prior to any construction or demolition on overpass structures and shall typically extend 10 feet beyond the limits of the overpass structure. Sheds shall be removed within one week of the completion of all construction or demolition activity on the overpass structure.

Sheds shall provide an unobstructed passageway with a minimum clear width of 5 feet and a clear height of 8 feet for pedestrian access and shall be lighted at all times by either natural or artificial light. The level of illumination shall have an intensity of not less than five footcandles measured at the walkway level to ensure the safe movement of persons.

Lighting shall be vandal proof fixtures mounted a minimum of 8 feet above the sidewalk level. Sheds shall have a solid roof deck designed for a minimum construction load of 150 psf. Edges of roof deck shall be detailed with debris guards that prevent miscellaneous construction debris from falling onto areas accessible to pedestrians. Sheds shall be designed with open sides facing the adjacent roadway. The side walls on the far side from the roadway may be designed as open or solid faced.

The Contractor shall not store materials on the shed or use the shed to support other construction activities unless the shed was specifically designed and detailed for such use.

The Contractor shall be responsible for the maintenance of sidewalk sheds including the lighting. Snow or construction debris accumulations on the roof of sheds shall be removed as a regular

maintenance activity and the Contractor's design of the shed shall account for the loads associated with snow, construction debris and the removal of same.

The Contractor shall remove portions of the shed when construction access or a work area is required to perform adjacent construction on bridge substructures. Such removal and the subsequent reinstallation shall only take place when the section of sidewalk is closed to pedestrian traffic and an alternate pathway is open for pedestrians in accordance with the Item "Maintenance and Protection of Traffic".

Method of Measurement: This work will be measured for payment by the actual number of linear feet of sidewalk sheds installed as shown on the plans or as ordered by the Engineer, measured along the centerline of the shed.

Basis of Payment: This work will be paid for at the contract unit price per linear feet for "Sidewalk Shed" complete in place, which price shall include all materials, equipment, tools and labor incidental thereto, including the preparation of working drawings, the furnishing of lighting including the power source, maintenance of the sheds including lighting and removal of the sheds at the completion of the construction activity requiring the shed. Partial removal of sheds and reinstallation required for Contractor construction access or a work area is included in the unit price for this item with no additional payment for this work.

Temporary barrier required to protect shed structures from vehicles shall be paid under the item "Temporary Precast Concrete Barrier Curb"

Pay Item	Pay Unit
Sidewalk Shed	l.f.

ITEM NO. 0992093A - RESET BRICK PAVING

This work shall conform to Section 8.14 of Form 816 supplemented as follows:

Description:

Add the following:
The work shall include the removal and resetting of brick pavers at the northwest corner of Station Place and Atlantic Street on new or existing base material to the limits and grades as shown on the plans.

Base materials shall consist of granular fill, concrete and a sand layer as shown on the details.

Materials:

Delete the section and replace with the following:

Brick Pavers shall be existing. Pavers that are not usable shall be replaced with equal material of the same color and texture.

Material for this work shall conform to the following requirements:

Concrete: 3,000 psi Class "C" Concrete in accordance with the provisions of Article 4.01.03 for Concrete Pavement.

Wire Fabric: 6x6 – W2.9xW2.9 sheets in accordance with Article M.06.01.

Brick Pavers: The Contractor shall provide samples of the brick for approval by the Engineer.

Sand: In accordance with Article M.03.01 – 2 for Fine Aggregate

Granular Fill: In accordance with Article M.02.01 for Granular Fill

Construction Methods:
Add the following:
Resetting of brick pavers will consist of removing existing pavers and base material to the limits shown or as directed, storing material, installing the base materials and brick pavers to the proposed limits and grade. Damaged or unusable brick paver material shall be replaced with pavers of the same color and texture. Pavers shall be installed to match the existing pattern and cut as need to match the proposed curb radius and abut the adjacent pieces.

1 – Excavation: Excavation shall be made to required depths below finish grade, as shown necessary to achieve the desire surface drainage for the finish surface. The Contractor shall be careful of the adjacent concrete sidewalks, building and bituminous concrete driveway and curbing. Any damage caused to the surrounding features will be replaced at the Contractor's

expense.

2 –Granular Fill Base Course: The Granular Fill shall be uniformly spread upon the compacted subgrade to the require depth and thoroughly compacted in accordance with Article 9.21.03-2.

3 – Concrete: Place concrete over the prepared granular fill bedding layer in accordance with Article 9.21.03. Wire Fabric to be discontinued at all expansion joints.

4 – Brick Pavers: The brick pavers shall be placed on a sand leveling layer of approximately 1 inch thick to provide a flush joint at the interface with the adjoining curbing and or concrete sidewalk. The brick pavers shall be set to the line and grade to achieve the desired finished surface and grade using the running bond pattern. The brick pavers shall be installed hand tight with a maximum joint not to exceed 1/8". After the brick pavers have been completely laid, sweep joint sand into the joints until full. Lightly fog with water and continue to fill with sand until no further settlement occurs. Paver edge restraints shall be installed around the entire perimeter that is not restrained by the concrete sidewalk. Place the edge restraint on the base material and spike through pre-drilled holes into the compacted base material using 10" x 3/8" diameter steel spikes as per the manufacturer's recommendations. Upon completion, the surface shall be swept clean.

Method of Measurement:

Add the following:
Resetting of brick pavers will be measured for payment by actual number of square feet of brick pavers reset and accepted, complete in place, which shall include the removal of existing pavers, storage of materials, furnishing and installing the base materials, cutting the pavers if needed and resetting the pavers to the new grade.

Basis of Payment:

Add the following:
The work will be paid for at the contract unit price, Square Foot for "Reset Brick Paving" complete in place, which price shall include the removal of existing pavers, storage of materials, adjusting the base materials, furnishing and installing the base materials, cutting the pavers if needed and resetting the pavers to the new grade.

Pay Item	Pay Unit
Reset Brick Paving	Square Foot

ITEM #0952001A – SELECTIVE CLEARING AND THINNING

Description: This work shall conform to Section 9.52, supplemental as follows:

Construction Methods – Description is amended as follows:

Add the following:

Where the Contractor is directed by the Engineer or shown on the plans, materials to be cut, trimmed or removed shall be as follows:

Those items that restrict access to the CCTV or VMS installation location and would severely limit Contractor equipment maneuverability.

Those items that obstruct the sight lines of the CCTV or VMS locations. The Contractor shall refer to the plans for location of the sight line clearing for each site.

Those items that are necessary to be removed in order to install the controller foundation, pole foundation, sign support foundation and conduits to have a complete installation.

All trees scheduled to be removed shall be visibly marked or flagged by the Contractor at least five (5) business days prior to removal of such trees.

The Engineer will inspect the identified trees with the Contractor the limits of the clearing and thinning prior to the Contractor proceeding with cutting operations.

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 to coordinate and expedite all phases of the work required for the project and 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 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 Contractor, 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.

Computer Software and Printer: 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 Construction 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 – 6 ft (1.8 m)

The Contractor is responsible for service and repairs to all computer hardware. All repairs must be performed within 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 represent 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 including but not limited to

- Winter shutdowns
- Environmental permits/applications 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 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 bridges and other structures, include major components such as: Abutments, wingwalls, piers, decks and retaining walls; further breakdown by footings, wall sections, parapets etc.

Temporary Earth Retention Systems
Cofferdam and Dewatering

Structure Excavation
Piles/test piles
Temporary Structures
Removal of Superstructure
Bearing Pads
Structural Steel (Breakdown by fabrication, delivery, installation, painting etc.)
Bridge deck

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, Plastic, 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 Construction
CSI 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 31 – Earthwork
CSI Division 32 – Exterior Improvements
CSI Division 33 – Utilities

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.

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.

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, presenting in detail 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 the Project’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, it 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 # 0969066A - CONSTRUCTION FIELD OFFICE, EXTRA LARGE

Description: Under the item included in the bid document, adequate weatherproof office quarters shall be provided by the Contractor for the duration of the work, and if required for a maximum of 90 days thereafter, at the discretion of the Engineer, for the exclusive use of CTDOT forces and others who may be engaged to augment CTDOT 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 \ Office Size	Extra Large
Minimum Sq. Ft. of floor space with a minimum ceiling height of 7 ft.	2000
Minimum number of exterior entrances.	2
Minimum number of parking spaces.	15

Office layout: The office shall have a minimum square footage as indicated in the table above, and shall be partitioned as shown on the building floor plan as provided by the Engineer.

Tie-downs and skirting: Modular offices shall be tied-down and fully skirted to ground level.

Lavatory Facilities: For field offices sizes Small and Medium the Contractor shall furnish a toilet facility at a location convenient to the field office for use by Department personnel and such assistants as they may engage; and for field offices sizes Large and Extra Large the Contractor shall furnish two (2) separate lavatories with toilet (men and women), in separately enclosed rooms that are properly ventilated and comply with applicable sanitary codes. Each lavatory shall have hot and cold running water and flush-type toilets. For all facilities the Contractor shall 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, with appropriate handrails. Stairways shall be ADA/IBA compliant and have non-skid tread surfaces. An ADA/ABA compliant ramp with non-skid surface shall be provided with the Extra-Large field office.

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.

Additional Equipment, Facilities and Services: The Contractor shall provide at the field Office at least the following to the satisfaction of the Engineer:

Parking Facility: The Contractor shall provide a parking area, adjacent to the field office, of sufficient size to accommodate the number of vehicles indicated in the table above. If a paved parking area is not readily available, the Contractor shall construct a parking area and driveway consisting 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 CTDOT electrical inspector, must be contacted at 860-594-2240. (Do Not Call Local Town Officials)
I. Prior to field office removal the CTDOT 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^{o}-80^{o} Fahrenheit within the field office.

The following furnishings and equipment shall be provided in the applicable field office type:

Description \ Office Size	Qty.			
	Small	Med.	Large	Extra Large
Office desk (2.5 ft x 5 ft) with drawers, locks, and matching desk chair that have pneumatic seat height adjustment and dual wheel casters on the base.	1	3	5	8
Standard secretarial type desk and matching desk chair that has pneumatic seat height adjustment and dual wheel casters on the base.	-	-	-	1
Personal computer tables (4 ft x 2.5 ft).	2	3	5	8
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	1	1	2
Conference table, 3 ft x 12 ft.	-	-	-	1
Table – 3 ft x 6 ft.	-	-	-	1
Office Chairs.	2	4	8	20
Mail slot bin – legal size.	-	-	1	1
Non-fire resistant cabinet .	-	-	2	4
Fire resistant cabinet (legal size/4 drawer), locking.	1	1	2	3
Storage racks to hold 3 ft x 5 ft display charts.	-	-	1	2
Vertical plan racks for 2 sets of 2 ft x 3 ft plans for each rack.	1	1	2	2
Double door supply cabinet with 4 shelves and a lock – 6 ft x 4 ft.	-	-	1	2
Open bookcase – 3 shelves – 3 ft long.	-	-	2	2
White Dry-Erase Board, 36” x 48”min. with markers and eraser.	1	1	1	1
Interior partitions – 6 ft x 6 ft, soundproof type, portable and freestanding.	-	-	6	6
Coat rack with 20 coat capacity.	-	-	-	1
Wastebaskets - 30 gal., including plastic waste bags.	1	1	1	2
Wastebaskets - 5 gal., including plastic waste bags.	1	3	6	10
Electric wall clock.	-	-	-	2
Telephone.	1	1	1	-

Description \ Office Size	Qty.			
	Small	Med.	Large	Extra Large
Business telephone system for three lines with ten handsets, intercom capability, and one speaker phone for conference table.	-	-	-	1
Mini refrigerator - 3.2 c.f. min.	1	1	1	1
Hot and cold water dispensing unit. Disposable cups and bottled water shall be supplied by the Contractor for the duration of the project.	1	1	1	1
Microwave, 1.2 c.f. , 1000W min.	1	1	1	1
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.	*	*	*	*
Electric pencil sharpeners.	1	2	2	2
Electronic office type printing calculators capable of addition, subtraction, multiplication and division with memory and a supply of printing paper.	1	1	2	4
Laser Copier/Scanner/Fax combination unit, network capable, as specified below under Computer Hardware and Software. All supplies, paper and maintenance shall be provided by the Contractor.	1	1	1	1
Computer System as specified below under Computer Hardware and Software. All supplies and maintenance shall be provided by the Contractor.	2	3	5	8
Digital Camera as specified below under Computer Hardware and Software. All supplies and maintenance shall be provided by the Contractor.	1	1	3	3
Video Projector as specified below under Computer Hardware and Software.	-	-	-	1
Smart Board as specified below under Computer Hardware and Software.	-	-	-	1
Infrared Thermometer, including third party certified calibration, case, and cleaning wipes.	1	1	1	2
Rain Gauge.	1	1	1	1
Concrete Curing Box as specified below under Concrete Testing Equipment.	1	1	1	1
Concrete Air Meter as specified below under Concrete Testing Equipment as specified below. Contractor shall provide third party calibration on a quarterly basis.	1	1	1	1
Concrete Slump Cone as specified below under Concrete Testing Equipment.	1	1	1	1

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: For a Small, Medium and Large field office 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. For an Extra-Large field office this shall consist of four (4) telephone lines: three (3) lines for phone/voice service and one (1) line dedicated for 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 CTDOT Data Center staff in coordination with the designated field office personnel as soon as the facility is in place. The CTDOT 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.

For a Small, Medium and Large field office the Contractor shall 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. For an Extra-Large field office the Contractor shall 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 run / jack shall be clearly labeled with an identifying Jack Number.

The installation of a data communication circuit between the field office and the CTDOT Data Communication Center in Newington will be coordinated between the CTDOT District staff, CTDOT Office of Information Systems and the local phone company. The CTDOT District staff will coordinate the installation of the data communication service with CTDOT PC Support once the field office phone number is issued. The Contractor shall provide the field office telephone number(s) to the CTDOT Project Engineer as soon as possible to facilitate data line and computer installations.

Computer Hardware and Software: Laser Copier/Scanner/Fax, Computer Systems, Digital Camera(s) and Smart Board shall comply with the posted requirements at Departments web site www.ct.gov/dot DOING BUSINEES WITH CTDOT > Contractor Resources > Computer Hardware and Software.

Before ordering the computer hardware and software, the Contractor must submit a copy of their proposed order(s) with catalog cuts and specifications for review by the CTDOT Data Center. Computer hardware and software proposed at a minimum must comply with requirements in place 30 days before submission.

Before any equipment is delivered to the Data Center, arrangements must be made at least one business day in advance by contacting person or unit name? 860-594-3500. All software, hardware and licenses provided 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 CTDOT Data Center, 2710 Berlin Turnpike, Newington, CT, where it will be configured and prepared for field installation. Installation will then be coordinated with CTDOT 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 3-1-15):*

Processor – Intel® Core i5 Processor (3.20 GHz, 1600 MHz FSB 6MB Cache)
Memory – 8 GB DDR3 1600MHz.
Monitor – Dual (2) 24.0 inch LCD color monitors.
Graphics – Intel Integrated Graphics.
Hard Drive – 500 GB 7200 RPM SATA or equivalent (Western Digital, IBM or Seagate).
Optical Drive – CD-RW/DVD-RW.
Multi-Card Reader – Must include SD
Multimedia Package – Integrated Sound and speakers.
Case – Small Form or Mid Tower, capable of vertical or horizontal orientation.
Integrated Network Adapter
Keyboard – 104+ Keyboard.

Mouse – Optical 2-button mouse with scroll wheel.
Operating System – Windows 7 Professional 64-Bit Service Pack 1
Application Software – MS Office 2010 Professional Edition (or newer).
Additional Software (Latest Releases, including subscription services for the life of the Contract.–

- Symantec Endpoint Protection
- CD/DVD burning software (ROXIO or NERO)
- Blue-Beam **Revu eXtreme** (*Must be original purchased Licensed Media CD/DVD or authentic digital down load certificate*).
    - Adobe Acrobat Professional may be specified as an alternative to Blue-beam Revu eXtreme, upon request by administrating District (*Must be original purchased Licensed Media CD/DVD or authentic digital down load certificate*)

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 CTDOT 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) Laser Printer – Minimum Specification:
Contact CTDOT Department of Technology Services (1-860-594-3500) for the current approved printer list.

> Note B1: Laser printer brands are limited to Hewlett-Packard and Savin brands only. The CTDOT 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 megapixel, with 3x optical zoom.
Memory – 2 GB.
Features – Date/time stamp feature.
Connectivity – memory card reader.
Software – Must be compatible with Windows 7.
Power – Rechargeable battery and charger.

D) Smart Board or Video Projector (only applicable for Extra –large Office):
Contact CTDOT Office of Construction (1-860-594-2658) for the current approved smart board or Video Projector specifications.

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 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 five thousand dollars ($5,000) 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, rounded up? to the nearest month.

There will not be any price adjustment due to any change in the minimum computer hardware and software requirements.

Basis of Payment: The furnishing and maintenance of the construction field office will be paid for at the Contract unit price per month for "Construction Field Office, (Type)," 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, (Type)."

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, (Type)	Month

ITEM 0970006A – TRAFFIC PERSON (MUNICIPAL POLICE OFFICER)
ITEM 0970007A – TRAFFIC PERSON (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.

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":

Atlantic Street, South State Street, Canal Street, Manhattan Street and All Other Roadways

The Contractor shall maintain and protect existing traffic operations.

Excepted therefrom will be those periods during the allowable periods when the Contractor is actively working at which time the Contractor will be permitted to reduce the roadway width to 11 foot travel lanes with 1 foot shoulder widths.

Excepted therefrom will be described below in "STAGE CONSTRUCTION REQUIREMENTS" and as shown on the Maintenance and Protection of Traffic Plans shown in the contract drawings.

STAGE CONSTRUCTION REQUIREMENTS

During stage construction, traffic operations will be considered to be shown on the Maintenance and Protection of traffic plans contained in the contract plans supplemented as follows:

Roadway

Stage 1 – This stage maintains the traffic from the Phase 1 project, maintaining existing Atlantic Street lanes and two lanes on South State Street except at the South State merge with the new I-95 NB Off Ramp South State Street will be reduced to one lane to provide sufficient room to construct Wall 106.

Stage 2 - opens traffic to South State Street full width utilizing the south portion constructed in Stage 1. After full width is in place the SPMT roll in will be performed over the week of July 4, 2019 to July 12, 2019. During this week Atlantic Street and South State Street will be closed.

Stage 3 - After the new Bridge is in place, stage 3 work lowers Atlantic Street, South State Street and Manhattan Street by incremental lowering during off peak traffic periods. Final construction operations will include curb installation and final paving.

Bridge

Bridge Abutment and Pier Construction - In advance of the roll-in of the Bridge Superstructure sections, the abutment and pier work will need to be constructed. Over the roadway Stage 1 period this work will be completed. Weekend and other off-peak closures of Atlantic Street will be needed for the work.

Roll-in of New Atlantic Street Bridge - Railroad operations will be curtailed during beginning on Thursday July 4, 2019 through Friday July 12, 2019 to allow the bridge roll-in to be performed during Stage 2 of the M&PT Plan. The new Bridge deck is anticipated to be installed in six total sections, with the south side consisting of Tracks 2 and 4 (center sections

with Tracks 1 and 3 and north sections with Tracks 5 and 7). The Tracks 2 and 4 sections are anticipated to be rolled in first requiring track outage on Tracks 4, 2 and 1.

The center sections of the bridge will be rolled-in second, requiring a continuous weekend outage on Tracks 5 and 3, and with Track 1 remaining out of service. The new bridge, consisting of Tracks 3 and 1 will be installed.

The remaining north sections of the bridge will be rolled-in last requiring a continuous weekend outage to perform the work.

With the above schedule the new bridge will be installed by July 12, 2016 for release to the railroad to perform their work for operational tracks for the July 13, 2019 Monday morning peak.

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.

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.

Pedestrian Access

The Contractor shall maintain safe pedestrian access at all times throughout the construction by maintaining existing sidewalks or providing temporary sidewalks. At a minimum, pedestrian walkways will be provided on both sides of the street on Atlantic Street excepting that during construction of the abutments for the I-95 Exit 8 NB Off Ramp structure, pedestrian walkways will be provided on one side of the street, opposite of the active work area and during the placement of the bridge superstructure, the pedestrian traffic may be detoured in accordance with the detour plan included in the plans or as approved by the Engineer. The pedestrian detour shall be used only for the short period required to place the bridge superstructure.

The cost for temporary pedestrian walkways will not be paid for separately but shall be included in the lump sum payment for Maintenance and Protection of Traffic.

When sidewalks need to be closed due to work operations and or unsafe conditions, the Contractor shall erect “Sidewalk Closed” signs and provide clear direction to alternate pedestrian routes.

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.

Roadside Protective Systems

The Contractor is alerted that all hazardous areas that are exposed to traffic which have been caused by the removal of specified lengths of roadside protection due to construction operations shall be replaced by the Contractor within the same workday.

In the event that the leading end of a parapet or other obstruction is exposed by the Contractor's operations the contractor shall protect said obstruction from live traffic utilizing a Type A Impact Attenuation System as detailed on the plans or other method of protection as approved by the Engineer.

Where permanent or temporary precast concrete barrier curb is installed for the protection of traffic from a hazardous area, the terminal end facing approaching traffic within 30' of a travel lane shall be protected with a Type A Impact Attenuation System as shown on the plans or as directed by the Engineer. These units will be paid for at the contract unit price for the item involved.

Pavement Markings - Limited Access Highways, Turning Roadways and Ramps

During construction, the Contractor shall maintain all pavement markings throughout the limits of the project.

Interim Pavement Markings

The Contractor shall install painted pavement markings, which shall include lane lines (broken lines), shoulder edge lines, stop bars, lane-use arrows and gore markings, on each intermediate course of bituminous concrete pavement and on any milled surface by the end of the work day/night. All painted pavement markings will be paid under the appropriate items.

If the Contractor does not install permanent Epoxy Resin Pavement Markings by the end of the work day/night on exit ramps where the final course of bituminous concrete pavement has been installed, the Contractor shall install temporary 12 inch wide white stop bars. The temporary stop bars shall consist of Temporary Plastic Pavement Marking Tape and shall be installed by the end of the work day/night. 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 these markings when the permanent Epoxy Resin Pavement Markings are 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.

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 spacing 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.

SECTION 6. **WORK ZONE SIGNS AND TRAFFIC CONTROL PLANS**

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

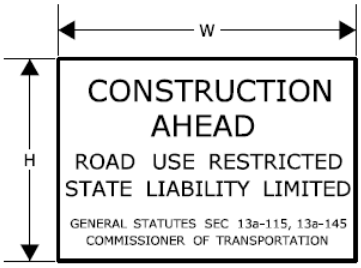
CONNECTICUT DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & CONSTRUCTION

APPROVED

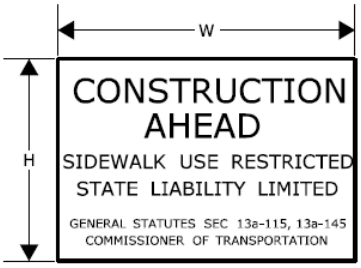
Charles S. Harlow
2012.06.05 15:50:35-04'00'

PRINCIPAL ENGINEER

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.

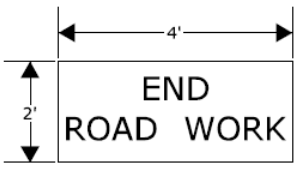
REGULATORY SIGN "ROAD WORK AHEAD, FINES DOUBLED"

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.

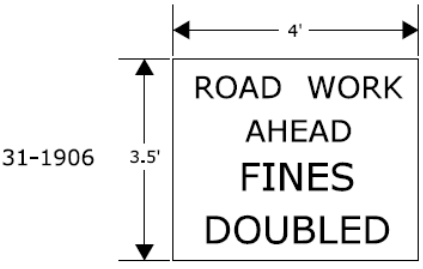
THE "ROAD WORK AHEAD FINES DOUBLED" REGULATORY SIGN SHALL BE PLACED AFTER THE SERIES 16 SIGN AND IN ADVANCE OF THE "ROAD WORK AHEAD" SIGN.

"END ROAD WORK" SIGN

THE LAST SIGN IN THE PATTERN MUST BE THE "END ROAD WORK" SIGN.



80-9612



31-1906

SCALE: NONE

CONSTRUCTION TRAFFIC CONTROL PLAN

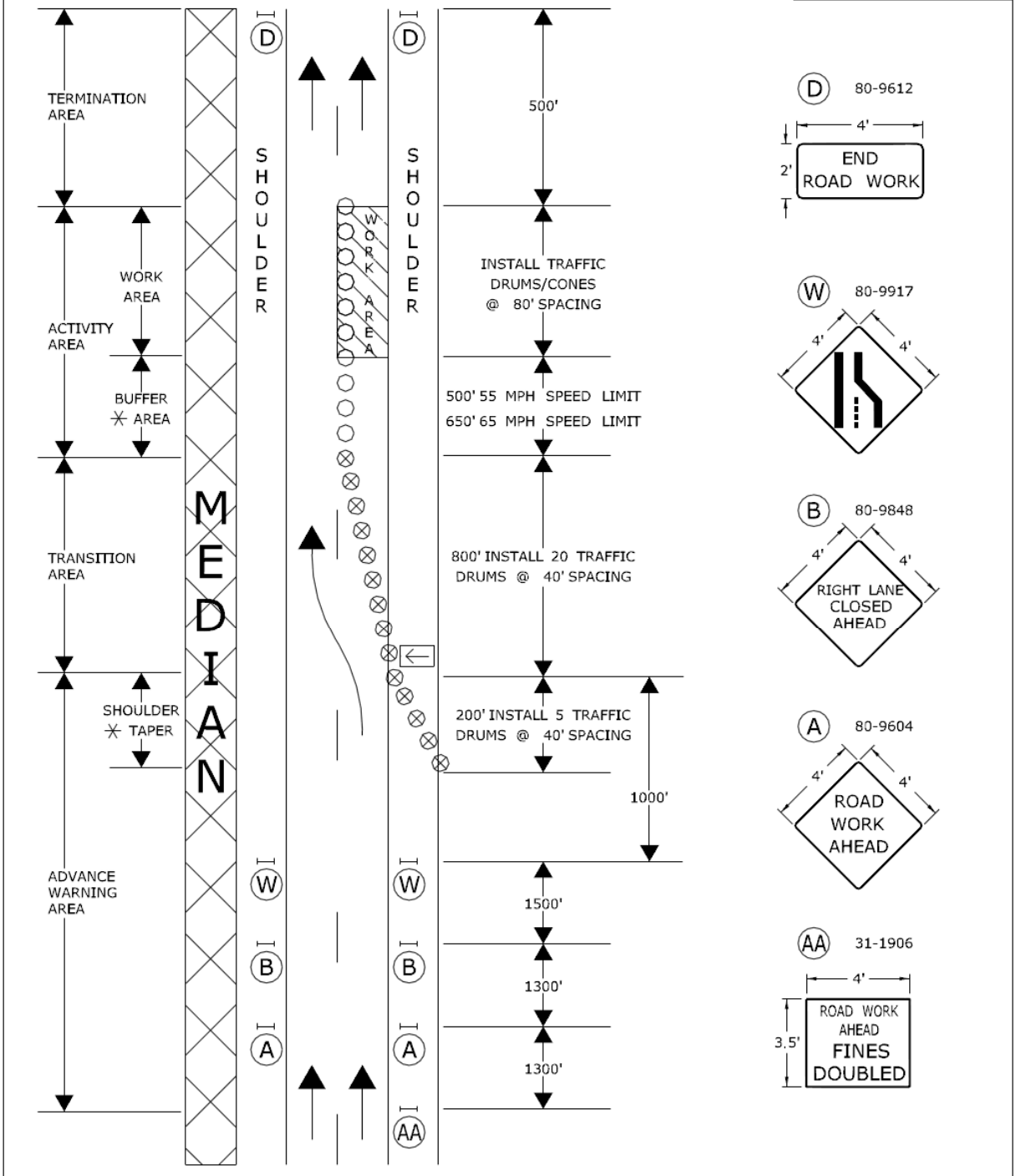
REQUIRED SIGNS

CONNECTICUT DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & CONSTRUCTION

APPROVED _____ Charles S. Harlow 2012.06.05 11:35:43-04'00'
PRINCIPAL ENGINEER

WORK IN RIGHT LANE - MULTILANE HIGHWAY

SIGN FACE
126 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 1

SEE NOTES 1, 2, 3, 4, 5, 6, 8, 9

CONNECTICUT DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & CONSTRUCTION

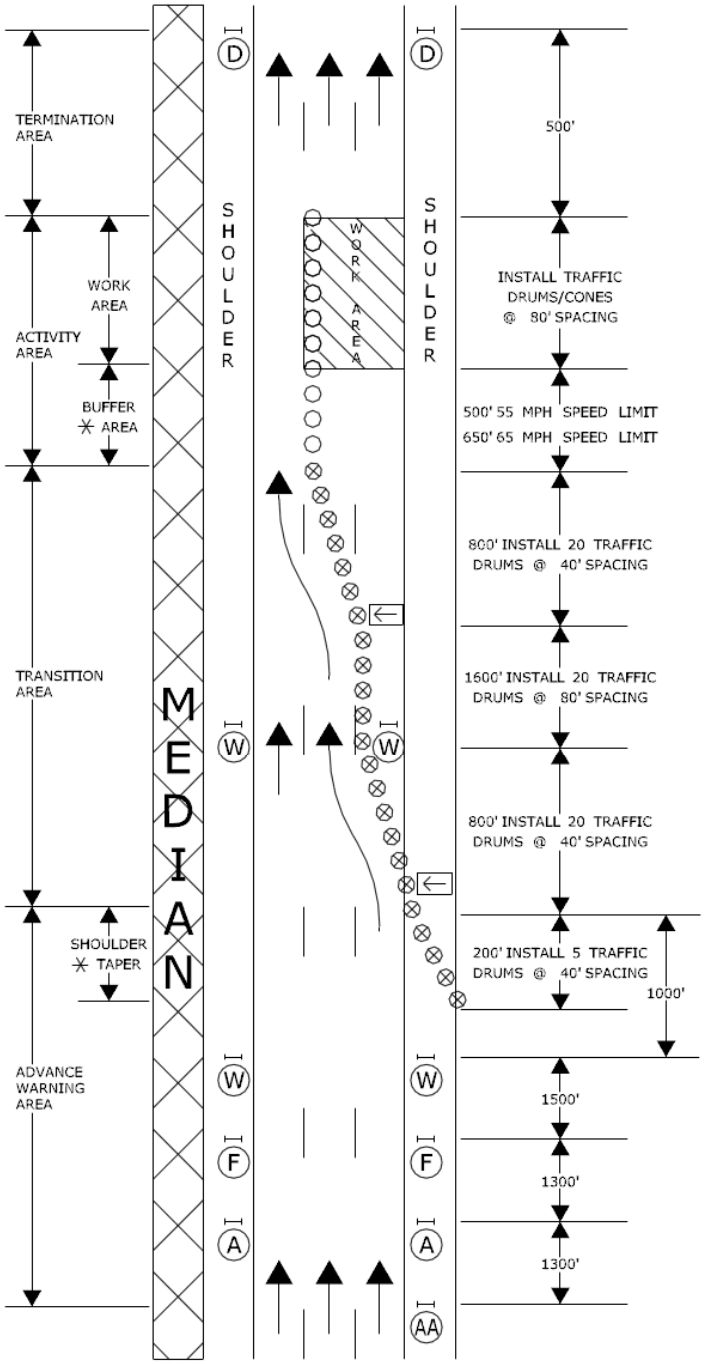
APPROVED

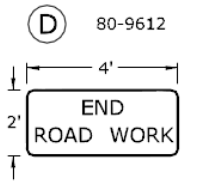
Charles S. Harlow
2012.06.05 15:51:00-04'00'

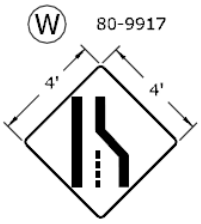
PRINCIPAL ENGINEER

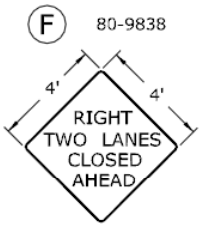
WORK IN RIGHT TWO LANES - MULTILANE HIGHWAY

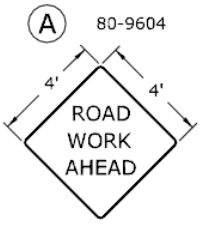
SIGN FACE
158 SQ. FT (MIN.)

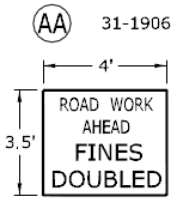












TRAFFIC CONE **OR** TRAFFIC DRUM
OPTIONAL TRAFFIC DRUM PORTABLE SIGN SUPPORT
HIGH MOUNTED INTERNALLY ILLUMINATED FLASHING ARROW

SCALE: NONE

CONSTRUCTION TRAFFIC CONTROL PLAN

PLAN 2

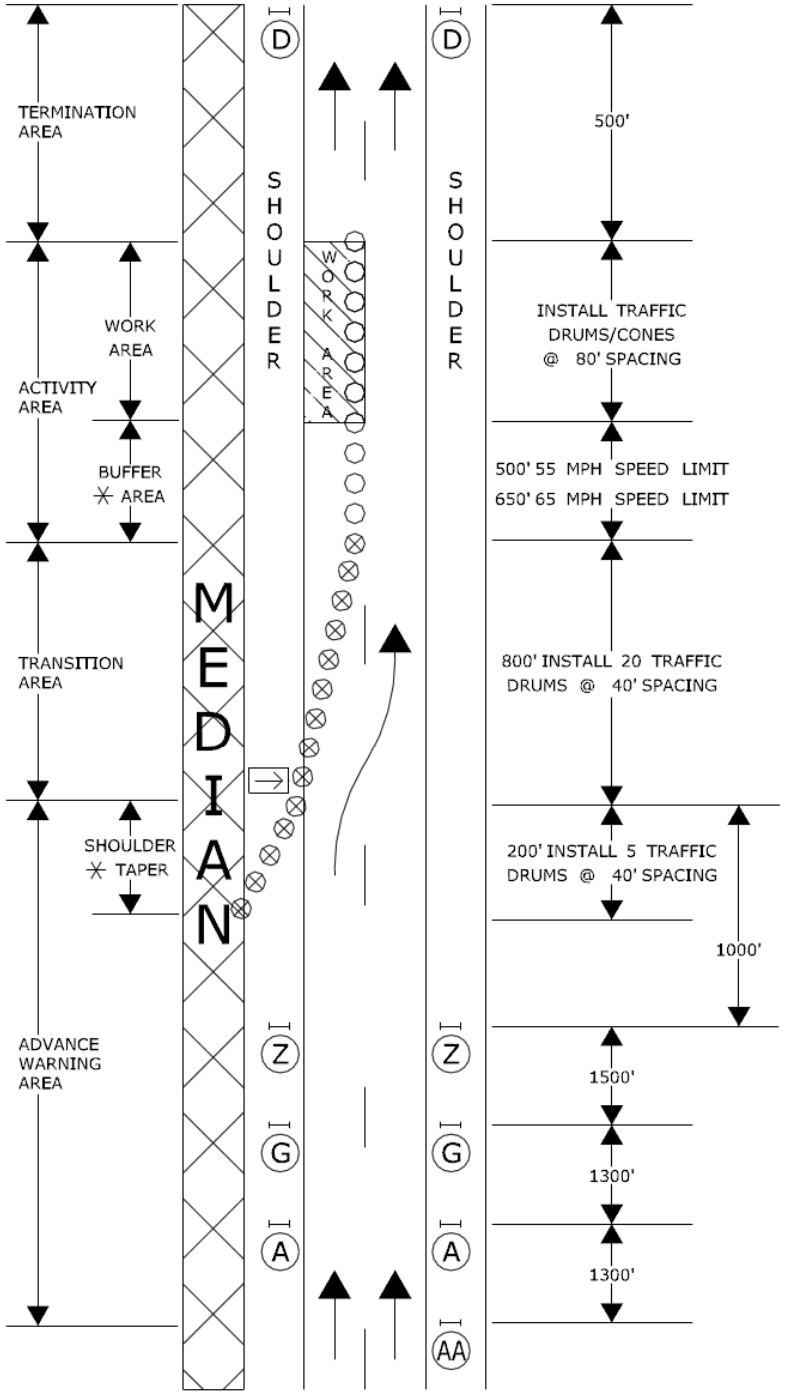
SEE NOTES 1, 2, 3, 4, 5, 6, 8, 9

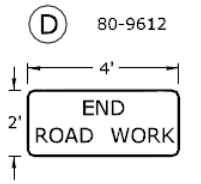
CONNECTICUT DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & CONSTRUCTION

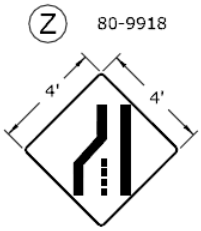
APPROVED Charles S. Harlow 2012.06.05 15:51:23-04'00'
PRINCIPAL ENGINEER

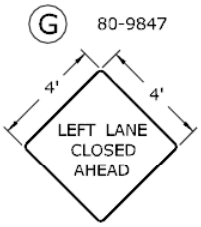
WORK IN LEFT LANE - MULTILANE HIGHWAY

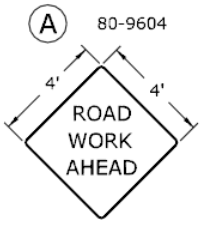
SIGN FACE
126 SQ. FT (MIN.)

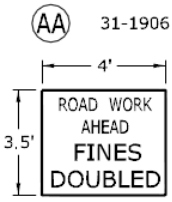












TRAFFIC CONE **OR** TRAFFIC DRUM
OPTIONAL TRAFFIC DRUM PORTABLE SIGN SUPPORT
HIGH MOUNTED INTERNALLY ILLUMINATED FLASHING ARROW

SCALE: NONE

CONSTRUCTION TRAFFIC CONTROL PLAN

PLAN 3

SEE NOTES 1, 2, 3, 4, 5, 6, 8, 9

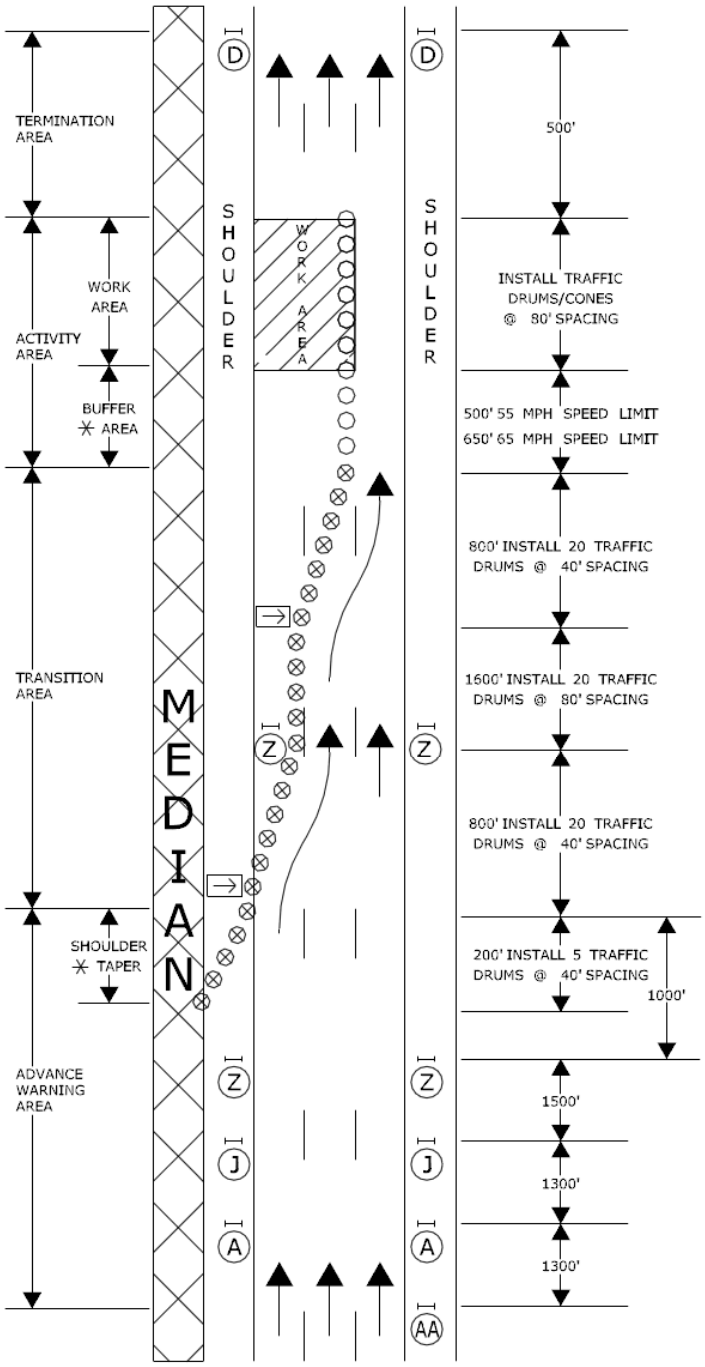
CONNECTICUT DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & CONSTRUCTION

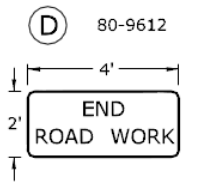
APPROVED _____ PRINCIPAL ENGINEER

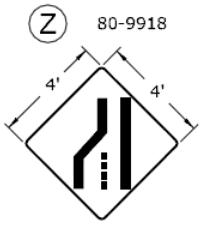
Charles S. Harlow
2012.06.05 15:51:46-04'00'

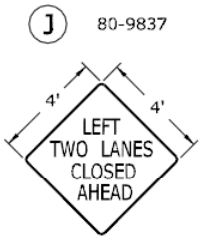
WORK IN LEFT TWO LANES - MULTILANE HIGHWAY

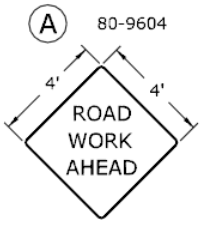
SIGN FACE
158 SQ. FT (MIN.)

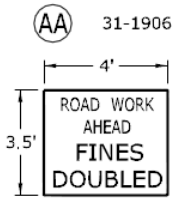












TRAFFIC CONE **OR** TRAFFIC DRUM
OPTIONAL TRAFFIC DRUM PORTABLE SIGN SUPPORT
HIGH MOUNTED INTERNALLY ILLUMINATED FLASHING ARROW

SCALE: NONE

CONSTRUCTION TRAFFIC CONTROL PLAN

PLAN 4

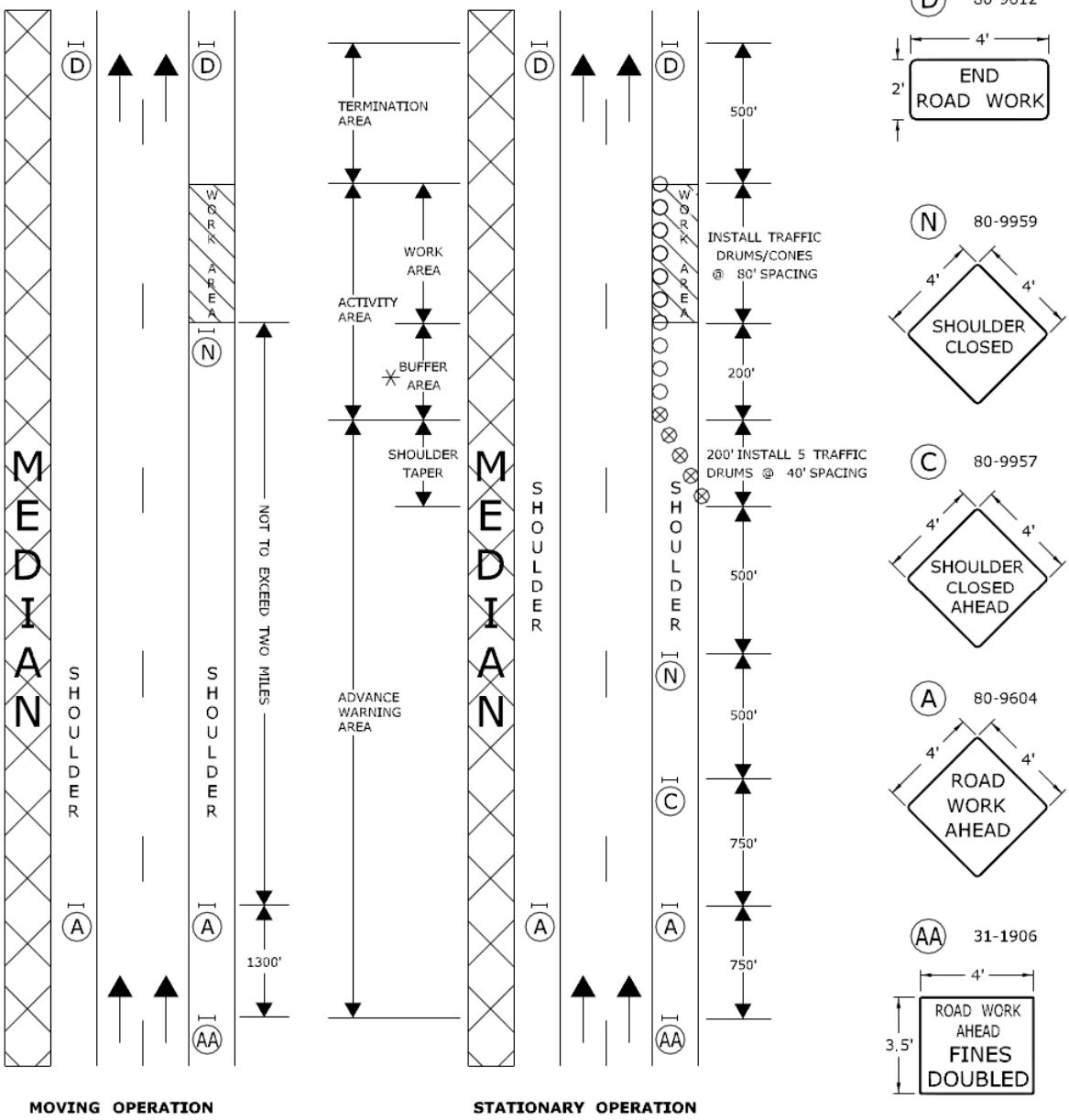
SEE NOTES 1, 2, 3, 4, 5, 6, 8, 9

CONNECTICUT DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & CONSTRUCTION

APPROVED Charles S. Harlow 2012.06.05 15:52:10-04'00'
PRINCIPAL ENGINEER

WORK IN SHOULDER AREA - MULTILANE HIGHWAY

SIGN FACE
94 SQ. FT (MIN.)



D 80-9612
4' × 2'
END ROAD WORK

N 80-9959
4' × 4'
SHOULDER CLOSED

C 80-9957
4' × 4'
SHOULDER CLOSED AHEAD

A 80-9604
4' × 4'
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

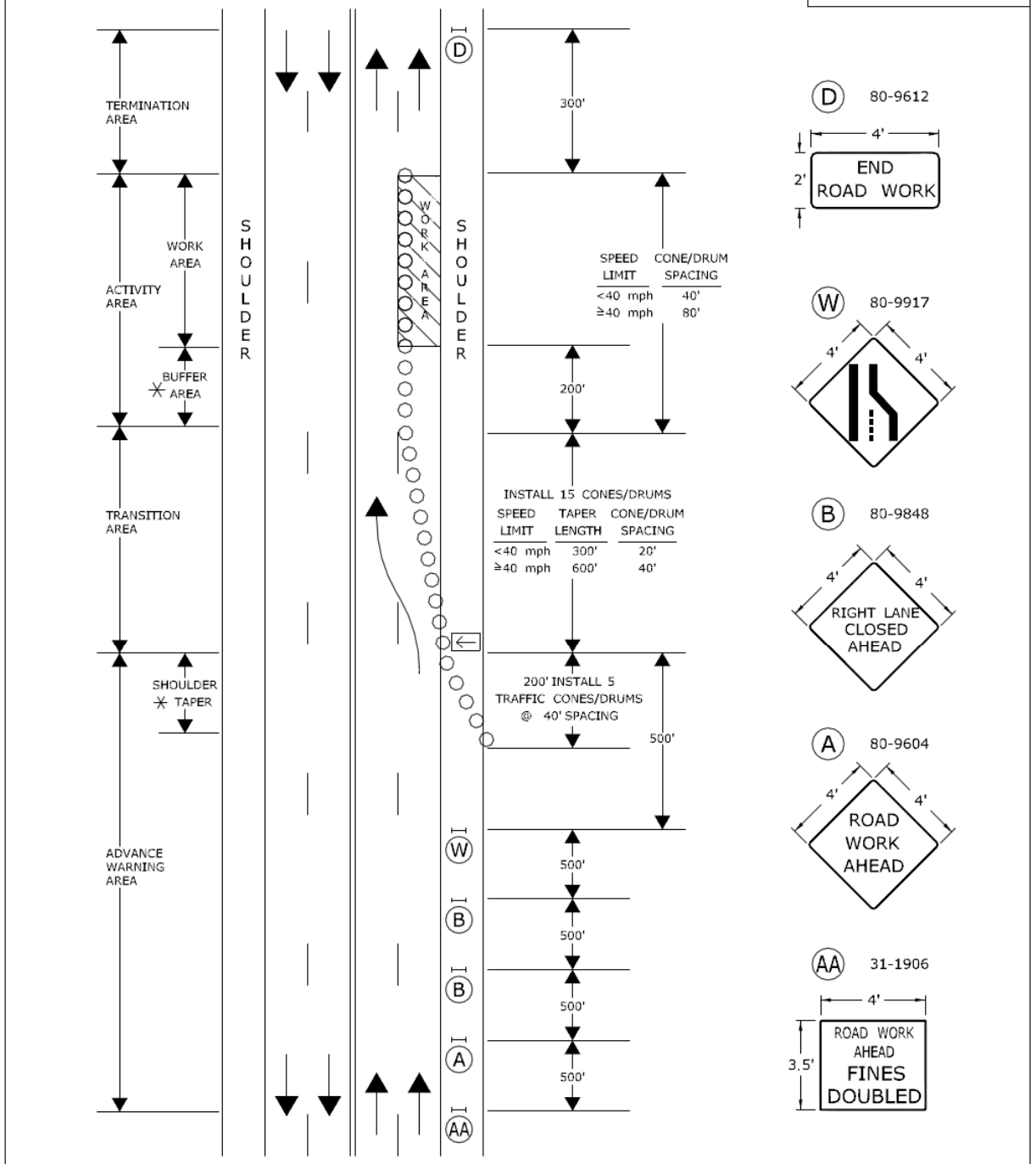
CONSTRUCTION TRAFFIC CONTROL PLAN
PLAN 6
SEE NOTES 1, 2, 4, 8

CONNECTICUT DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & CONSTRUCTION

APPROVED
Charles S. Harlow
2012.06.05 15:52:38-04'00'
PRINCIPAL ENGINEER

WORK IN RIGHT LANE - 4 LANE UNDIVIDED HIGHWAY

SIGN FACE
86 SQ. FT (MIN.)



TRAFFIC CONE **OR** TRAFFIC DRUM
OPTIONAL TRAFFIC DRUM PORTABLE SIGN SUPPORT
HIGH MOUNTED INTERNALLY ILLUMINATED FLASHING ARROW

SCALE: NONE

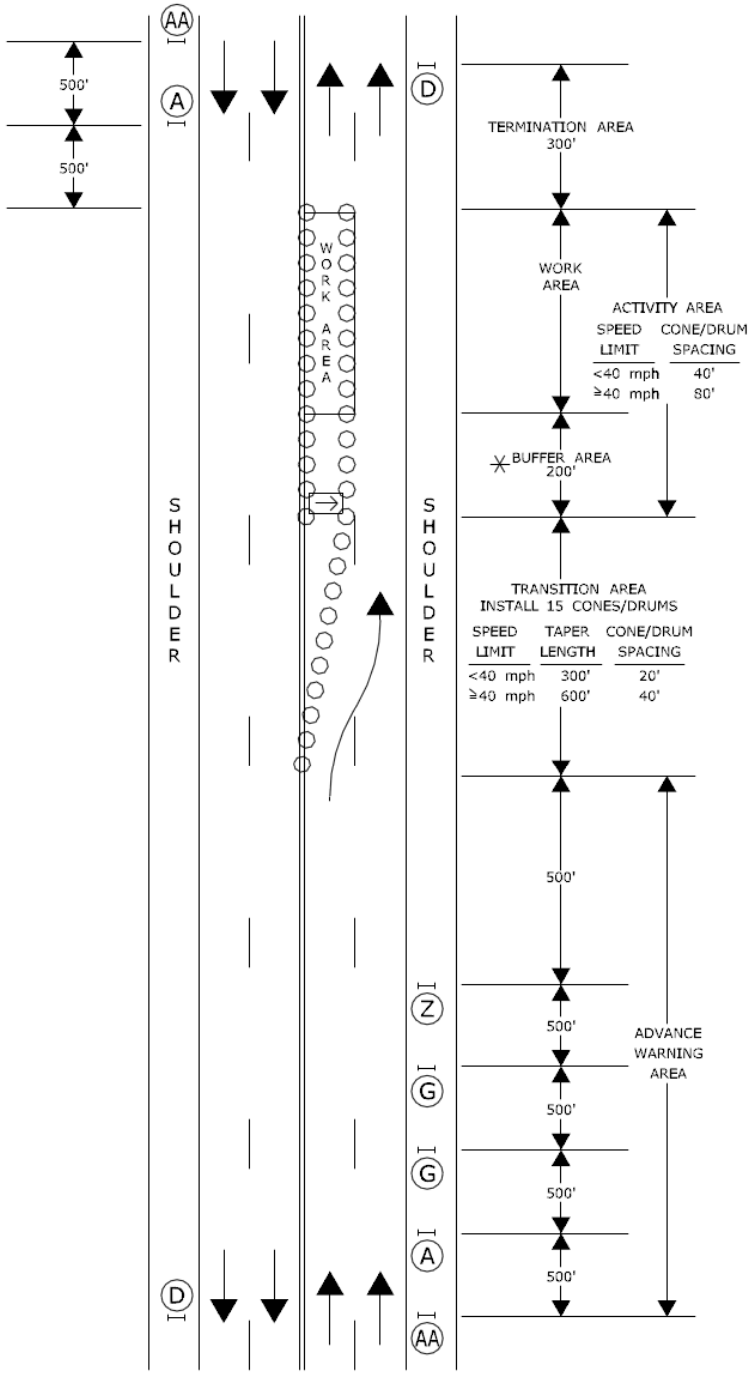
CONSTRUCTION TRAFFIC CONTROL PLAN
PLAN 10
SEE NOTES 1, 2, 3, 4, 5, 6, 7, 8

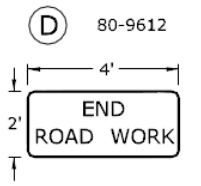
CONNECTICUT DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & CONSTRUCTION

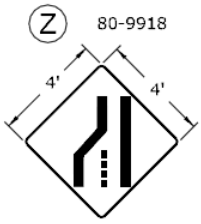
APPROVED
Charles S. Harlow
2012.06.05 15:54:15-04'00'
PRINCIPAL ENGINEER

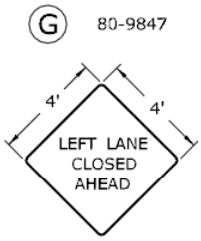
WORK IN LEFT LANE - 4 LANE UNDIVIDED HIGHWAY

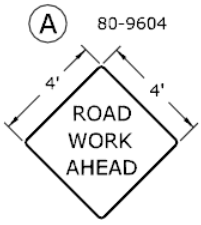
SIGN FACE
124 SQ. FT (MIN.)

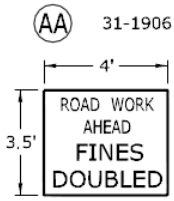












TRAFFIC CONE **OR** TRAFFIC DRUM
OPTIONAL TRAFFIC DRUM PORTABLE SIGN SUPPORT
HIGH MOUNTED INTERNALLY ILLUMINATED FLASHING ARROW

SCALE: NONE

CONSTRUCTION TRAFFIC CONTROL PLAN

PLAN 11

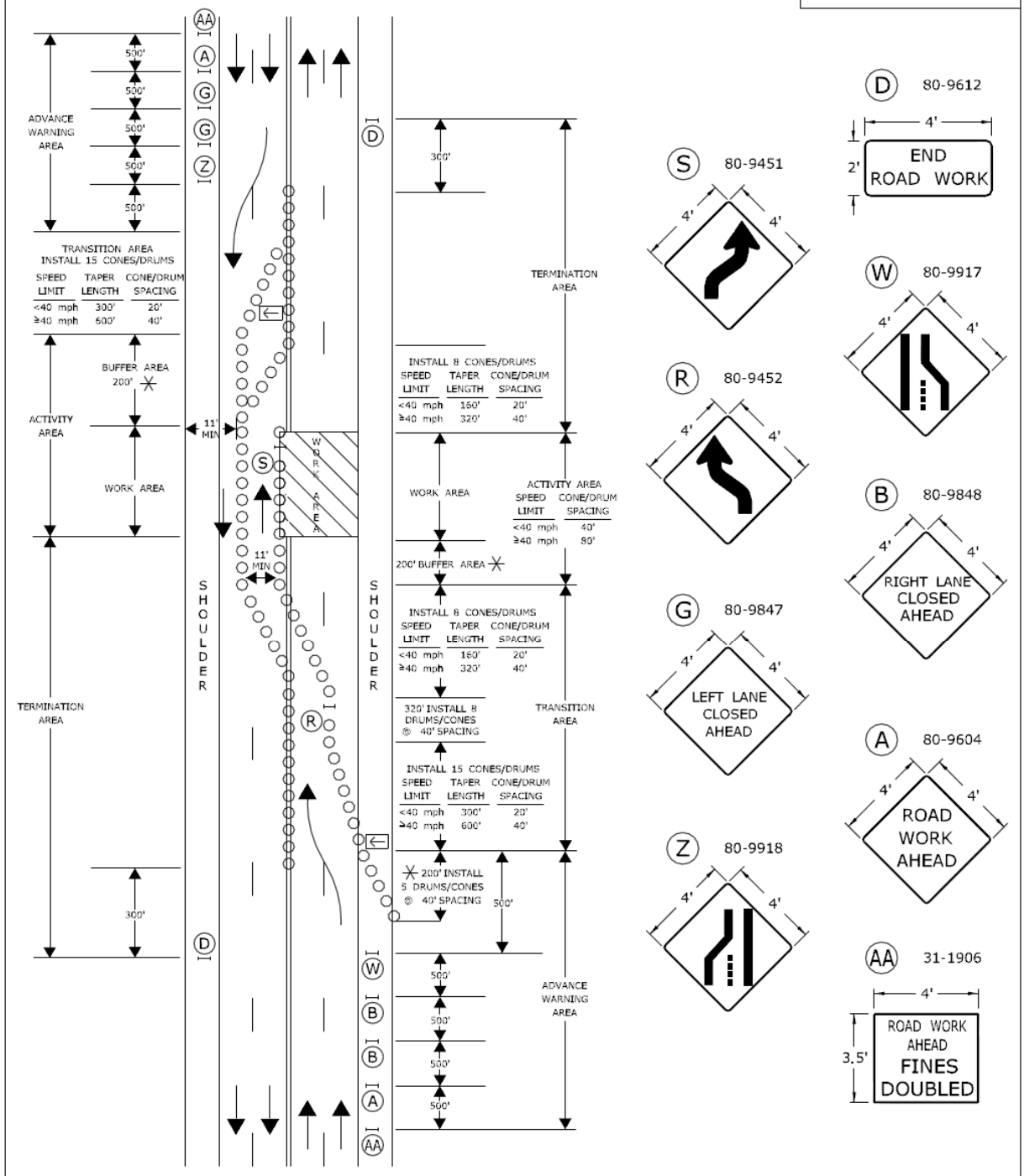
SEE NOTES 1, 2, 3, 4, 5, 6, 7, 8

CONNECTICUT DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & CONSTRUCTION

APPROVED _____ Charles S. Harlow 2012.06.05 15:54:36-04'00'
PRINCIPAL ENGINEER

WORK IN BOTH LANES - 4 LANE UNDIVIDED HIGHWAY

SIGN FACE
204 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 12

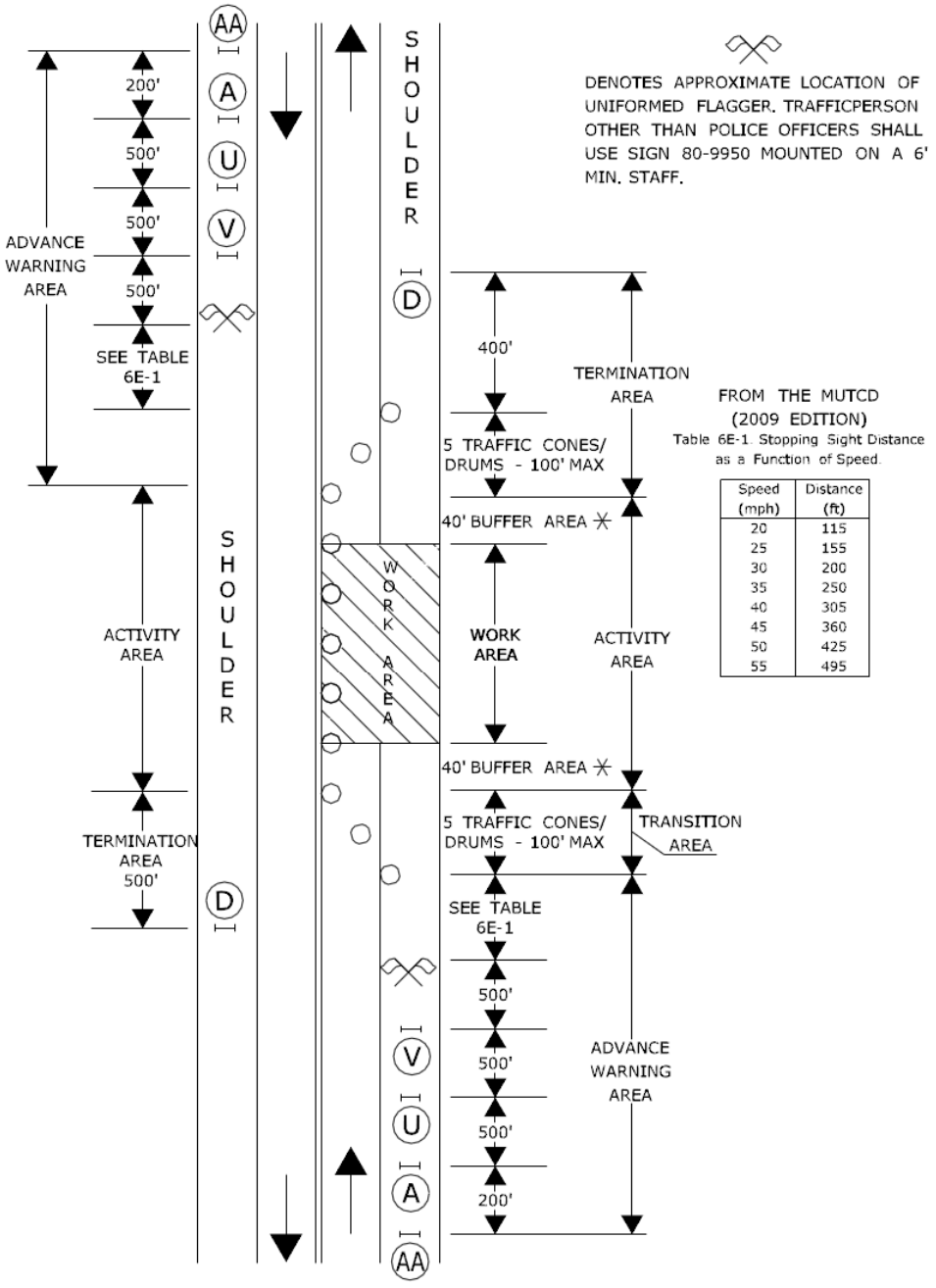
SEE NOTES 1, 2, 3, 4, 5, 6, 7, 8

CONNECTICUT DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & CONSTRUCTION

APPROVED Charles S. Harlow 2012.06.05 15:55:01-04'00'
PRINCIPAL ENGINEER

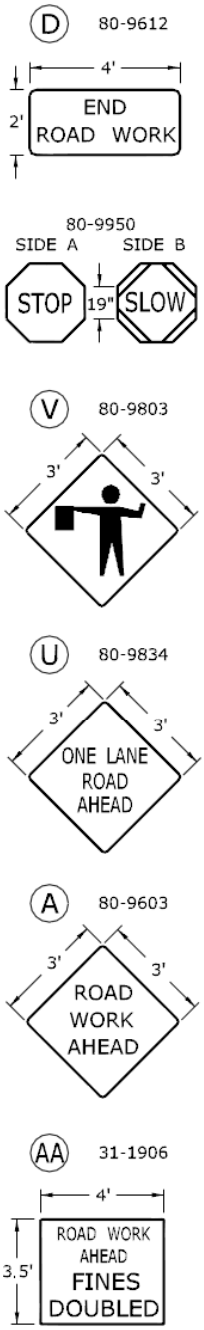
WORK IN TRAVEL LANE AND SHOULDER
TWO LANE HIGHWAY
ALTERNATING ONE-WAY TRAFFIC OPERATIONS

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

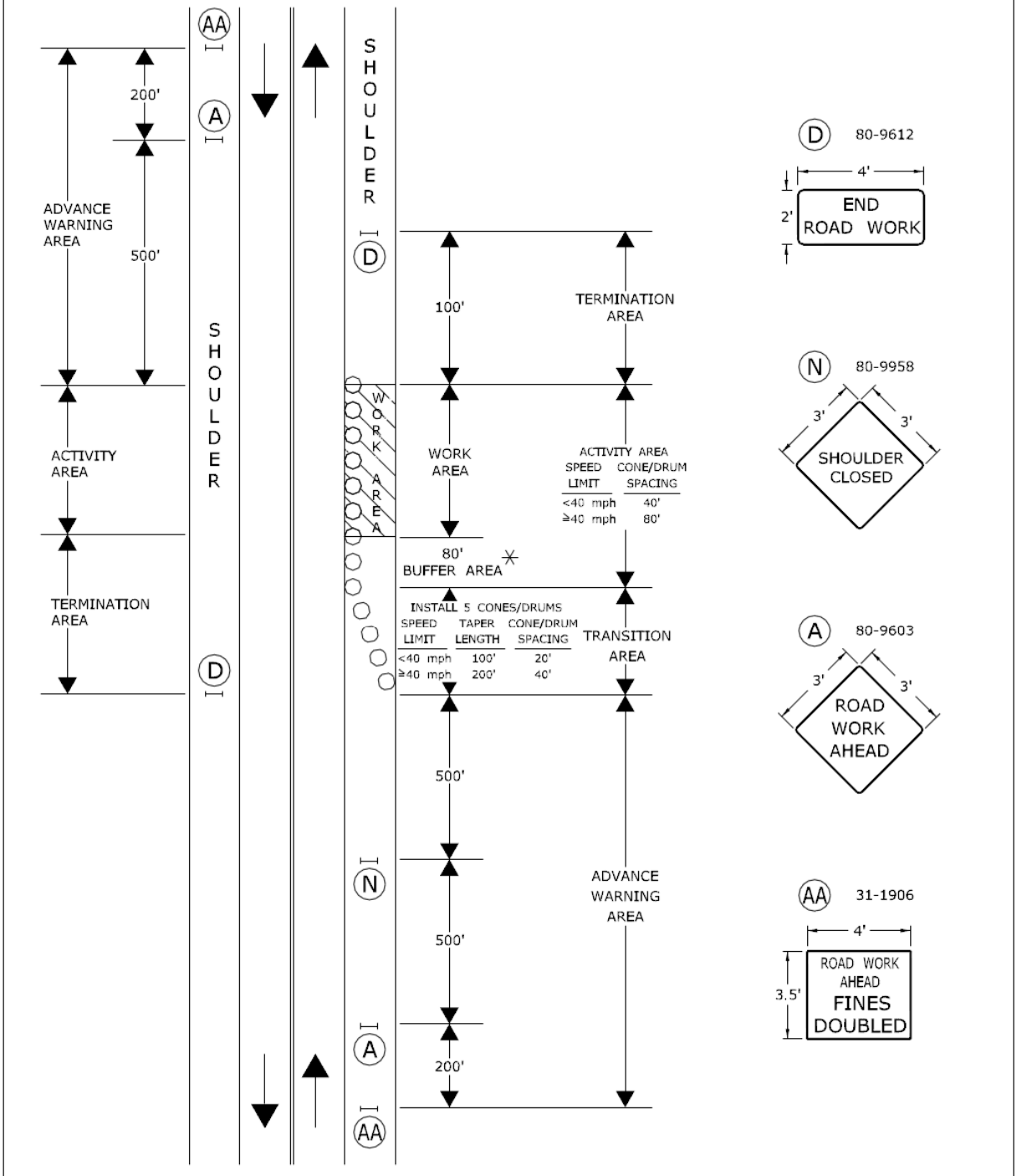
CONSTRUCTION TRAFFIC CONTROL PLAN
PLAN 13 - SHEET 2 OF 2
SEE NOTES 1, 2, 4, 6, 7, 8

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

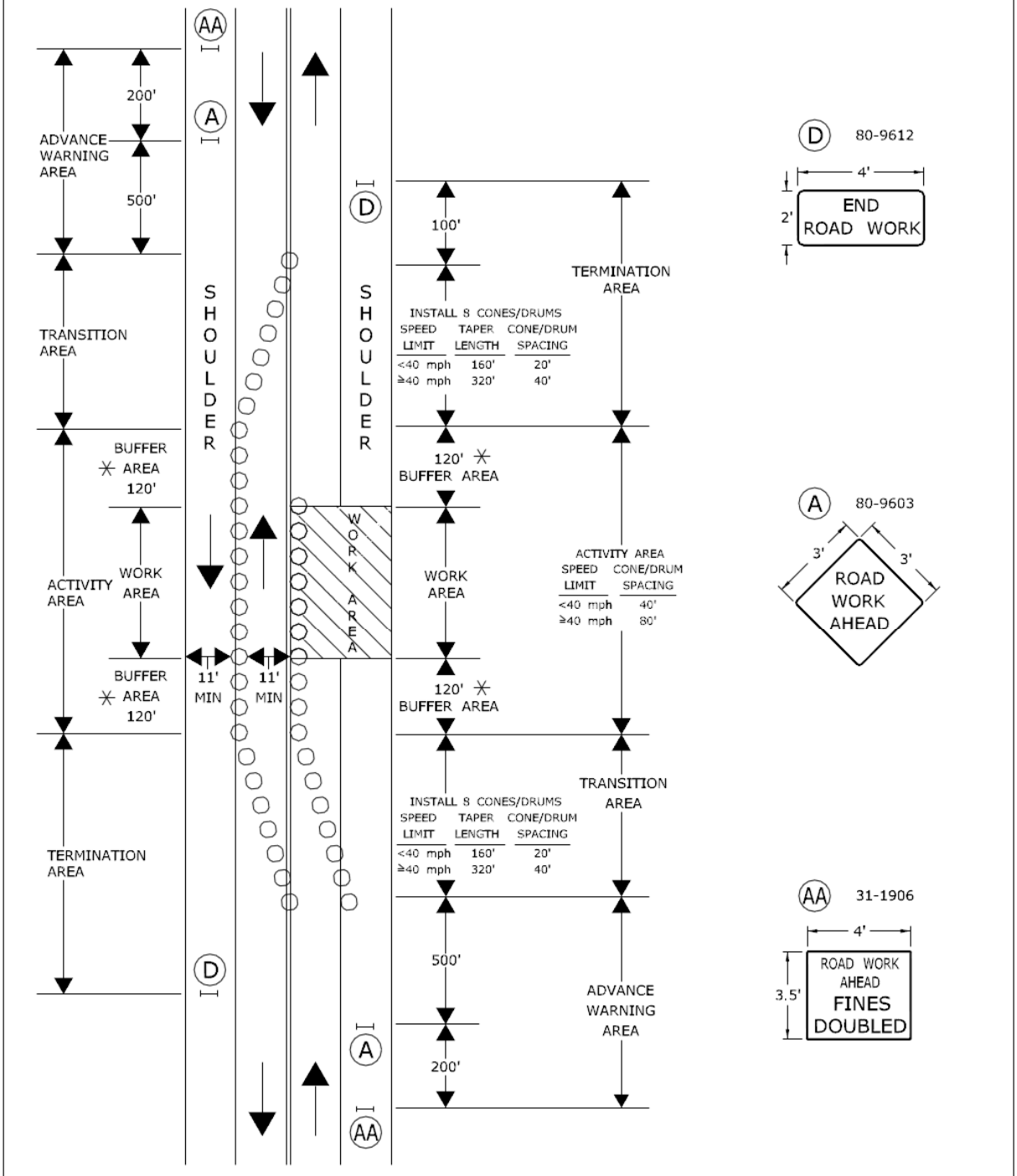
APPROVED

Charles S. Harlow
2012.06.05 15:56:09-04'00'

PRINCIPAL ENGINEER

WORK IN TRAVEL LANE AND SHOULDER
TWO LANE HIGHWAY

SIGN FACE
62 SQ. FT (MIN.)



○ TRAFFIC CONE **OR** TRAFFIC DRUM
✳ OPTIONAL ⊗ TRAFFIC DRUM ⊢ PORTABLE SIGN SUPPORT
HIGH MOUNTED INTERNALLY ILLUMINATED FLASHING ARROW

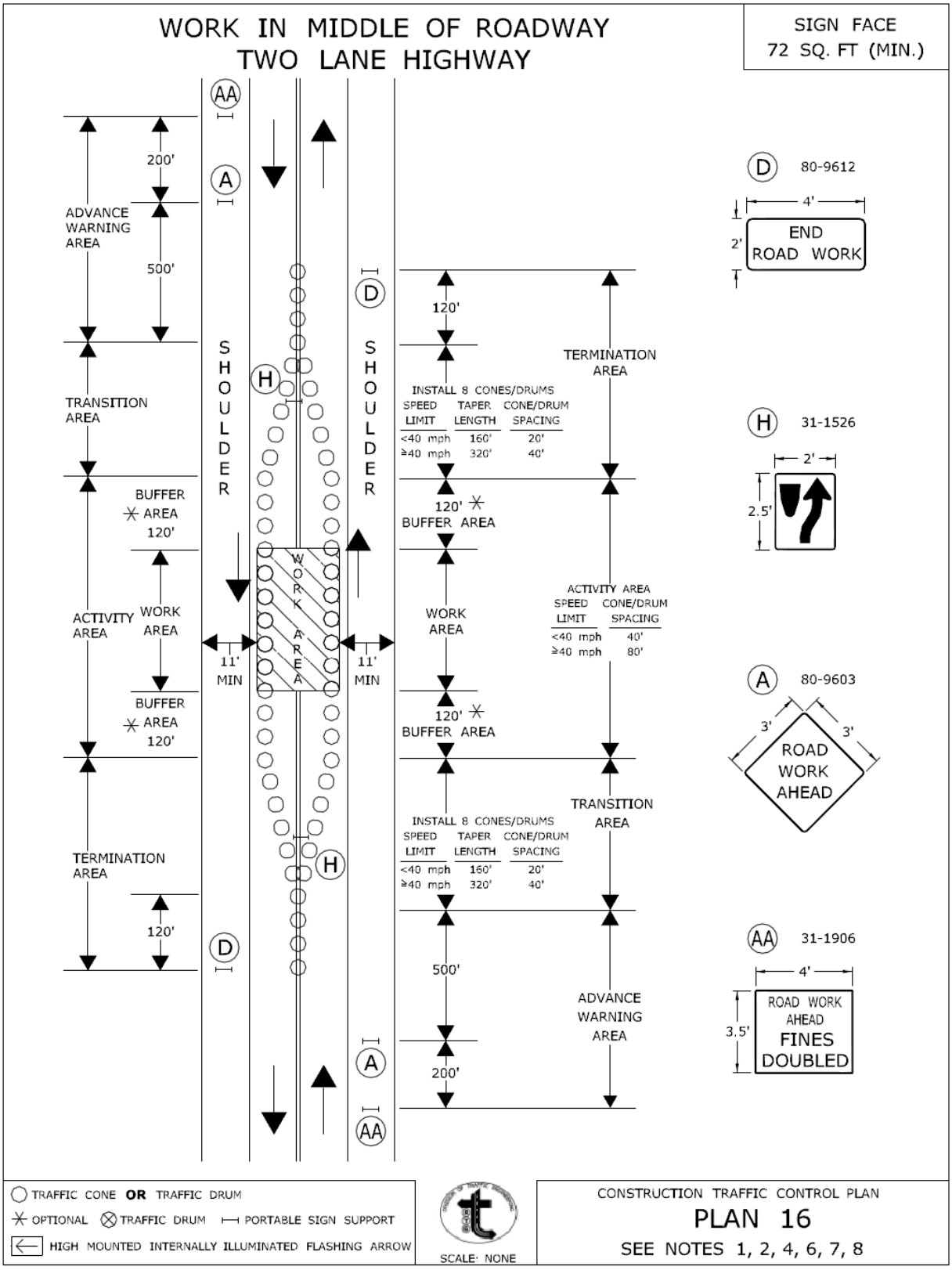
SCALE: NONE

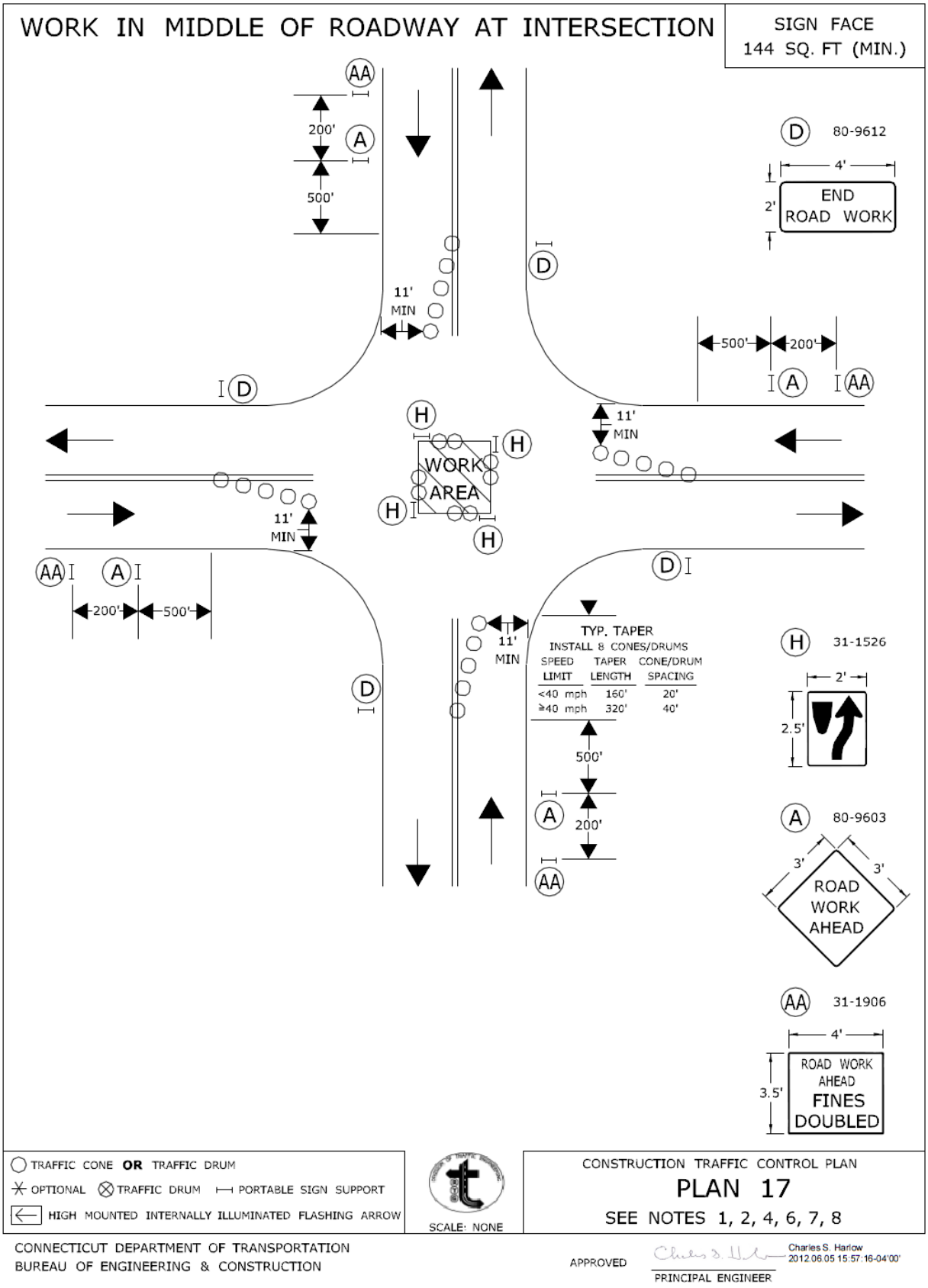
CONSTRUCTION TRAFFIC CONTROL PLAN
PLAN 15
SEE NOTES 1, 2, 4, 6, 7, 8

CONNECTICUT DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & CONSTRUCTION

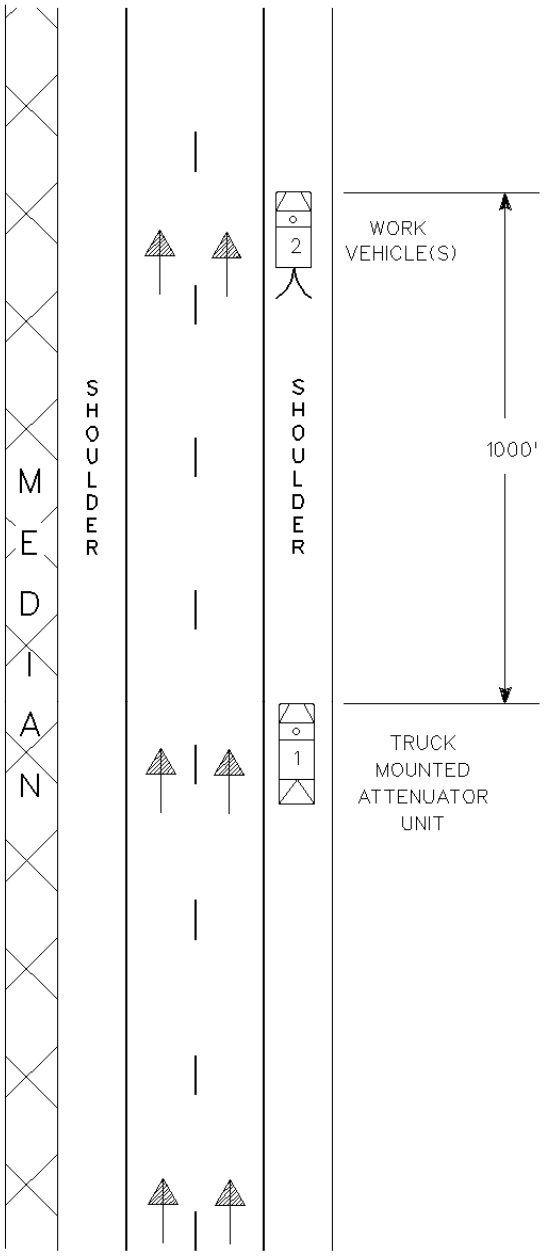
APPROVED Charles S. Harlow 2012.06.05 15:56:29-04'00'
PRINCIPAL ENGINEER

WORK IN MIDDLE OF ROADWAY
TWO LANE HIGHWAY

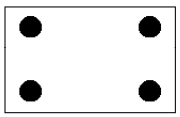



WORK IN MIDDLE OF ROADWAY AT INTERSECTION
SIGN FACE
144 SQ. FT (MIN.)
AA
200'
A
500'
11'
MIN
D
80-9612
4'
2'
END
ROAD WORK
500'
200'
H
WORK
AREA
TYP. TAPER
INSTALL 8 CONES/DRUMS
SPEED LIMIT
TAPER LENGTH
CONE/DRUM SPACING
<40 mph 160' 20'
≥40 mph 320' 40'
31-1526
2'
2.5'
80-9603
3'
3'
ROAD
WORK
AHEAD
31-1906
ROAD WORK
AHEAD
FINES
DOUBLED
3.5'
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
PRINCIPAL ENGINEER
Charles S. Harlow
2012.06.05 15:57:16-04'00'

MOVING OPERATION ON RIGHT SHOULDER
MULTILANE HIGHWAY & SECONDARY ROADWAYS



SIGN MOUNTED ON TRUCK 1



DEPARTMENT APPROVED
ARROW BOARD
(FLASHING YELLOW MODE)

REV'D 1-02

CONNECTICUT
DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & HIGHWAY OPERATIONS
DIVISION OF TRAFFIC ENGINEERING

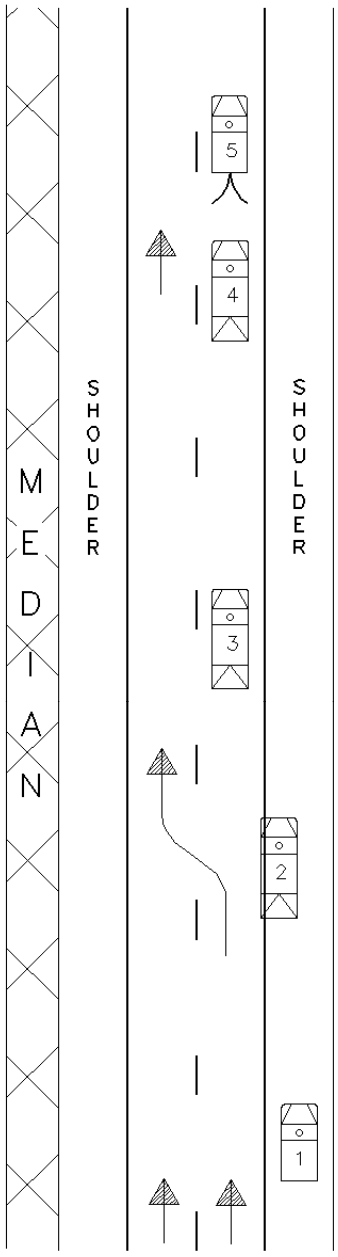
CONSTRUCTION
TRAFFIC CONTROL PLAN

PLAN 19

SCALE NONE

APPROVED J. Mccall PRINCIPAL ENGINEER DATE 1-30-02

MOVING OPERATION IN RIGHT LANE AND OUTSIDE SHOULDER AT THE SAME TIME MULTILANE HIGHWAY



WORK VEHICLE(S)

150'

TRUCK MOUNTED ATTENUATOR UNIT

DISTANCE VARIES ACCORDING TO OPERATION

TRUCK MOUNTED ATTENUATOR UNIT

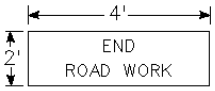
800'

TRUCK MOUNTED ATTENUATOR UNIT

1000'

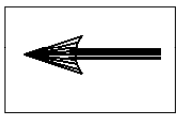
ADVANCE WARNING VEHICLE

SIGN MOUNTED ON VEHICLE 5



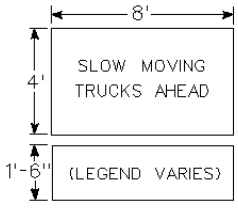
80-9612

SIGN MOUNTED ON TRUCKS 2, 3, & 4



DEPARTMENT APPROVED ARROW BOARD

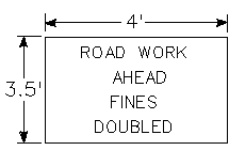
SIGNS MOUNTED ON VEHICLE 1



80-9815
THIS SIGN SHOULD BE COVERED WHEN NOT IN USE.

80-9914
USE APPROPRIATE MESSAGE FOR OPERATION.

SIGN MOUNTED ON VEHICLE 2



31-1906

REV'D 1-02

CONNECTICUT
DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & HIGHWAY OPERATIONS
DIVISION OF TRAFFIC ENGINEERING

CONSTRUCTION
TRAFFIC CONTROL PLAN

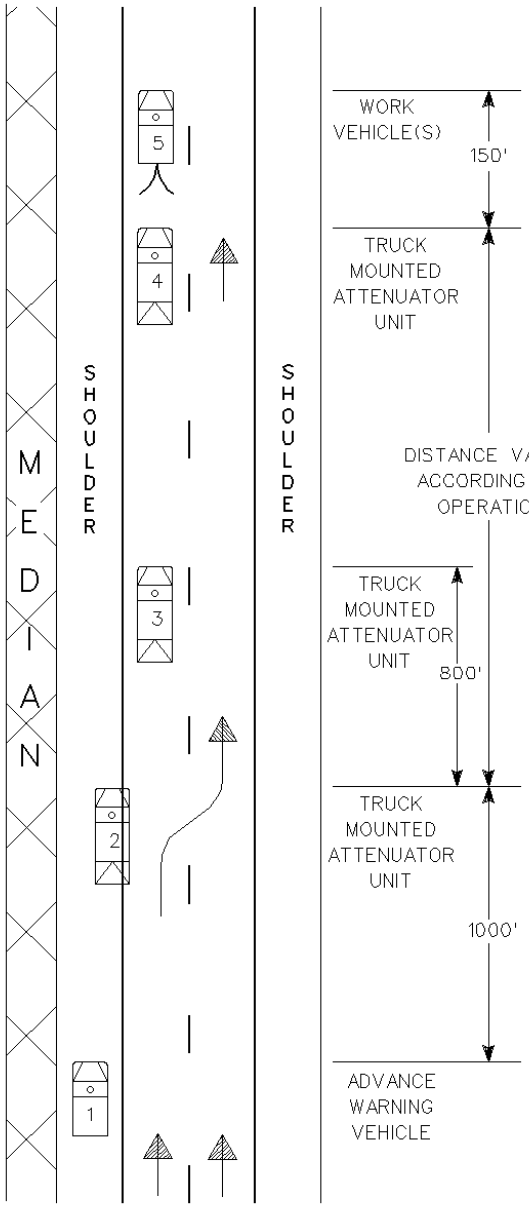
PLAN 20

SCALE NONE

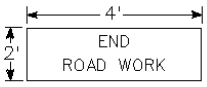
APPROVED John D. Micall
PRINCIPAL ENGINEER

DATE 1-30-02

MOVING OPERATION IN LEFT LANE AND INSIDE SHOULDER AT THE SAME TIME MULTILANE HIGHWAY

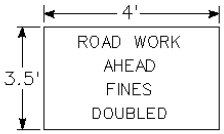


SIGN MOUNTED ON VEHICLE 5



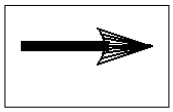
80-9612

SIGN MOUNTED ON VEHICLE 2



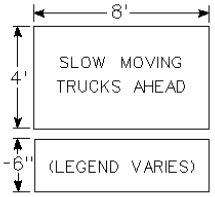
31-1906

SIGN MOUNTED ON TRUCKS 2, 3, & 4



DEPARTMENT APPROVED ARROW BOARD

SIGNS MOUNTED ON VEHICLE 1



80-9815
THIS SIGN SHOULD BE COVERED WHEN NOT IN USE.

80-9914
USE APPROPRIATE MESSAGE FOR OPERATION.

WHEN THE LEFT SHOULDER WIDTH CANNNOT ACCOMMODATE A VEHICLE, THEN ADVANCE WARNING VEHICLE 1 MAY DRIVE PARTIALLY IN THE LANE.

REV'D 1-02

CONNECTICUT
DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & HIGHWAY OPERATIONS
DIVISION OF TRAFFIC ENGINEERING

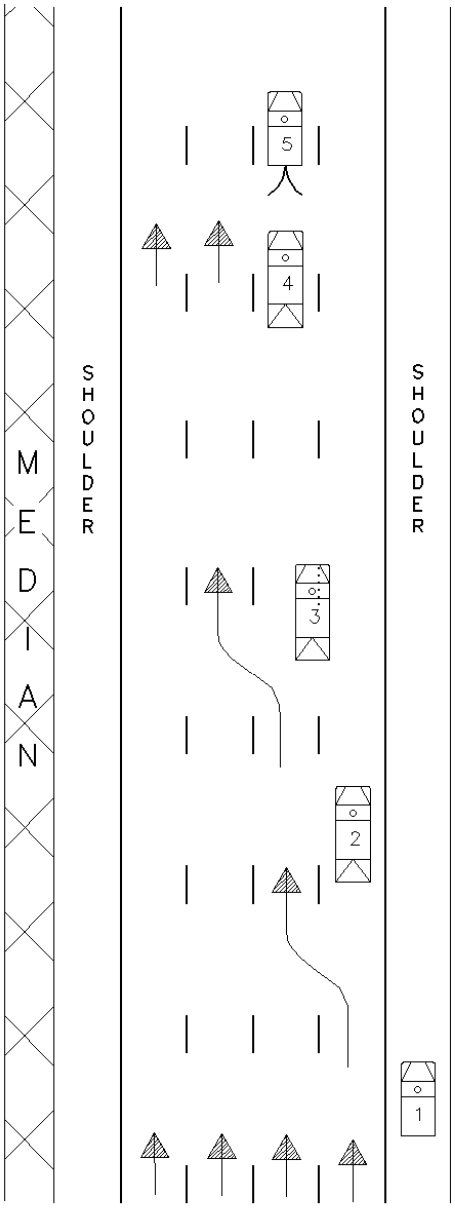
CONSTRUCTION
TRAFFIC CONTROL PLAN

PLAN 21

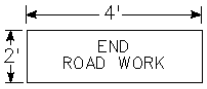
SCALE NONE

APPROVED John D. Micali
PRINCIPAL ENGINEER
DATE 1-30-02

MOVING OPERATION IN CENTER LANE
MULTILANE HIGHWAY

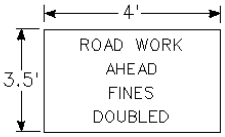


SIGN MOUNTED ON VEHICLE 5



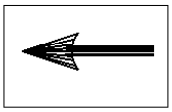
80-9612

SIGN MOUNTED ON VEHICLE 2



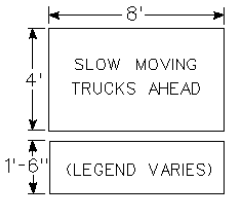
31-1906

SIGN MOUNTED ON TRUCKS 2, 3, & 4



DEPARTMENT APPROVED ARROW BOARD

SIGNS MOUNTED ON VEHICLE 1



80-9815
THIS SIGN SHOULD BE COVERED WHEN NOT IN USE.

80-9914
USE APPROPRIATE MESSAGE FOR OPERATION.

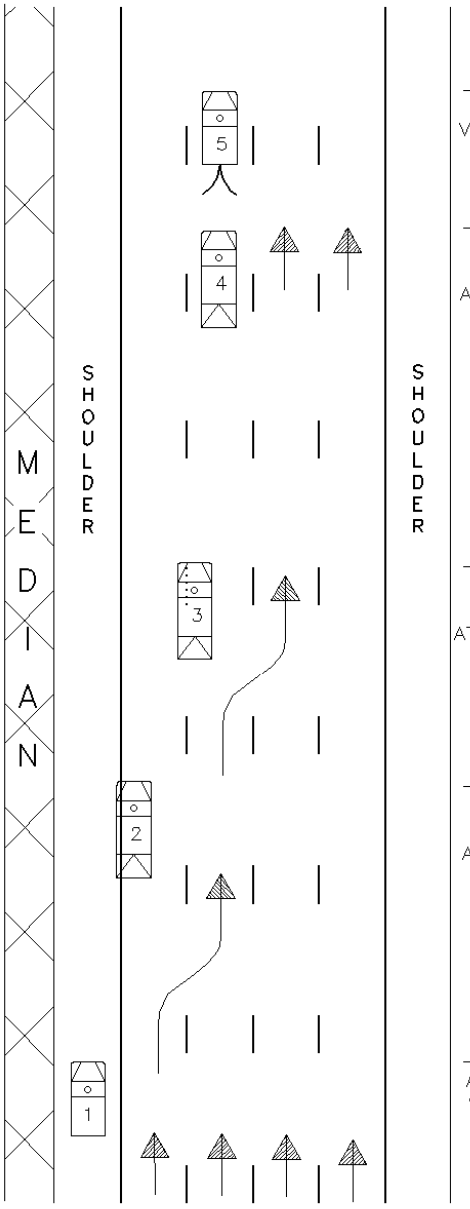
REV'D 1-02

CONNECTICUT
DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & HIGHWAY OPERATIONS
DIVISION OF TRAFFIC ENGINEERING

CONSTRUCTION
TRAFFIC CONTROL PLAN
PLAN 22
SCALE NONE

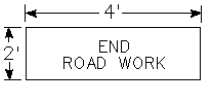
APPROVED John D. Micall PRINCIPAL ENGINEER DATE 1-30-02

MOVING OPERATION IN CENTER LANE
MULTILANE HIGHWAY



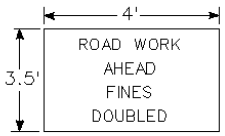
WORK VEHICLE(S)
150'
TRUCK MOUNTED ATTENUATOR UNIT
DISTANCE VARIES ACCORDING TO OPERATION
TRUCK MOUNTED ATTENUATOR UNIT
800'
TRUCK MOUNTED ATTENUATOR UNIT
1000'
ADVANCE WARNING VEHICLE

SIGN MOUNTED ON VEHICLE 5



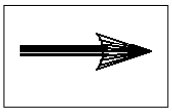
80-9612

SIGN MOUNTED ON VEHICLE 2



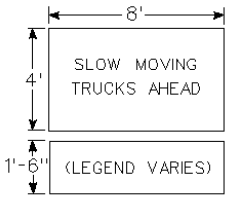
31-1906

SIGN MOUNTED ON TRUCKS 2, 3, & 4



DEPARTMENT APPROVED ARROW BOARD

SIGNS MOUNTED ON VEHICLE 1



80-9815
THIS SIGN SHOULD BE COVERED WHEN NOT IN USE.

80-9914
USE APPROPRIATE MESSAGE FOR OPERATION.

WHEN THE LEFT SHOULDER WIDTH CANNNOT ACCOMMODATE A VEHICLE, THEN ADVANCE WARNING VEHICLE 1 MAY DRIVE PARTIALLY IN THE LANE.

REV'D 1-02

CONNECTICUT
DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & HIGHWAY OPERATIONS
DIVISION OF TRAFFIC ENGINEERING

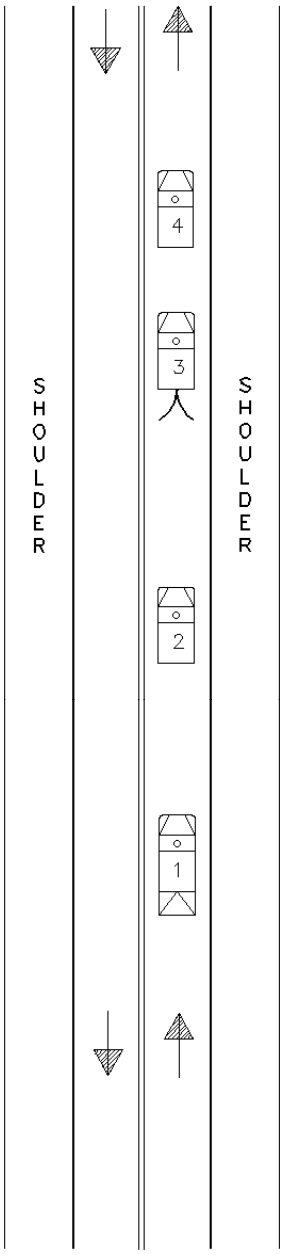
CONSTRUCTION
TRAFFIC CONTROL PLAN

PLAN 23

SCALE NONE

APPROVED John D. Micali
PRINCIPAL ENGINEER
DATE 1-30-02

MOVING OPERATION
TWO LANE HIGHWAY



LEAD VEHICLE

DISTANCE VARIES

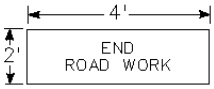
WORK VEHICLE(S)

DISTANCE VARIES ACCORDING TO OPERATION

WORK VEHICLE(S)

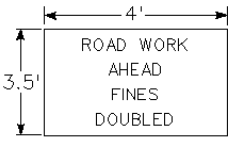
TRUCK MOUNTED ATTENUATOR UNIT

SIGN MOUNTED ON VEHICLE 4



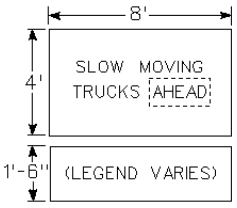
80-9612

SIGN MOUNTED ON VEHICLE 2



31-1906

SIGNS MOUNTED ON VEHICLE 1



80-9815
COVER THE WORD "AHEAD" WITH BLANK PANEL

80-9914
USE APPROPRIATE MESSAGE FOR OPERATION.

REV'D 1-02

CONNECTICUT
DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & HIGHWAY OPERATIONS
DIVISION OF TRAFFIC ENGINEERING

CONSTRUCTION
TRAFFIC CONTROL PLAN

PLAN 24

SCALE NONE

APPROVED John D. Mccall
PRINCIPAL ENGINEEER
DATE 1-30-02

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 0973723A - WORKSITE TRAFFIC SUPERVISOR

Description :
Under this item the Contractor shall furnish the services of a certified person(s) to act as a Worksite Traffic Supervisor on site for each workday that the traffic control devices are being used. This individual(s) must be certified through the American Traffic Safety Services Association (ATSSA) as a Worksite Traffic Supervisor or a similar training course acceptable to CONNDOT. The individual(s) must have taken the course, passed the exam and have certification or have applied for certification to be accepted or conditionally accepted for this position by the Department. If not already certified, certification must be obtained within six months of conditional acceptance by the Department. Certification must be maintained throughout the duration of the project. The certified Worksite Traffic Supervisor(s) may be a member(s) of the Contractor's
staff or as a subcontractor.

The Worksite Traffic Supervisor (s) shall be designated by name, in writing with a resume of their qualifications, within fourteen (14) calendar days after bid opening and shall not be changed without prior written notice to the Department.

Construction Methods:
A Worksite Traffic Supervisor(s) shall be present, on site, throughout each work shift where temporary traffic control signing is employed. During periods when no temporary traffic control signing is employed a Worksite Traffic Supervisors shall inspect the permanent traffic control signing a minimum of once each weekday (i.e. Mon.-Fri.).

The Worksite Traffic Supervisor's duties will include but are not limited to the following:

Monitoring erection, relocation, removal, cleaning and aligning construction signing patterns, signs and sign supports existing or required on the project.

Assuring all signing and pavement marking installation (both temporary and permanent) deficiencies caused by construction or vehicular traffic are corrected by the Contractor's forces.

Inspect all traffic control devices and pavement markings in use on a daily basis for proper installation in accordance with the contract traffic control plans, CONNDOT standards, and MUTCD requirements.

Monitor and enforce compliance by workers in the wearing of high visibility protective clothing and other safety related clothing.

Inspect and notify the Engineer of any deficiencies to traffic related mechanical devices located on the project and the corrective actions to be taken.

Perform a monthly inventory of all construction signing, cones, drums and traffic control devices to assure compliance with the "Quality Standards for Work Zone Traffic Control Devices" as published by ATSSA. Assure removal from service of all "marginal" or "unacceptable" devices.

Monitor work zone signing and safety practices of all subcontractors on the project to ensure their compliance with workzone safety requirements.

Recommend and implement enhancements to the Traffic Control Plan to meet site conditions. Monitor installed traffic control patterns a minimum of four (4) times per shift, assure implementation of any necessary corrections.

Maintain a daily log of all Worksite Traffic activities and provide to the Engineer on a weekiy basis a report of activities performed by the Worksite Safety Supervisor (by noon on Monday of the following week).

Conduct weekly inspections with the Engineer of all permanently mounted worksite traffic control signs, drums, pavement markings, VMS signing, arrow boards and other traffic control devices.

Prior to the installation of any signing pattern on the project, the Worksite Traffic Supervisor shall submit to the Engineer a copy of the proposed Daily Worksite Traffic Safety Log to be utilized throughout the duration of the project. The Daily Log shall include at a minimum the following information:

Date, weather conditions, temperature, type sign patterns installed, time of installation, modifications to standard patterns, time of removal, time of periodic reviews of patterns, status of all permanently mounted traffic control signs, condition of pavement markings, deficiencies noted and corrective action taken, operational problems, evidence of accidents, worksite traffic safety supervisors name and Contractor's name.

In addition, prior to installing any construction signing on the project, the Worksite Traffic Supervisor shall develop and submit to the Engineer site specific installation and removal plans for all temporary signing patterns and construction sign installations to be utilized on the project.

The Worksite Traffic Supervisor shall conduct safety meetings with the sign installation crew prior to installing any signing patterns on the project and a minimum of monthly thereafter, or more frequently if required due to staffing changes or installation and removal problems.

The Worksite Traffic Supervisor shall conduct monthly Traffic Safety “tailgate” sessions with all workers on the project. A report of the safety tailgate sessions held along with a record of attendees shall be submitted to the Engineer by the tenth of the following month.

If the Worksite Traffic Supervisor(s) will not be available as required due to circumstances beyond the control of the Contractor (i.e. Illness, etc.) the Contractor shall notify the Engineer of the absence within one (1) hour of the start of the workday (workshift).

Method of Measurement:
Upon receipt of the monthly report, the per month cost for the services of the ~worksite Traffic Supervisor" will be certified for payment.

This work will be measured for payment by the number of months a worksite Traffic Supervisor(s) is provided on site as required.

Basis of Payment:
This service will be paid for at the contract unit price Per Month for "Worksite Traffic Supervisor" complete, which price shall include all inspections, reports, meetings and handling of all traffic appurtenances, and all materials, equipment, labor and work incidental of this service. Only one
monthly payment will be made for each calendar month regardless of the number of certified personnel required due to multiple shift operations. Failure of the Contractor to provide a Worksite Traffic Supervisor(s) as required by this specification will result in the following reductions to the monthly payment:
Four Hundred Dollars ($400. 00) for each work shift that is not covered as required by this specification. A work shift is defined as any eight (8) hour period, or portion thereof. The total deduct for any calendar month may exceed the monthly bid price for the item if the Contractor fails to provide the Worksite Traffic Supervisor (except where absence is beyond the Contractor's control).

Pay Item	Pay Unit
Worksite Traffic Supervisor	MO.

ITEM #0975004A - MOBILIZATION AND PROJECT CLOSEOUT

9.75.01 – Description:
This item shall consist of all work necessary for the movement of personnel and furnishing equipment to the project site, and for the establishment of all Contractors' field offices, buildings and other facilities necessary to the performance of the work. In addition, this item shall include the preparation of work plans and submittals necessary to facilitate the commencement of physical construction. These initial submittals are identified elsewhere in the contract and may include project schedules, project management plans, safety plans, quality plans, erosion and sedimentation control plans and similar submittals addressing the general sequencing and management of the project. This item shall also include demobilization of plant and equipment, completion of all punchlist work, and administrative closeout items necessary to satisfy all contract requirements.

This item may not be subcontracted, in whole or part.

9.75.04 – Method of Measurement:
This work will be measured for payment in the manner described hereinafter; however, the determination of the total contract price earned shall not include the amount of mobilization earned during the period covered by the current monthly estimate - but shall include amounts previously earned and certified for payment.

1. When the first payment estimate is made, 25 percent of the lump sum bid price for this item or 2.5 percent of the total original contract price, whichever is less, shall be certified for payment.

2. When the initial project submittals necessary to begin construction are accepted by the Engineer, 50 percent of the lump sum bid price for this item or 5.0 percent of the total original contract price, whichever is less, minus any previous payments, shall be certified for payment.

3. When the initial project submittals are accepted by the Engineer, and 15 percent of the total original contract price is earned, 70 percent of the lump sum price of this item or 7.0 percent of the total original contract price, whichever is less, minus any previous payments, will be certified for payment.

4. When 30 percent of the total original contract price is earned 85 percent of the lump sum price of this item or 8.5 percent of the total original contract price, whichever is less, minus any previous payments, will be certified for payment.

5. When the requirements of Article 1.08.13 have been satisfied 95 percent of the lump sum price of this item, minus any previous payments, will be certified for payment.

6. When the requirements of Article 1.08.14 have been satisfied 100 percent of the lump sum price of this item, minus any previous payments, will be certified for payment.

Nothing herein shall be construed to limit or preclude partial payments otherwise provided for by the contract.

9.75.05 – Basis of Payment:
This work will be paid for at the contract lump sum price for "Mobilization and Project Closeout" which price shall include materials, equipment, tools, transportation, labor and all work incidental thereto.

This item shall not be paid more than one time. If the Contractor is required to mobilize equipment or facilities more than one time, due to reasons solely the responsibility of the Department, any additional efforts will be paid as Extra Work under Section 1.04.05.

Pay Item	Pay Unit
Mobilization and Project Closeout	l.s.

ITEM #0979003A - CONSTRUCTION BARRICADE TYPE III

Article 9.79.01 – Description: The Contractor shall furnish construction barricades to conform to the requirements in National Cooperative Highway Research Program (NCHRP) Report 350 or the AASHTO Manual for Assessing Safety Hardware (MASH) and to the requirements stated in Article 9.71 "Maintenance and Protection of Traffic," as shown on the plans and/or as directed by the Engineer.

Article 9.79.02 – Materials: Prior to using the construction barricades, 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 have been crash tested and have approval in writing from FHWA conforming to the requirements in National Cooperative Highway Research Program (NCHRP) Report 350 or the AASHTO Manual for Assessing Safety Hardware (MASH), as appropriate.

Alternate stripes of white and orange Type III or Type VI reflective sheeting shall be applied to the horizontal members as shown on the plans. Application of the reflective sheeting shall conform to the requirements specified by the reflective sheeting manufacturer. Only one type of sheeting shall be used on a barricade and all barricades furnished shall have the same type of reflective sheeting. Reflective sheeting shall conform to the requirements of Article M.18.09.01.

Construction barricades shall be designed and fabricated so as to prevent them from being blown over or displaced by the wind from passing vehicles. Construction barricades shall be approved by the Engineer before they are used.

Article 9.79.03 – Construction Methods: Ineffective barricades, 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.

Barricades that are no longer required shall be removed from the project and shall remain the property of the Contractor.

Article 9.79.04 – Method of Measurement: Construction Barricade Type III will be measured for payment by the number of construction barricades required and used.

Article 9.79.05 – Basis of Payment: "Construction Barricade Type III" required and used will be paid for at the Contract unit price per each. Each barricade will be paid for once, regardless of the number of times it is used.

Pay Item	Pay Unit
Construction Barricade Type III	EA.

ITEM NO. 0980001A – CONSTRUCTION STAKING

9.80.01—Description: The work under this item shall consist of construction layout and reference staking necessary for the proper control and satisfactory completion of all work on the project, except property lines, highway lines, or non-access lines.

9.80.02—Materials: All stakes used for control staking shall be of the same quality as used by the Department for this purpose. For slope limits, pavement edges, gutter lines, etc., where so-called "green" or "working" stakes are commonly used, lesser quality stakes will be acceptable, provided the stakes are suitable for the intended purpose.

9.80.03—Construction Methods: The Department will furnish the Contractor such control points, bench marks, and other data as may be necessary for the construction staking and layout by qualified engineering or surveying personnel as noted elsewhere herein.

The Contractor shall be responsible for the placement and preservation of adequate ties to all control points, necessary for the accurate re-establishment of all base lines, center lines, and all critical grades as shown on the plans.

All stakes, references, and batter boards which may be required for construction operations, signing and traffic control shall be furnished, set and properly referenced by the Contractor. The Contractor shall be solely and completely responsible for the accuracy of the line and grade of all features of the work. Any errors or apparent discrepancies found in previous surveys, plans, specifications or special provisions shall be called to the Engineer's attention immediately for correction or interpretation prior to proceeding with the work.

During roadway construction (or site work), the Contractor shall provide and maintain for the periods needed, as determined by the Engineer, reference stakes at 100 foot intervals outside the slope limits. Further, the Contractor shall provide and maintain reference stakes at 50 foot intervals immediately prior to and during the formation of subgrade and the construction of all subsequent pavement layers. These stakes shall be properly marked as to station, offset and shall be referenced to the proposed grade, even if laser or GPS machine controls are used.

The Contractor shall provide and maintain reference stakes at drainage structures, including reference stakes for the determination of the structure alignments as may be needed for the proper construction of the drainage structure. The reference stakes shall be placed immediately prior to and maintained during the installation of the drainage structure. These stakes shall be properly marked as to station, offset and shall be referenced to the proposed grade.

The Contractor shall furnish copies of data used in setting and referencing stakes and other layout markings used by the Contractor after completion of each operation.

The Contractor shall provide safe facilities for convenient access by Department forces to control points, batter boards, and references.

All staking shall be performed by qualified engineering or surveying personnel who are trained, experienced and skilled in construction layout and staking of the type required under the contract. Prior to start of work, the Contractor shall submit for review and comment the qualifications of personnel responsible for construction staking on the project. On all projects with an original contract value greater than $25 million and bridge rehabilitation and reconstruction projects greater than $10 million, surveying shall be performed under the direct supervision of a Professional Surveyor licensed in the State of Connecticut. The submission shall include a description of the experience and training which the proposed staff possesses and a list of state projects the personnel have worked on previously. All field layout and staking required for the project shall be performed under the direct supervision of a person, or persons, of engineering background experienced in the direction of such work and acceptable to the Engineer. If the personnel responsible for construction staking change during the course of the project, then a revised submittal will be required.

The Department may check the control of the work, as established by the Contractor, at any time as the work progresses. The Contractor will be informed of the results of these checks, but the Department by so doing in no way relieves the Contractor of responsibility for the accuracy of the layout work. The Contractor shall correct or replace, at the Contractor's own expense, any deficient layout and construction work which may be the result of the inaccuracies in the Contractor's staking operations or the failure to report such inaccuracies, or the Contractor's failure to report inaccuracies found in work done by the Department or by others. If, as a result of these inaccuracies, the Department is required to make further studies, redesign, or both, all expenses incurred by the Department due to such inaccuracies will be deducted from any monies due the Contractor.

The Contractor shall furnish all necessary personnel, engineering equipment and supplies, materials, transportation, and work incidental to the accurate and satisfactory completion of this work.

For roadways where the existing pavement markings and grades need to be reestablished: Prior to any resurfacing or obliteration of existing pavement markings, the Contractor and a representative of the Engineer must establish and document pavement marking control points from the existing markings. These control points shall be used to reestablish the positions of the lanes, the beginnings and endings of tapers, channelization lines for on and off ramps, lane use arrows, stop bars, and any lane transitions in the project area. The Contractor shall use these control points to provide appropriate premarking prior to the installation of the final markings.

The Contractor shall provide and maintain reference stakes and/or markings at 100 foot intervals immediately off the edge of pavement to be used to reestablish the existing pavement markings. The Contractor shall also provide and maintain reference stakes and/or markings at any point where there is a change in pavement markings to reestablish the existing pavement markings.

The Contractor shall also record and document the existing gutter grade and the edge of the roadway grade for I-95 NB along walls 101 and 102 prior to the construction of the walls and removal of the existing I-95 shoulder to confirm existing grades and the top of wall elevation as

shown on the plans. The grades shall be obtained at 25 feet intervals. The information shall be submitted to the Engineer for review and approval prior to the removal of the existing shoulder and parapet.

For non-limited access roadways
On non-limited access roadways it may be necessary to adjust the final locations of the pavement markings to accommodate pedestrians and bicyclists where feasible. Prior to any resurfacing or obliteration of existing pavement markings, the Contractor, a representative of the Engineer, and a representative of the Division of Traffic Engineering must establish and document pavement marking control points from the existing markings as described above. The control points at that time may be adjusted to provide minimum shoulder widths of 4 to 5 feet wherever possible while maintaining travel lane widths of no less than 11 feet and no more than 12 feet.

9.80.04—Method of Measurement: Construction staking will be at the Contract lump sum for construction staking.

9.80.05—Basis of Payment: Construction staking will be paid for at the Contract lump sum price for "Construction Staking," which price shall include all materials, tools, equipment, labor and work incidental thereto. A schedule of values for payment shall be submitted to the Department for review and comment prior to payment.

Pay Item	Pay Unit
Construction Staking	l.s.

ITEM #1001001A - TRENCHING AND BACKFILLING

The materials for this work shall conform to the State of Connecticut Department of Transportation Standard Specifications for Roads, Bridges and Incidental Construction (Form 816) Section 10.01 amended as follows:

Article 10.01.01 - Description:

In the second paragraph, replace "pavement or sidewalk structure" with the following:
"pavement, pavement base and sidewalk structure including brick pavers"

In the second paragraph insert the following:
It shall also include the removal, reconstruction, and/or resetting of curbing disturbed by the trenching and backfilling operation.

10.01.03 - Construction Methods:

Add the following paragraph: The Contractor shall reinstall the brick pavers in accordance with the details on the drawings.

Add the following paragraph:
The minimum depth of the trench shall be to accommodate the top of conduit depth at "36 inches". When other utilities are encountered at this depth the new conduit may be placed between 24 inches and 36 inches with concrete encasement. If the conduit depth can not be more than 24 inches, the contractor shall excavate the trench to place the conduit under the conflicting utility. This additional depth excavation length shall be measured for twice the unit price.

Add the following paragraph:
All cuts in roadways shall be done in a neat and workmanlike manner, so as to cause the least possible injury to all other improvements. The Contractor should provide protection to all slopes, roadways, guide rails, drainage structures, illumination conduit and appurtenances, utilities, etc. as may be necessary or as required by the Engineer. Any property damage caused by excavation shall be repaired as directed by, and to the satisfaction of, the Engineer at no additional compensation. Excavating shall not be performed until immediately before installation of conduit and other appurtenances. The material from the excavation shall be placed where directed by the Engineer and in a position where the least damage and obstruction to vehicular traffic and the least interference with the surface drainage will occur.
All excavations shall be closed at the end of each day.
All pavement cutting required for this item, regardless of the type, shall be included as work under this item.
Where possible, communication conduit and electrical conduit shall be installed in the same trench and shall be paid for under this item as one. Payment shall not be made for separate trenching and backfilling where electrical and communication conduit may be installed in the same trench, but have been installed separately by the Contractor.

When trenching occurs in roadways, neat lines shall be drawn on the surface and the roadway shall be saw cut and removed to neat lines as indicated on the plans or as directed by the Engineer.

Temporary Pavement Repair

Description:

Temporary pavement repair consists of replacing pavement that has been removed for the installation of conduits. The Contractor shall repair the pavement immediately upon completion of the trench backfilling and compaction in accordance with these specifications and to the dimensions on the contract drawings or as directed by the Engineer.

Materials:

Superpave 12.5 mm and Superpave 9.5 mm shall conform to the requirements of Article M.04 of the Standard Specifications.

Construction Methods:

Temporary pavement replacement shall be constructed in accordance with the details shown on the plans.

Permanent Pavement Repair

Description:

After the temporary pavement has been in place for 30 days and within 3 months of placing the temporary pavement, the Contractor shall make permanent pavement repairs. Where trenching occurs across bituminous concrete overlayed concrete pavement, immediate permanent pavement repairs shall take place. These repairs shall include filling the trench with high-early concrete fill and upon curing, permanent surface pavement repairs.

Materials:

Concrete fill for restoration of bituminous concrete overlayed concrete pavement shall conform to the requirements of Article M.03.01 of the Standard Specifications and shall be capable of achieving 3000 psi within 12 hours. The Contractor shall submit a design mix to the Engineer for approval.

Processed Aggregate Base shall conform to the requirements of Article M.05.01 of the Standard Specifications.

Superpave 12.5 mm and Superpave 9.5 mm shall conform to the requirements of Article M.04 of the Standard Specifications.

Joint Seal shall conform to the requirements of Article M.04.02 of the standard specifications.

Reinforcement shall conform to the requirements of ASTM A615, Grade 60.

Unpaved Areas

Description:

Unpaved areas disturbed during construction shall be restored with a minimum of 50 MM of topsoil and established turf.

Materials:

Topsoil shall conform to the requirements of Article M.13.01-1 of the standard specifications. Turf Establishment materials shall conform to Article M.13 of the Standard Specifications.

Construction Methods:

Topsoil shall be provided in conformance to Section 9.44.03 of the standard specifications. Turf Establishment shall conform to Section 9.50.03 of the Standard Specifications.

10.01.05 - Method of Measurement:
Add the following:
Curbing replacement and brick paver replacements will not be measured for payment, but shall be included in the price per linear foot of Trenching and Backfilling.

Add the following:
There shall be no separate measurement for sawcutting, temporary pavement repair, concrete fill, joint sealing, permanent pavement repair, sidewalk repair, cutting reinforcement, reinforcement, topsoil and turf establishment.

10.01.05 - Basis of Payment:

In the second paragraph, replace “pavement or structure” with the following:
“pavement and pavement base”

In the second paragraph, add the following:
It shall also include the replacement, reconstruction and/or resetting of curbing and replacement of brick pavers.

Delete the second paragraph and replace with the following:
It shall also include all sand encasement, backfilling, grading, seeding, fertilizing, mulching, disposal of surplus material, as well as furnishing and installing concrete fill, topsoil or pavement as the case may be.

Delete the fifth paragraph and replace with the following:
Pavement, pavement structure, sidewalk or curbing replaced beyond the maximum trench limits as shown on the plans and approved by the Engineer will be not be paid for separately but will be included in the cost for the Contract unit price for “Trenching and Backfilling”. The limits of the replacement shall be as approved under the Construction Staking item. The concrete encasement in trench where required shall be included in the unit price.

Pay Item	Pay Unit
Trenching and Backfilling	LF

ITEM #1002202A – TRAFFIC CONTROL FOUNDATION – MAST ARM

Description: This item shall consist of designing, furnishing and installing a light standard or traffic control foundation of the type called for at the location and to the dimensions and details shown on the plans or as directed by the Engineer and in conformity with these specifications. Rock, in so far as it applies to "Rock in Foundation Excavation," shall be defined as rock in definite ledge formation, boulders, or portions of boulders, cement masonry structures, concrete structures or portland cement concrete pavement which has a cross-sectional area that exceeds 50% of the cross-sectional area of the designed foundation hole.

Materials: The materials for the work shall conform to the following:

Article M.02.01 for Gravel Fill
Article M.03.01 for Class "A" Concrete
Article M.04.01 for Class 2 Bituminous Concrete
Article M.06.01 for Bar Reinforcement
Article M.08.02-4 for Precast Concrete
Article M.13.01 for Topsoil
Article M.13.03 for Fertilizer
Article M.13.04 for Seed Mixture
Article M.13.05 for Mulch Materials
Article M.15.02 for Anchor Bolts
Article M.15.03 for Rock Anchors
Article M.15.09 for Electrical Conduit
Article M.15.15-7 for Ground Rods

Construction Methods: The design and construction of the foundation shall conform to the requirements of AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals – latest edition, including the latest interim specifications, in accordance with the details shown on the plans, in accordance with these specifications and as ordered by the Engineer.

Prior to construction, the Contractor shall submit working drawings and design computations to the Engineer for review in accordance with Article 1.05.02. Working drawings shall be submitted on 11" x 17" (279 mm x 432 mm) (Ledger/Tabloid) sheets with an appropriate border and title block. Design computations, procedures and other supporting data shall be submitted on 8 ½" x 11" (216 mm x 279 mm) (Letter) sheets.

The working drawings and design computations shall be sealed by a Professional Engineer, licensed in the State of Connecticut, who shall also be available for consultation in interpreting his computations and drawings, and in the resolution of any problems which may occur during the performance of the work. Please note that each working drawing must be sealed.

The design computations shall include, but not be limited to the following:

- the project number, town and post identification number;

- analysis and design computations;
- references to design specifications, including interim specifications, and the applicable code section and articles;
- description/documentation for all computer programs used in the design;
- results of the application of all group loads and load combinations.

The working drawings shall include complete details of all foundation components and reinforcement. The drawings shall include, but not be limited to the following:

- the project number, town and pole identification number;
- reference to the design specifications, including interim specifications;
- reference to the design specifications design criteria, such as design wind speed, minimum design life, fatigue category, vehicle speed, etc.;
- material specifications for all components.

The Traffic Control Foundations shall be constructed in accordance with the pertinent provisions of Article 6.01.03. The Engineer shall decide whether rock anchors shall be used or the rock shall be excavated. The finished elevation of the top of the foundation shall be as shown on the plans. The final elevation of the top of the light standard foundation shall be 1 1/2" (38 millimeters) above finished grade or as directed by the Engineer. The top of the foundation shall be level in all respects. Concrete for foundation shall be placed monolithically against undisturbed soil for poured in place foundations. Necessary electrical conduit, anchor bolts, ground rod sleeves and ground rods shall be placed in proper position and shall be held in place by means of a template. The concrete may be placed against the sides of the excavation, however, the exposed portion of the foundations shall be formed to the neat lines as shown on the plans. When in the judgment of the Engineer, unusual soil conditions prevent excavation to neat lines as shown on the plans, the complete foundation shall be formed. After the forms have been completely removed, the entire excavation shall be backfilled in accordance with Section 2.14. All conduits shall be capped with standard pipe caps before placing the concrete and shall remain capped until the cable is installed. Electrical conduit of the size indicated shall extend 2 feet (600 millimeters) outside the foundation. All portions of the foundations which will remain exposed to view shall be finished to the satisfaction of the Engineer. Forms shall not be removed until after the concrete has hardened properly and not less than 24 hours after the concrete has been placed. The Contractor shall allow sufficient time for the foundation to cure before placing any strain on the foundation. Steel poles shall not be installed until a minimum of seven days after the concrete has been placed and a minimum of ten days before making span wire attachments thereto. Mast arm assemblies shall not be installed until 10 days after the concrete has been placed. Where a foundation is placed within or adjacent to a concrete sidewalk, the entire section of sidewalk between joints shall be replaced in accordance with Section 9.21, unless otherwise directed by the Engineer.

Method of Measurement: Light Standard and Traffic Control Foundations of the type specified shall be measured for payment by the number of units installed and accepted. This measurement shall include the electrical conduit sweeps which shall extend 2 feet (600 millimeters) outside of the foundation. The rock-in-foundation excavation will be measured

from the top of rock to the bottom of rock excavation. Gravel will be measured in accordance with Article 2.13.04.

Basis of Payment: This work will be paid for at the Contract unit price each for Light Standard and Traffic Control Foundations of the type specified which price shall include all materials, equipment, forms, excavation, disposal of surplus material, Class "A" concrete, electrical conduit sweeps, conduit caps, ground rod, sleeves, bonding bushings, anchor bolts, steel reinforcement, backfill, topsoil, grading, seeding, fertilizing, mulching, riprap, restoration of bituminous concrete sidewalk and pavement surfaces. All concrete sidewalk replaced due to foundation installation shall be paid for at the Contract unit price for “Concrete Sidewalk”. When rock is encountered within the limits of excavation, its removal will be paid for at the Contract unit price per vertical foot (vertical meter) for "Rock-in-Foundation Excavation," which price shall include any additional excavation to remove the rock and any additional concrete required to fill the excavation beyond the designed foundation hole dimensions.

Pay Item	Pay Unit
Traffic Control Foundation – Mast Arm	EA.

ITEM 1002214A – TRAFFIC CONTROL FOUNDATION--CONTROLLER--TYPE IV MODIFIED

All work shall conform to the requirements of Section 10.02 of the Standard Specifications with the following modifications:

Article 10.02.01 - Description:

Add the following:

This item will also include the installation of a traffic control foundation for a traffic management system cabinet.

Article 10.02.03 - Construction Methods:

Add the following paragraph:

Where a foundation is placed within or adjacent to a concrete sidewalk, unless otherwise directed by the Engineer, the entire section of sidewalk shall be replaced in accordance with Section 9.21.

The foundation dimensions will be as required to support the traffic management system cabinet and as shown on the approved foundation drawing.

The Contractor shall be responsible for the re-grading of the area surrounding the Traffic Control Foundation - Type IV Modified to allow for the adjacent concrete sidewalk pad installation to be installed level with a ¼" per foot pitch. See the Miscellaneous Details provided in the contract plans.

Article 10.02.05 - Basis of Payment:

In the first sentence insert the words "installation of borrow" after the words "disposal of surplus material".

In the first paragraph insert the word "bituminous" before the word "sidewalk".

Add the following sentence:

All concrete sidewalk replaced due to foundation installation shall be paid for at the contract unit price for "Concrete Sidewalk".

ITEM #1006139A - WALL MOUNTED LUMINAIRE

DESCRIPTION: This item shall consist of furnishing and installing a light emitting diode (LED) wall mounted luminaire of the wattage, distribution, and voltage as specified, completely wired and surface mounted to a concrete retaining wall in accordance with the plans and specifications.

MATERIALS: The LED luminaire shall be manufactured by Lithonia Lighting, and shall be the "CSXW" wall mounted luminaire, catalog number: CSXW LED-30C-700-40K-T4M-480-BBW-DDBXD, or approved equal.

The Department reserves the right to disapprove any alternate luminaire based solely on photometric performance, lumen maintenance, and construction. Alternate luminaires are required to meet average illuminance and uniformity ratio as recommended by the Illuminating Engineering Society of North America (RP-8-00) for the given roadway application as calculated by the Department.

The housing of the luminaire shall be heavy-duty cast aluminum and shall be completely sealed against moisture and environmental contaminants with an IP65 rating. The LED luminaire shall weigh approximately 30 lbs. and have approximate dimensions of 7.125" x 16.375" x 9.3" (HxWxD). The housing shall feature dark bronze polyester powder coat paint with a 3.0 mil nominal paint thickness. The fixture shall be equipped with a surface mounted back box for connection to surface mounted conduits. The back box shall be rated for outdoor use, shall be painted the same color as the luminaire, and shall be supplied as an option by the manufacturer of the luminaire. All hardware integral to the luminaire shall be stainless steel.

LED optics shall consist of sealed LED modules with an IP66 rating. The luminaire optics shall provide warm white light at a standard 4000K CCT with no sacrifice in lumen output. The LED luminaire shall draw approximately 70 watts or less and shall operate at a drive current of 700mA. The luminaire shall provide an initial delivered lumen output of 7,017 lumens or greater, and shall provide an IESNA type 4 medium light distribution. The luminaire shall produce a minimum of 102 lumens per watt. Lumen maintenance shall be greater than 90% at 50,000 hours. Theoretical L85 shall be 100,000 hours at 25°C. The luminaire shall produce zero uplight and be rated as IES full-cutoff.

LED drivers shall be Class 1 with a power factor >90%, THD<20%, and a life expectancy of 100,000 hours with <1% failure rate. The LED luminaire shall be provided with integral surge protector which meets a minimum Category C low operation (per ANSI/IEEE C62.41.2). The electrical components shall have a quick disconnect harness. The LED luminaire shall be suitable for temperature operation from -40°C to 40°C (-40°F to 104°F). The luminaire shall operate at 480 volts.

The LED luminaire shall carry a limited 5 year warranty on the LEDs and the Driver, and shall be ARRA compliant.

CONSTRUCTION METHOD: The LED luminaire shall be surface mounted to retaining wall No. 103 at the location indicated on the plans and at a mounting height of 15'. The wall mounted luminaire with back box shall be securely anchored to the wall using 1/4" diameter stainless steel mechanical anchors. Length of anchors and embedment depth shall be as recommended by the anchor manufacturer for the given load. Care shall be taken when drilling into the retaining wall to avoid damaging reinforcing bars. The installed luminaire shall be properly oriented, connected to the power supply conductors, cleaned, and ready for operation. The luminaire shall be leveled by placing an electronic (digital) level along the flat bottom face of the luminaire.

The Contractor shall ensure that once installed the LED wall mounted luminaire functions properly.

METHOD OF MEASUREMENT: This work will be measured for payment by the number of wall mounted luminaires of the type specified, installed, complete and accepted.

BASIS OF PAYMENT: This work will be paid for at the contract unit price each for "Wall Mounted Luminaire", complete and accepted in place, which price shall include all materials including luminaire, LEDs, driver, surge suppressor, back box, connections, drilling, anchoring, leveling, delivery, and all labor, tools, equipment and work incidental thereto.

ITEM 1008115A – 2" RIGID METAL CONDUIT IN TRENCH
ITEM 1008117A – 3" RIGID METAL CONDUIT IN TRENCH
ITEM 1008700A – 4" MULTI DUCT RIGID METAL CONDUIT - SURFACE

DESCRIPTION:

The mainline conduit shall be a 4" (100 mm) multiduct conduit system designed and engineered for direct burial and protection of optical fiber cable. The multiduct concept shall maximize duct usage by compartmentalization of cables for current requirements and for future expansion.

The Temporary mainline conduit shall be a 2" (50mm) RMC conduit designed and engineered for direct burial and protection of optical fiber cable. The temporary conduit shall not have multiduct's

For the 4" (100 mm) PVC conduit, the Contractor shall be required to install the conduit **simultaneously** with the pullboxes to insure that the conduit innerduct on each side of the pullbox is at exactly a 90-degree angle to the side of the pullbox. For Rigid Metal Conduit under Roadway, the Contractor shall be required to install the conduit simultaneously with the installation of the pullboxes. For Rigid Metal Conduit under Roadway, the Contractor shall be required to install a minimum of 10 feet (3.0 meters) of Flexible Conduit on each side of the pullbox to insure that the innerduct enters the pullbox at exactly a 90 degree angle to the side of the pullbox. **The cost of the Flexible Metal Conduit shall be included in the cost of the appropriate conduit item; it shall not be paid for separately. The required installation is shown on the IMS details. The required length of Flexible Metal Conduit on each side of a structure shall be as shown on the appropriate detail.**

The mainline conduit shall contain four (4) factory installed 1.25" (30 mm) PVC inner-ducts within a 4" (100 mm) outer-duct. Conduit under road, and as noted on the plans, shall be Rigid Metal. Conduit in trench, and as noted on the plans, shall be 4" (100 mm) Polyvinyl Chloride.

The 2" (50 mm) RMC conduit shall be used for mainline optical fiber cable, branches off the mainline conduit, telephone service and electrical service as indicated on the plans. The 2" (50 mm) RMC – Surface used as risers on utility poles shall include an entrance fitting (weatherhead) at the top termination of the conduit run as indicated on the plans. The 3" (75 mm) conduit shall be used for utility service for CCTV cameras and variable message signs as indicated on the plans.

As part of this item, the Contractor will be required to test the integrity of the conduit with a poly-line and to install a pull tape in each and separate innerduct as required in the specification.

Work under the above items shall conform to Public Utility Commission Rules and Regulations, where applicable, and to Section 10.08 of the standard specifications, supplemented and amended as follows:

MATERIALS:

A. General:

The multi-cell conduit system shall be a pre-assembled conduit manufactured from a 4" (100 mm) round outerduct containing four (4) factory installed innerducts. The innerducts shall be held together in a square configuration by a system of spacers, bands, or other mechanism. The coupling system shall be resistant to water infiltration, air loss during cable installation, and shall be capable of locking the system tightly together to not allow free twisting of the innerducts.

The conduit shall be free from defects including non-circularity and foreign inclusions. It shall be nominally uniform (as commercially practical) in color, density, and physical properties. It shall be straight and the ends shall be cut square to the inside diameter. Polyvinyl Chloride (PVC) conduit shall be Type 40 grade conforming to Section M.15.09 of the standard specifications. Rigid Metal Conduit shall be galvanized steel also conforming to Section M.15.09 of the standard specifications. The PVC conduit shall include a grounding wire conforming to Article M.15.13 of the standard specifications. PVC conduit and fittings shall be supplied with an ultraviolet inhibitor.

B. PVC Outerduct:

The complete PVC Type 40 Multi-cell conduit system shall be UL Listed, designed and engineered for direct burial or encased underground applications. Protective outer-duct shall be 4" (100 mm) PVC Type 40 with extended 6" (150 mm) integral bell end and have a lay length of 20 feet (6.1 m). The outer-duct shall have a longitudinal running print line to assure proper innerduct orientation and alignment. This line shall consist of the following wording: "INSTALL THIS SIDE UP – Connecticut D.O.T. Cable – For Assistance Call 860-594-3447". The outer-duct shall be marked with data traceable to plant location, date, shift, and machine of manufacture.

The outer-duct shall have a circumferential ring on the spigot end of the ducts so as to provide a reference point for ensuring the proper insertion depth when connecting conduit ends. Both ends of the conduit shall be capped to protect inner-duct during shipment and job site storage.

The PVC conduit system to be utilized shall be a complete system and the Contractor shall provide the following fittings:

- Coupling Kits
- Terminator Kits
- Lubrication Fittings
- Repair Kits
- Installation Accessories

A complete line of fittings, adapters, and elbows shall be available and shall be manufactured from the same materials and manufacturing process as the conduit. The multi-cell conduit shall be joined by use of a coupling system that effectively seals the outerducts and innerducts but

allows for expansion or contraction in the system. A silicone non-petroleum base lubricant may be used for assembly of the multi-cell conduit.

All conduit entering and exiting conduit termination points shall have a terminator installed that is made of PVC with an anti-reversing gasket that prevents ingress of water and debris into the outer conduit and the innerduct.

C. Couplings:

The PVC coupling body shall allow for transitions from PVC conduit to RMC conduit to Flexible Sweeps and any combination thereof. The coupling body shall have a factory assembled, multi-stage gasket that is anti-reversing for sealing both the outer and inner-duct. A secondary, mid-body gasket shall be seated at the shoulder of the bell to assure 100psi (690 kPa) air pressure (in accordance with Bellcore GR-2884 Issue 1) and watertight integrity with minimum joint infiltration of 6 psi (41 kPa). This will allow for the use of Air-Jet technology to be used in the placing of cables. The PVC conduit system shall be designed so that both straight sections and fittings will assemble without the need for cement or glue.

The coupling body shall be designed so that when the conduit is joined, the outer walls of the innerducts and the inner walls of the outerduct shall be sealed, providing an airtight seal from within the innerduct system and a watertight seal from the outside of the outerduct. The coupling body shall be tested for water tightness and air-tightness in accordance with Bellcore GR-2884-CORE Issue 1, July 1995 (R3-41 for water-tightness and R3-43 for air-tightness). The coupling body shall conform to the following requirements:

Watertightness: 6 psi (41 kPa) minimum
Air Tightness: no significant leakage at 100 psi (690 kPa)

The system shall be designed so that expansion and contraction of the inner-duct shall take place in the coupling body, and the fittings shall allow going from steel to PVC without compromising air/water tightness, or pulling capabilities. The coupling body shall be factory assembled in the bell end of the outer duct and shall be manufactured from high impact engineered thermoplastic. The coupling body face shall be supplied with lead-ins to facilitate assembly. The coupling body shall have each conduit entrance identified with a raised number and the white inner duct locator conduit entrance shall have raised ribs that can be felt through a glove.

The PVC system shall be designed so that the assembly of components can be accomplished by inserting the spigot end into the male bell end to the marked insertion depth. (The insertion depth is marked on the spigot end)

D. Sweeps:

The PVC conduit system shall offer a complete line of fixed and flexible sweep-bends with system compatible bell and spigot ends. The PVC conduit system shall offer and the Contractor shall utilize the following standard fixed sweep-bends:

Radius	Bend	System
4 ft & 3 ft. (1200mm & 900mm)	11.25°, 22.5°, 45°, 90°	4-way

Note: Direction changes shall not exceed 90 degrees.

The flexible sweep-bend shall be supplied in two lengths to meet field requirements. They shall have a PVC outer jacket and be acceptable for exposed and direct burial installation. The inner-duct shall extend 6" out of the spigot end of the flexible elbow. Once the elbow is bent to the proper angle, the innerducts shall be trimmed to the proper length for insertion to the bell end. PVC inner ducts shall not be allowed in bend and sweeps.

Length Feet (Meters)	**Radius** Feet (Meters)	**Bend** degrees (°)	**System**
10 (3.2)	4 (1.2) min	0-90	4-way
10 (3.2)	6 (1.8)	0-70	4-way
10 (3.2)	9 (2.7)	0-55	4-way
16 (4.9)	4 (1.2) min	0-90	4-way
16 (4.9)	6 (1.8)	0-70	4-way
16 (4.9)	9 (2.7)	0-55	4-way

All bends, including flexible sweeps, shall have a minimum radius of 3 ft. (900 mm). The inner-duct system shall be solvent welded to the coupling body; supported by a moveable spacer every 4 ft. (1.32 m). The bends shall not violate the minimum bending radius of the fiber optic cable.

All bends shall have nylon inner ducts, or approved equivalent, installed to prevent burn-through in accordance with test procedure outlined in Bellcore GR-2884 Issue 1 Section R3-35 and R3-36.

E. Innerduct:

The inner-duct in straight lengths shall be manufactured from PVC or high density polyethylene (HDPE). Innerducts shall be factory treated with atomized silicone or manufactured in a manner to reduce friction during pulling of fiber optic cable.

Innerduct to be used in bends and sweeps shall have a minimum burn through time of 90 minutes when tested in accordance with Bellcore GR-2884 Issue 1 Section R3-35, and R3-36.
PVC inner ducts shall not be allowed in bends and sweeps.

The innerducts shall have a permanent dry lubricant extruded within the inner wall and shall incorporate longitudinal ribs within the inner wall. The innerducts shall have a nominal size of 1.25" (30 mm) and shall consist of 4 unique colors: white, red, orange, and yellow. Innerduct colors shall be oriented in a clockwise direction as specified above, looking at the spigot end of the multi-cell conduit system. The white innerduct shall be located directly under the print line on the outerduct.

Each inner-duct shall be sealed with an expanding Neoprene Plug that withstands 22 psi (150 kPa) and seals the inner-duct from water and debris infiltration, and a provision for tying off a pull line.

F. Steel Outerduct:

All components of the conduit system shall meet or exceed the following specifications and standards:

1. ASTM A 36. Standard Specification for Structural Steel.
2. ASTM A 53. Standard Specification for Steel Pipe.
3. ASTM A 570 Standard specification for Steel.
4. ASTM A 479 Standard Specification For Stainless Steel.

In addition, the steel outer duct shall conform to the following industry standards:
NEC Article 346
ANSI C80.1
U.L. 6

The conduit system shall be a complete system with all the following fittings:

Manhole Terminator Kits
Deflection Fittings
Offset Fittings
Expansion/Contraction Fittings
Lubrication Fittings
Repair Kits
Installation Accessories
Steel to PVC Sched. 40
Steel PVC-Coated Flexible Elbows
Stand Off Fittings
Entrance Fittings

Galvanized outer-duct shall be hot dipped galvanized inside and out; conduit shall be smooth and free from burrs and coated with rust inhibitor.

Rigid steel shall be supplied in 10 foot (3-meter) lengths with a length tolerance of +/- ½ " (10mm) and shall be Schedule 40 minimum. Conduit shall be supplied with thread protectors.

Each section of steel conduit shall be supplied with one reversing spin coupling that allows straight sections and fittings to be joined without spinning the conduit. The reversing coupling shall be galvanized and have three set screws to lock the coupling in place.
The Steel Outerduct system shall be designed so that the assembly of components can be accomplished in the following steps:

a. Loosen set screws on coupling spin back to allow for insertion
b. Insert male into female and spin coupling forward to bottom
c. Once the spin coupling is installed, there shall be no threads visible on the 4" (100 mm) steel conduits.
d. Tighten set screws

The Steel conduit system shall offer a complete line of fixed and flexible sweep-bends with system compatible bell and spigot ends. The Steel conduit system shall offer and the Contractor shall utilize the following standard fixed sweep-bends:

Radius	Bend	System
4 ft & 3 ft. (1200mm & 900mm)	11.25°, 22.5°, 45°, 90°	4-way

Note: Direction changes shall not exceed 90 degrees.

The flexible sweep-bend shall be supplied in two lengths to meet field requirements. They shall have a steel core with a PVC outer jacket and be UL Listed for exposed and direct burial installation. The inner-duct shall always remain flush to the end of the flexible elbow, even when bending. PVC inner ducts shall not be allowed in bend and sweeps.

Length Feet (Meters)	Radius Feet (Meters)	Bend degrees (°)	System
10 (3.2)	4 (1.2) min	0-90	4-way
10 (3.2)	6 (1.8)	0-70	4-way
10 (3.2)	9 (2.7)	0-55	4-way
16 (4.9)	4 (1.2) min	0-90	4-way
16 (4.9)	6 (1.8)	0-70	4-way
16 (4.9)	9 (2.7)	0-55	4-way

All bends, including flexible sweeps, shall have a minimum radius of 3 ft. (900 mm). The inner-duct system shall be solvent welded to the coupling body; supported by a moveable spacer every 4 ft. (1.32 m). The bends shall not violate the minimum bending radius of the fiber optic cable.

All bends shall have nylon inner ducts, or approved equivalent, installed to prevent burn-through in accordance with test procedure outlined in GR-2884 Issue 1 Section R3-35 and R3-36.
.
The following performance requirements shall be met:

Yield	30,000 psi (200 MPa)
Tensile	50,000 psi (345 MPa)
Hardness	Rockwell "B" 55-65

All conduit entering and exiting conduit terminal points shall have a terminator installed that is made of PVC with an anti-reversing gasket that prevents ingress of water and debris into the outer conduit and inner-duct.

The rigid steel conduit system shall offer expansion/contraction fittings with system compatible threads and reversing couplings. The inner-duct of the expansion/contraction fittings shall also be system compatible. The capacity of the fitting shall be 8" (200 mm) total stroke with 4" (100 mm) expansion and 4" (100mm) contraction capacities.

G. Conduit Testing:

The poly-line installed to verify the integrity of the conduit system shall be ¼" (6 mm) polypropylene.

The detectable pull tape shall consist of a single 24 AWG copper wire with polyethylene or PVC jacket woven into the polyester tape. The pull tape shall be NEPTCO Part No. DP1250P, or approved equal, for cable sizes of less than 97 fibers. NEPTCO Part No. DP1800P, or approved equal, shall be used for cable size of 97-288 fibers.

The detectable pull tape shall have the following properties:

- 1250 lb (567 Kg) tensile strength
- flat, not round, construction
- printed foot markings
- pre-lubricated for reduced pulling tension at start of cable pull
- low susceptibility to absorption of moisture; moisture resistant

Underground utility marking tape shall have a minimum tensile strength of 78 lbf (350 N) and a minimum elongation of 700 percent before breakage. The detectable tape shall not delaminate nor smear when wet and shall be resistant to insects. The tape shall not degrade when exposed to alkalis, acids or other corrosive elements found in soil.

Pressure treated wood for Identification Posts shall conform to Article M.12.13 of the Standard Specifications. Signs on Identification Posts shall conform to Article M.18.13 of the Standard Specifications.

H. Bedding Material:
Bedding material for all conduit shall be No. 100 fine aggregate as defined in Section M.03 of the standard specifications and backfill for the pits shall be pervious structure backfill conforming to Article 2.16.02.

CONSTRUCTION METHODS:

A. General:

Construction methods shall conform to Article 10.08.03 of the Standard Specifications and to the manufacturer's instructions.

The Contractor shall layout the trench for the conduit in conjunction with the installation of pullboxes, vaults, or manholes. When installing the conduit, the Contractor shall be aware of the location of the proposed conduit terminal point when they are at a sufficient distance from the terminal point to allow for adjustment of the trench so that the conduit will line up flush with the applicable entry point. Flexible conduit will not be used indiscriminately.

A silicon, non-petroleum based lubricant on the coupling body may be used to facilitate installation.

PVC conduits entering conduit terminal points shall terminate flush with the inside wall. The inner-duct shall extend 6" (150 mm) from the inside face.

Galvanized rigid steel conduit shall extend 2" (50 mm) into the manhole/vault/pull box for installation of grounded end bushings.

Conduits and inner-duct entering conduit terminal points or where terminated in trench, shall be capped or sealed to prevent ingress of water and debris into the conduit. Conduits containing inner-duct shall be plugged using a quadplex expansion plug inside the conduit around the inner-duct. Inner-duct containing one cable shall be plugged using an expandable cable seal off. Conduits terminating in a trench shall be clearly marked and flagged, both in trench and above trench for future locating.

At each conduit terminal point, a PVC coupling body with anti-reversing gasket that seals between the conduit and inner-duct shall be used as follows:

In places where the field installed inner-duct enters and exits existing conduit, the space between the conduit and the inner-duct, as well as the space between the inner-duct and the cable shall be sealed by means of a split internal expansion plug. Bushing sleeves shall be equipped to suit varying cable sizes. Sealing capacity shall withstand 22 psi (150 kPa).

All inner-duct shall be sealed by means of a polypropylene duct plug equipped with a neoprene or polyurethane gasket. Plugs shall be equipped with an attachment to secure the pull rope in the inner-duct.

When PVC cannot be installed at the required depth, such as where ledge or rock is encountered, the Contractor shall install Rigid Metal conduit at the maximum depth possible. If the Contractor is unable to obtain a minimum depth of 18" (0.45 meters), the Contractor shall install the conduit as directed by the Engineer.

Warning Tape shall be placed in trench over conduit as shown on the details. Identification Posts shall be carefully placed adjacent to conduit in trench at intervals not to exceed 1200 ft. (365 meters) in length, except at long span bridges and paved areas.

B. Conduit Under Roadway:

The preferred method of installing steel casing under roadway shall be by veneering or cutting. In areas where the conduit is installed under live traffic, such as a ramp crossing, the conduit will be capped in concrete. In areas where the conduit is installed in the shoulder and the required depth cannot be obtained, the conduit shall be installed at a minimum depth of 18" (0.45 meters) and capped in concrete.

Where veneering or cutting is not possible, and under the direction of the Engineer, steel casing may be furnished and installed by jacking. The casing shall be designed to withstand all the loads that it will be subject to, including the loads during installation and the in-service highway loads. The casing shall be designed by and bear the seal and signature of a Connecticut Licensed Professional Engineer and the computations shall be submitted with the Jacking Plan. The pipe shall be installed to preclude interference with highway traffic or damage to traveled lanes or shoulders. Jacking operations shall be conducted so as to prevent caving ahead or to cause voids outside of the pipe.

The auger head shall not proceed more than 4" (100 mm) ahead of the pipe being jacked. Removal of the material from the jacking pits by washing or sluicing will not be permitted.

A shoring and jacking pit plan shall be prepared by and bear the seal and signature of a Connecticut licensed Professional Engineer.

After the casing pipe is jacked in place, the inside shall be thoroughly cleaned free from grease, dirt, rust, moisture or other deleterious contaminants. All welding on the steel casing pipe shall be done by a certified welder. The galvanized steel conduit shall be inserted with skids securely attached to maintain full support of the conduit and to prevent damage.

The space between the conduit and the casing shall be grout sealed for at least 1 ft. (0.30 meters) from each end of the casing. Grout shall attain a minimum of 400 psi (2.76 MPa) compressive strength after 7 days. Pits shall be back-filled with pervious structure backfill as prescribed in Article 2.16.03 of the Standard Specifications.

For Jacking operations, the Contractor shall provide the following:

A. A jacking pit plan depicting:
   (1) Protection of traffic and pedestrians
   (2) The dimension of pit
   (3) Shoring, bracing struts, walers, or sheet pile
   (4) Size and type of casing
   (5) Conduit skids and means of attachment

B. The proposed method of jacking including:
   (1) The jacking system
   (2) A detail of the separator-cushion at the end of casing against which the jacking force will be applied.
   (3) The support system behind the jack
   (4) The support system under the jack and at the bottom of the pit.

C. Conduit Testing:

The Contractor shall test each cell of the multicell conduit after the conduit is installed. All testing shall be performed using the procedures and mandrel size recommended by the multicell or conduit manufacturer. The Contractor will be required to install a poly-line within each cell of the conduit. The intention of the conduit testing is to verify the integrity of the completed system; therefore, this testing will only be allowed to commence once the conduit system has been completely installed. Testing shall be performed in the presence of the Engineer. The Engineer will document the date, time, and the results of the testing and shall submit this information to Highway Operations for record keeping purposes.

D. Detectable Pull Tape:

The Contractor shall install detectable pull tape, by hand pulling, blowing, or via vacuum method, into each empty conduit and empty cell within a multi-cell conduit during conduit installation. The Contractor shall install the detectable pull tape after conduit testing has been completed. The Contractor shall neatly coil and secure 10 ft (3 meters) of slacked pull tape in each vault location.

The detectable pull tape shall be field installed within each innerduct for the purpose of attaching to, and pulling of, the fiber optic cable. The Detectable Pulling Tape shall be tied off to an expanding Neoprene Plug.

E. As -Built Plans:

The Contractor shall advise the Engineer of any change of measurement of layout of the Plans submitted to them. Upon completion of construction but prior to acceptance of the contract, the Contractor shall furnish as-built plans on 2 ft. by 3 ft. (55 cm by 91 cm) standard plan sheets. All construction changes, with the final location and depth of the conduits, etc. shall be shown in sepia or other reproducible format. These plans shall include all field installations. One sepia or other reproducible of the Project Plans will be provided to the Contractor for their use. Any other base maps that may be necessary for the Contractor to comply with this requirement shall be the Contractor's responsibility.

METHOD OF MEASUREMENT:

The conduit shall be measured for payment by the actual number of feet (meters) of the type and size installed and accepted**. Expansion fittings, fixed and flexible sweep-bends, conduit fittings, will not be measured for payment but shall be included in the pay item for the conduit of the type and size specified.** The measured length shall be from end to end along the centerline through all fittings.

All work necessary to complete the attachment of the rigid metal conduit of the type indicated, including but not limited to mounting brackets, clamps, hangers, anchors, bolts, fittings etc. to the structures, will not be measured for payment but shall be included in the pay item for the conduit. In-Structure conduit installed under the bridge deck and within the girders shall be measured for payment as conduit of the size and type specified – surface.

The warning tape, identification posts with signs, pull tape, and the poly-line conduit testing will not be measured for payment but shall be included in the pay item for the conduit of the type and size specified.

The #8 Bare copper ground cable, splices, and installation will not be measured for payment but shall be included with the cost of "4" (100 mm) PVC MULTI DUCT CONDUIT - IN TRENCH".

BASIS OF PAYMENT:

Article 10.08.05 – Basis of Payment shall be amended as follows:
In the second paragraph, after the words "bonding bushings", add the words "bonding wire,".

This work shall be paid for at the contract unit price per foot (meter) for conduit of the size and type indicated, within the limits shown on the plans and in the details. This price shall include all materials required including expansion fittings, fixed and flexible sweep-bends, conduit fittings, pervious structure backfill, boxes, caps, entrance fittings, detectable pull tape, poly-line, inserts, warning tape, ground wire, identification posts with signs, structural supports, equipment, tools, labor and work incidental thereto.

Trenching and backfilling shall be paid as specified in Section 10.01 of the Standard Specifications.

PAY ITEM	**PAY UNIT**
2" Rigid Metal Conduit in Trench	LF
3" Rigid Metal Conduit in Trench	LF
4" Rigid Metal Multi Duct Conduit – Surface	LF

ITEM #1010038A - PRECAST POLYMER CONCRETE HAND HOLE TYPE I (36" X 36")
ITEM #1010039A - PRECAST POLYMER CONCRETE HAND HOLE TYPE II (17" X 30")

DESCRIPTION

This item shall consist of furnishing and installing Polymer Concrete Hand hole of the type called for at the location and to the dimensions and details shown on the plans, or as ordered by the Engineer and in conformity with these specifications.

Precast Polymer Concrete Hand Hole Type I refers to 36" (w) x 36" (d) x 36" (h) hand holes.
Precast Polymer Concrete Hand Hole Type II refers to 17" (w) x 30" (d) x 30" (h) hand holes.

REQUIRED SUBMITTALS

Shop Drawings:

Submit 5 copies of shop drawings for hand holes and covers in accordance with the contract general requirements.

Material Certificate of Compliance:

Submit 5 copies of material certificate of compliance for hand holes and covers in accordance with the contract general requirements.

MATERIALS

The materials for this work shall conform to the following specifications.

Precast Polymer Concrete Hand hole: These hand holes shall be as manufactured by "Quazite". Enclosures, covers and extensions shall be of monolithic material construction; components of dissimilar materials shall not be used. All products shall conform to all test provisions of ANSI/SCTE 77 "Specification for Underground Enclosures Integrity" for Tier15 (heavy duty) applications (Design Test Load = 22,500/33,750 lbs.) The following requirements shall apply:

All components in an assembly (box & cover) shall be manufactured using matched surface tooling. All covers are required to have a minimum coefficient of friction of 0.50 in accordance with ASTM C 1028. Enclosures are to be UL listed.

Covers for Type I shall be heavy duty two (2) piece style for ease of opening. Covers for all hand hole types shall have extra-large pull slots (1"x4") with "TRAFFIC" Logo. For each project the manufacturer shall supply two (2) pull hooks with extra wide handle (close to 12 inch wide) to accommodate both hands. A shop drawing shall be submitted for this hook.

Covers (Design Test Load = 16,000/22,500 lbs.) shall be secured with two stainless steel bolts. Bolts shall be self-retaining and shall withstand a minimum of 70 ft. lbs. torque and have a minimum 750 lbs. pull out strength. Nuts shall be floating and shall provide a minimum of ½" movement from the center of the nut.

CONSTRUCTION METHODS

Precast Polymer Concrete Hand hole: Excavation shall be 12 inches deeper than finished grade level. With the box set in place, crushed rock or gravel shall be installed in the excavation to a depth of 12 inches and with cover installed, soil is to be back filled and compacted around the box. At final installation the box and cover shall be flush with finished grade. When the hand hole is placed in the sidewalk the back fill shall be replaced with the trap-rock as fill material.

The areas disturbed by the excavation for the hand holes shall be neatly graded to conform to the adjacent surface and contours. Where topsoil has been removed, it shall be replaced to its original depth (except that in no case shall this depth be less than four inches) and the area shall be fertilized, seeded and mulched.

Where hand holes are shown in sidewalk or paved areas, the concrete hand hole shall be set flush and the surrounding area shall be replaced with the same type of material as removed.

All conduits entering the hand hole shall be bonded together by means of a jumper running from ground bushings on the conduit ends. All open conduit entrances in the walls of precast hand hole shall be grouted to prevent the surrounding sand or dirt entering into the hand hole.

When hand hole is placed in sidewalk areas, the sidewalk shall be sawcut at the nearest joint and the complete slab(s) of sidewalk shall be removed and replaced. When hand hole is placed in brick sidewalk areas, the sidewalk shall be restored matching the existing Pattern.

METHOD OF MEASUREMENT

This work will be measured for payment by the number of hand holes of the type specified, complete and accepted in-place.

BASIS OF PAYMENT

This work will be paid for at the contract price each for "PRECAST POLYMER CONCRETE HAND HOLE (TYPE)" of the type called for, complete in-place, which price shall include a precast polymer concrete hand hole, cover, crushed stone, excavating, backfilling and replacement of all surrounding areas including sidewalk, pavement, grading and placing topsoil, seeding, fertilizing, mulching and equipment, tools, labor and work incidental thereto. The contract unit price shall also include locating and intercepting existing conduit at those locations shown on the plans, and cutting exiting conduit and installing copper bonding jumpers in accordance with the details.

PAY ITEM	**PAY UNIT**
Precast Polymer Concrete Hand Hole Type I (36” X 36”)	EA
Precast Polymer Concrete Hand Hole Type II (17” X 30”)	EA

ITEM #1014901A - REMOVE CABLE

DESCRIPTION:
The work under this item shall include the removal and legal disposal of Incident Management System (IMS) cables where shown on the plans or as directed by the Engineer.

MATERIALS:
Removal of existing IMS cable shall include fiber optic cable, twisted pair communications cable and service entrance cable.

The Contractor shall install a ¼" (6 mm) polypropylene (poly) pull line for future use within all conduits where the IMS cables have been removed.

CONSTRUCTION METHOD:
The Contractor shall not remove existing cable until provisions for the new or temporary IMS cables have been installed and connected to IMS appurtenances such as Traffic Management System Cabinets or fiber optic cable has been spliced to the remaining fiber optic trunkline and at the direction of the Engineer.
Removal of existing IMS cable shall be performed in a manner and sequence not to damage portions of the cable that shall remain or other adjacent or nearby appurtenances.

The Contractor shall be responsible for damage to all equipment and materials incurred during removal, hauling and disposal. All repairs or replacements due to damage or loss by the Contractor shall be made at the Contractor's expense.

The Contractor shall install a ¼" (6 mm) poly pull line for future use within all conduit where the IMS cable has been removed and may be used as a future viable conduit system. The conduit systems that the Contractor shall install a ¼" (6 mm) poly pull line include the permanent 65 mm PVC conduit in the I-95 median, the 2 inch (50 mm) RMC systems on Bridge No.'s 52, 53 and 56.
The Contractor is <u>not</u> required to install a ¼" (6 mm) poly pull line in the existing 100 mm Multiduct conduit on I-95 Northbound that will be removed by the I-95 roadway widening.

The pull line shall have sufficient length at each end and be neatly tied off within the nearest manhole, handhole junction box or pullbox.

METHOD OF MEASUREMENT:
This work will be measured for payment by the actual number of lineal feet of IMS cables removed and ¼" (6 mm) poly pull line installed.

BASIS OF PAYMENT:
This work will be paid for at the contract unit price per lineal foot for "Remove Cable" as specified, which price shall include removal, storage, disposal, installation of poly pull line and all work, materials, tools and equipment incidental thereto.

<u>Pay Item</u>	<u>Pay Unit</u>
Remove Cable	LF

ITEM #1015034A - GROUNDING AND BONDING

Description: The work under this item shall consist of furnishing and installing the grounding and bonding systems as shown on the plans and as specified herein. The grounding and bonding systems shall meet the requirements of the National Electrical Code and the technical and safety recommendations of ANSI and IEEE.

The Contractor shall provide grounding and bonding for all new facilities as shown on the plans. Bonding and grounding of the steel superstructures shall be as per the plans and this specification.

Applicable Standards

Pertinent provisions of the following listed standards (latest edition) shall apply to the work of this Section, except as they may be modified herein, and are hereby made a part of this Specification to the extent required.

Organization	Number	Title
NFPA	70	National Electrical Code
NFPA	78	Lightning Protection Code
IEEE	81	Ground Resistance and Protection Gradients in the Earth, Recommended Guide for Measuring
IEEE	142	IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems
UL	467	Grounding and Equipment
ASTM	B8	Concentric lay-stranded copper conductors, hard, medium hard, or soft

Materials: Conductors for grounding, bonding and rail return cables shall be ASTM B8, Class B stranded annealed copper and sized as indicated on the plans.

Connectors and Clamps: Bolts, washers and stop nuts shall be of high-copper alloy, Everdur, Durium, Duronze or silicone bronze. Ferrous hardware will not be acceptable.

Ground wire shall be 4/0 AWG HD stranded copper conductor.

Ground rods shall be copper clad, ¾" diameter 10' long, connected to ground cables with Cadweld welded electrical connections by Erico International Corporation or approved equal.

Construction Methods:

1 - Submittals:

Test Reports: Reports of all field tests shall be submitted to the Engineer as required by these specifications and referenced standards.

Certified copies of test results on cables and other materials supplied under this Section, as per relevant standards.

The Contractor shall submit shop drawings for the complete grounding and bonding systems which shall include product data for all components of this section, material/procurement specifications and other related information for each component.

2 - Methods:

The size and type of the ground conductor shall be as indicated on the plans. Conductor connections shall be made as shown on the plans or as noted in this specification.

The Contractor shall perform all trenching and backfilling required for the installation of the grounding and bonding systems. Trenching and backfilling shall be performed in accordance with the provisions of sub-article 10.01 of the Standard Specifications. The Contractor is responsible to coordinate with the utility owners including Metro-North Railroad to determine the location of any existing underground facilities that may exist in the areas requiring trenching and modify operations as necessary to avoid impacting the existing utilities.

The Contractor shall install the Ground Wire from the superstructure to a ground rod and continuing on to the nearest catenary support as shown on the plans. The layout of the ground wire shall meet the minimum offset and depth as shown in the trench detail included in this specification but the actual layout including the ground rod location shall be determined in the field by Metro-North Railroad and the Engineer. Ground rods shall be installed in the cable trench and the top of the installed rods shall be at the elevation of the grounding cable. Ground rods shall generally be located as close as practical to the superstructure being grounded. Trench requirements are included in the trench detail included in this specification. The Contractor shall secure the conductor to the ground rods using welded electrical connections. The Contractor shall fasten the ground wire to the catenary support and make the connection to the aerial ground wire in accordance with the details provided herein.

The work shall be arranged in such a manner that each part of the grounding system which is laid below finished grade shall be completed and inspected before backfilling is done. All precautions shall be taken to assure that no damage is done to the grounding and bonding conductors or connections during backfilling, compacting and concreting operations. Testing for ground resistance shall be performed in accordance with the requirements of this Specification before any finish surfacing is laid above the grounding and bonding conductors.

Ground tap connections from the equipment to the grounded structural members shall be provided, as required. All paint, scale, rust, oxidation, or other foreign material shall be thoroughly removed from the points of contact on all metal surfaces before any ground connections are made.

The Contractor shall perform field testing, continuing throughout the installation, and fully documented, with the following as a minimum:

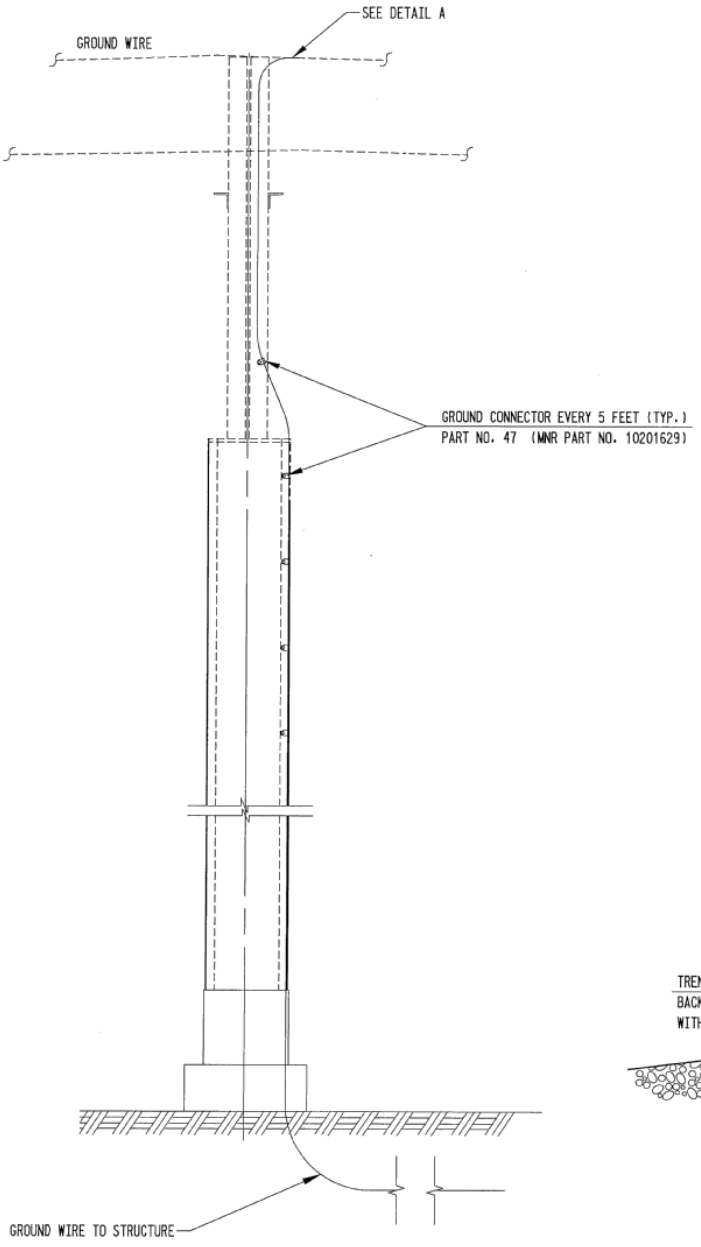
Electrical resistance tests shall be made during installation to verify continuity of the grounding

system.

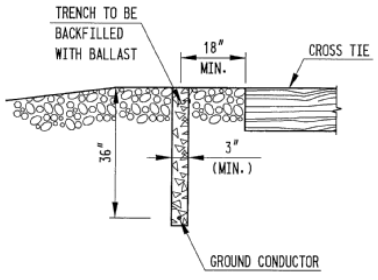
Measure, record and report the ground resistance at each location where grounding system is installed. The required ground resistance of the completed system shall be 5 ohms or less. Corrective measures shall be taken by the Contractor to achieve the specified ground resistance.

Resistance-to-earth tests shall be witnessed by the Engineer and written results of these tests shall be submitted for evaluation.

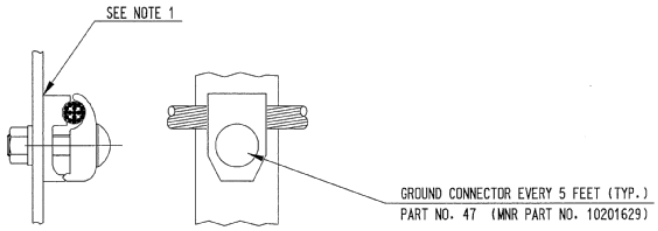
For sites that are constructed in stages, the Contractor shall be responsible to install the grounding and bonding in stages to provide working grounding and bonding systems for the completed construction in the interim conditions.



STRUCTURE GROUNDING WIRE AT POLE
N.T.S.

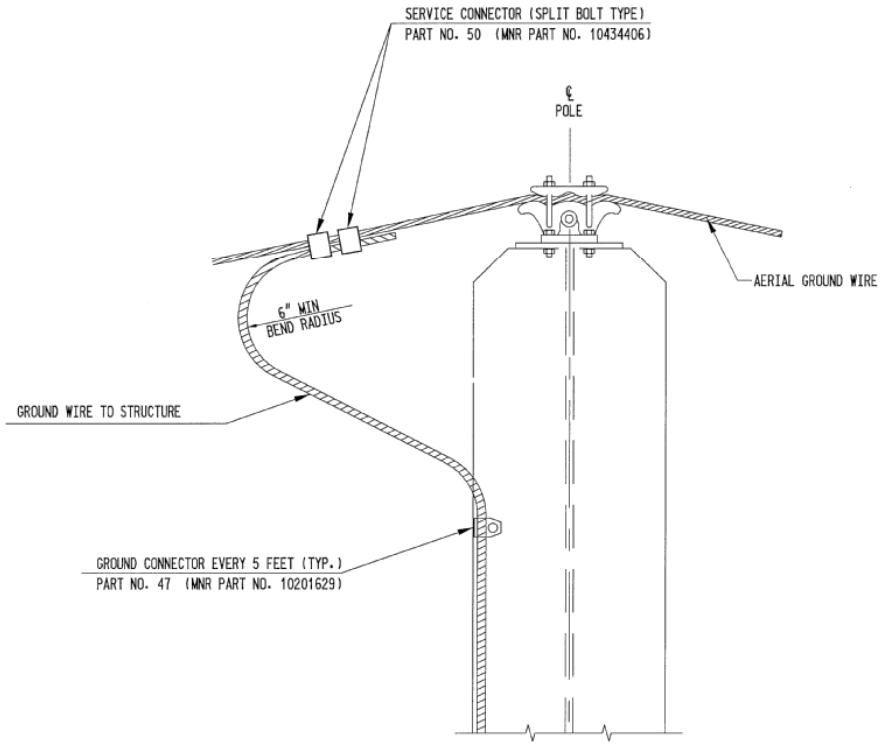


TYPICAL TRENCH SECTION
N.T.S.



GROUND CONNECTOR

CABLE TO FLAT SURFACE
GROUND CONNECTOR



NOTES:
1. BEFORE INSTALLING THE GROUND CONNECTOR AND/OR GROUND WIRE CLAMP ASSEMBLIES ON THE EXISTING STRUCTURES, REMOVE ALL PAINT AND RUST FROM THE SURFACE UNDERNEATH AND APPLY CONDUCTIVE GREASE AS REQUIRED.

2. THE GROUND WIRE CLAMP ASSEMBLIES SHALL BE ABLE TO SUSTAIN RADIAL LOAD OF 7450 LB AND PRODUCE SLIP STRENGTH OF 3000 LBS.

DETAIL A

STRUCTURE GROUND WIRE TO
AERIAL GROUND WIRE

Method of Measurement: Grounding and Bonding, being paid for on a lump sum basis, will not be measured for payment. Contractor shall submit a schedule of values for Basis of Payment.

All trenching and backfilling required for the installation of the grounding and bonding systems at each site shall be considered incidental to this item and shall not be measured for payment.

Basis of Payment: This work will be paid for at the contract lump sum price for "Grounding and Bonding", which price shall include all submittals, testing, materials, tools, equipment and labor incidental thereto including all trenching and backfilling.

Pay Item	Pay Unit
Grounding and Bonding	L.S.

ITEM #1015041A – PULL BOX

Description:

Pull Boxes for IMS are defined as structures implemented to facilitate cable installation, splicing and excess cable storage. Pull Boxes are generally located at intermediate locations to facilitate cable installation. This item shall consist of furnishing and installing concrete structures of the design and dimensions indicated in the details or as ordered by the Engineer, and in conformity with these specifications. Vaults and Pull Boxes installed underground may be precast or cast-in-place.

Materials:

All pull boxes and associated components shall comply with industry standards for communications applications and be of suitable construction for installation in an off-highway environment. Work in this section shall meet or exceed the applicable provisions of the following documents:

1. AASHTO HS 20-44 rating
2. AASHTO M-199.
3. ASTM C857-83, Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
4. ASTM C858-83, Underground Precast Concrete Utility Structures.

All pull boxes shall include the following provisions:

1. "C" Channel of length indicated.
2. Four ¾" (19mm) diameter pulling inserts in the floor.
3. Knockouts, located on each wall, aligned as close to the center of the pull box as possible, to facilitate cable pull through or direction change.
4. The galvanized steel cover with frame shall conform to Article M.08.02 of the Standard Specifications. The assembled steel covers shall include a locking mechanism that will not allow the covers to open more than 120 deg. from the closed position.
5. The steel covers shall be installed flush with the top of the concrete structure.
6. The minimum thickness of the pull box walls shall be 4" (100mm).

Pull Boxes and covers shall have a vertical proof-load strength of 25,000 lbf (110,000 Newtons) in accordance with Federal Specification RR-F-621e. The vaults and pullboxes shall be reinforced with a galvanized Z-bar welded frame and cover. Frames shall be anchored to the boxes by means of ¼" x 2" (6.25 mm x 51-mm) long concrete anchors. Hold down screws shall be 3/8" (9.5-mm) hex flange cap screws of Type 316 stainless steel. The nut shall be zinc plated carbon steel and shall be made vibration resistant with a wedge ramp at the root of the thread. The nut shall be spot welded to the underside of, or fabricated with, the galvanized Z-bar pull box frame.

Steel covers shall be countersunk approximately ¼" (6.35 mm) to accommodate the bolt head. The bolt head shall not extend more than 1/8" (3.2 mm) above the top of the cover when tightened down. A ¼" (6.35- mm) tapped hole and brass-bonding screw shall be provided.

After the installation of the precast units, the steel covers shall be installed and kept bolted down during periods when work is not actively in progress. When placing the steel cover for the final time, the cover and the Z-bar frame shall be cleaned of all debris and securely tightened down. Each pullbox supplied shall be secured with two bolts down locking hex bolts.

Construction Methods:

The Contractor shall contact Mr. Robert Kennedy of D.O.T. Highway Operations at 860-594-3458 to conduct a walk through of the project limits and to stake out the proposed locations of vaults, or pull boxes prior to installation.

All dimensions and exact locations of existing underground substructures and utilities shall be field verified by the Contractor prior to committing any materials or any excavation. Following are the parameters required for the execution of work in this section:

1. Excavation shall be performed in accordance with Article 2.02 of the Standard Specifications.
2. All pre-cast units shall be installed on a level foundation of granular fill, compacted.
3. All pre-cast units shall be installed at grade in paved areas, and one (1) inch (25 mm) above grade in unpaved areas.
4. Backfill shall consist of good compactable material as prescribed in Section M.02 of the Standard Specifications. In no case shall the material be saturated soil, or contain large rocks, or chunks.
5. All pre-cast units shall be free of debris and ready for cable installation.

The Contractor shall provide the excavation into which the individual components shall be lowered. The excavation shall allow for overall assembled height plus added height of risers, manhole castings, etc., and bedding material consisting of a minimum of 6" (150 mm) of granular fill, compacted conforming to Article 2.13 of the Standard Specifications. A minimum clearance of 6" (150 mm) around the sidewalls of the manhole shall be provided. The excavation hole shall not contain water during the installation. Where found during excavation, unsuitable material shall be excavated as directed by the Engineer and replaced with granular fill, compacted.

All spare conduits and innerducts shall be sealed by means of reusable mechanical plugs. The Contractor shall use extreme care with the cables especially with regard to the minimum bending limitations.

When all cables at each pre-cast unit are securely racked, the void areas around the conduits or innerducts containing cables shall be sealed using reusable mechanical plugs.

Method of Measurement:

This work shall be measured for payment by the number of pull boxes of the type specified, complete and accepted in-place.

Basis of Payment:

This work shall be paid for at the contract unit price each for "Pull Box", complete in-place, which price shall include all materials, concrete, steel cover, locks, pulling irons, conduit plugs, appurtenances, dewatering, any excavation, granular fill, backfilling, replacement of pavement, including grading and placing topsoil, seeding, fertilizing, mulching and all equipment, tools, labor and work incidental thereto.

Pay Item	Pay Unit
Pull Box	EA

ITEM# 1017032A - SERVICE (METERED)

Description:

Furnish and install a metered electric service at the location shown on the plans or as directed by the Engineer.

Materials:

- Meter Socket
  - UL listed
  - Manual lever bypass
  - Locking metal cover for the glass enclosure
  - Contact the serving utility company for a list of approved meter sockets
- Conduit Bond Clamp
  - UL listed
  - Rated for direct burial

Locations served by United Illuminating (UI) or Wallingford Electric Division (WED)

Meter socket rated at 100 amps

Locations served by Connecticut Light and Power Co. (CL&P)

Meter socket rated at 200 amps

Enclosure capable of accepting a 3 inch (75 mm) rigid metal conduit (RMC)

Construction Methods:

Comply with the National Electric Code (NEC), the Department of Public Utilities Control (DPUC), and the serving power company requirements. Install a meter socket with associated equipment on the outside of the controller cabinet, as shown on the plans. Mount the enclosure approximately 54 inches (1.37 meters) above the ground. Install an expansion fitting in the RMC between the ground and the enclosure. Attach a direct-buried bond clamp to the service RMC below ground level, adjacent to the foundation. Bond the service conduit to the controller cabinet ground rod. Install a continuous nylon pull rope of at least 200 lbs (90 Kg) breaking strength in the conduit between the meter socket and the service source. Ensure all circuit breakers are off when service is connected by the utility company. The work must be inspected and approved by the Engineer or his designated representative prior to scheduling a service connection. Record the meter number and the date service is connected for billing purposes.

Service Request

- Traffic Signal on State Road: Contact the CT DOT Traffic Electrical office to complete the necessary service request forms.
- Traffic Signal on Town Road: Complete all necessary request forms and forward to the appropriate power company office.
- Incident Management Site: Complete all necessary request forms and forward to the appropriate power company office.

Locations served by United Illuminating

Contact the UI office to have a Job Number assigned. When the work is complete notify the Engineer to inspect and confirm that the work is according to the National Electric Code. Request that the Engineer contact the United Illuminating, Work in Progress office, to report the job number and to schedule a service connection.

Locations served by Wallingford Electric Division

Contact the Electric Division, Engineering Office to arrange for service and/or to schedule work by the Electric Division on utility poles above 10 feet (3 meters). When the work is complete notify the Engineer to inspect and confirm that the work is according to the National Electric Code. Request that the Engineer contact the Electric Division 24 hours prior to the desired connection date.

Locations served by Connecticut Light and Power Co. and all other electric power providers

Contact the power company engineering representative for exact requirements of the service. All riser fees and any other installation charges required of an underground metered service are the responsibility of the Contractor. When the work is complete notify the Engineer to inspect and confirm that the work is according to the National Electric Code. Request that the Engineer contact the power company to schedule the connection.

Method of Measurement:

The installation of the Service (Metered) will be measured for payment by the number of metered electric services of the type specified, completed, with service connected, and accepted in place.

Basis of Payment:

This work will be paid for at the contract unit price each for "Service (Metered)" complete and accepted in place. The price shall include all material above ground such as the meter socket enclosure, surface conduit, expansion fitting, coupling, and load side service conductors. The price shall also include the direct-buried ground clamp, bonding wire, pull rope, all material, equipment, tools, labor and incidentals necessary.

The power company will provide the line-side conductors and the meter.

Pay Item	Pay Unit
Service (Metered)	EA

ITEM #1017033A - SERVICE CABINET

Description:

The work under this item shall consist of furnishing and installing a complete service cabinet of the type specified at the locations shown on the plans or as directed by the Engineer and in accordance with these specifications. The service cabinet may have single or multiple services to feed both CCTV and VMS sites.

Materials:

The service cabinet shall be manufactured to NEMA type 3R requirements of an aluminum alloy wall thickness of 3 mm, with a hinged weatherproof gasketed door, stainless steel handle and tumbler-type Conn-1 lock. The pedestal mounted cabinet shall be approximately 3 ft, 1.25ft deep, and 1.5ft wide in size or the equipment in volume.

The foundation shall conform to Section 10.02.

The pedestal shall conform to Section 11.02, 3 ft Aluminum Pedestal.

Ground rod shall conform to Article M.15.15-7.

Trenching and Backfilling shall conform to Section 10.01.

Rigid Metal Conduit shall conform to Section 10.08.

Cable shall conform to Section 11.13 and these specifications.

A meter socket shall be provided on the outside of the service cabinet and shall be paid for under its contract item.

A ¾ inch marine-grade plywood backboard painted black shall be provided.

A neutral and ground bus bar shall be mounted in the rear of the cabinet.

The circuit breakers shall be thermal magnetic type. The number of poles, voltage rating and current ratings shall be as shown on the plans.

Construction Methods:

The Contractor shall completely install the conduit, foundation, pedestal, cabinet, wiring, circuit breakers, bus bars, backboard and required equipment as indicated on the plans or as directed by the Engineer. The Contractor shall install the service cabinet at locations shown on the plans or as directed by the Engineer. The Contractor shall install in the pedestal foundation one spare 2 in RMC conduit sweep.

The service cabinet should be located behind metal beam rail, beyond fixed objects such as proposed wood poles or utility poles, abutments and beyond the travel way. The location of the service cabinet should not create an obstacle in the sight line of vehicles traveling on the adjacent roadways. The location of the service cabinet shall be adjusted with respect to roadway geometry as directed by the Engineer.

The service cabinet shall provide power to a camera cabinet, mini-hub cabinet and VMS cabinet as indicated on the plans.

Method of Measurement:

This work will be measured for payment by the number of service cabinets installed, complete and accepted. Each service cabinet will be measured for payment regardless of single or multiple services.

Basis of Payment:

This work will be paid for at the contract unit price each for "Service Cabinet" complete and accepted in place which price shall include the cabinet, trenching and backfilling, foundation, pedestal, circuit breakers, bus bars, backboard, conduit, cable, and all equipment, tools, labor, and work incidental thereto.

Pay Item	Pay Unit
Service Cabinet	EA

ITEM #1017034A - INSTALL SERVICE

Description:

The work under this item shall consist of the Contractor coordinating and scheduling the service installations/connections of the electrical service by the Utility Company from the utility service source to the meter socket on the service cabinet, Traffic Management System (TMS) cabinet, Traffic Management System Mini Hub (TMSMH) cabinet, Highway Advisory Radio (HAR) cabinet, Variable Message Sign (VMS) cabinet, Portable Variable Message Sign (PVMS) cabinet, or direct service connection from a cabinet or location with metered service to the TMS, TMSMH, HAR, VMS and PVMS cabinets. This work will also entail installation of the meter by the Utility Company, installation of riser conduit, installation of utility poles, installation of primary and secondary conductors, installation of transformers and transformer pads, and installation of conductors underground between the utility service source and the meter socket on the service, TMS, TMSMH, HAR, VMS or PVMS cabinet. The work shall also include energizing the metered or unmetered service connection.

The Utility Company may render a service charge to the Contractor for installation and connection of underground services. These charges are to be paid for under this item. This item will include all associated utility work to have power installed into the meter socket and energized. The IMS site plans detail in general the work that needs to be accomplished. The work detailed on the IMS site plans and specified herein will be paid for under this item.

Materials:

The materials for this work shall conform to the special provisions herein, utility specifications and the National Electrical Code

Construction Methods:

The Contractor may install the service only after contacting and obtaining approval from the Utility Company. A representative of the Utility Company must be present for work involved with installing electric service from a manhole or pad mounted transformer/transclosure, unless otherwise directed by the Utility Company.

Under this item, the Contractor shall verify the load requirements of the system components for each TMS, TMSMH, HAR, VMS and PVMS location and notify the Engineer of any potential changes in electric service that may result in inadequate service connections. The Contractor shall verify the type and size of electric service cable to be used for electric service from a cabinet or location with metered service to the TMS, TMSMH, HAR, VMS and PVMS cabinets, as shown on the site plans.

The Contractor shall contact the Utility Company representatives listed on the site plans at least 30 days in advance to coordinate the service connection work to be performed by the Contractor and the Utility Company. The date the service is connected and energized shall be recorded for billing purposes and provided to the Engineer or his designated representative. All work

performed by the Contractor under this item shall be in accordance with utility requirements and the National Electrical Code. The Contractor shall obtain the necessary utility specifications prior to any service work.

The Contractor shall make all arrangements with the utility company and complete the required service request forms for all service locations. Billing for the monthly energy charges shall be to the following:

State Of Connecticut Department of Transportation
P.O. Box 317546
Newington, CT 06131-7546

This item shall include all required service conductors on the load side of the meter socket.

All circuit breakers in the cabinet shall be off when service is connected by the utility company.

At all locations, the service installation shall be inspected and approved by the Engineer or his designated representative prior to the service being energized.

Method of Measurement:

This work will be measured for payment by the number of electric services installed, energized, complete and accepted by the Engineer and Utility Company.

Basis of Payment:

This work will be paid for at the contract unit price for each "Install Service", complete, energized and accepted in place, which shall include meter, service conductors between utility service source and meter socket, load side service conductors, riser conduit, utility poles, primary conductors, secondary conductors, transformers, transformer pads, all Utility Company charges, and all materials, equipment, tools, labor and incidentals thereto.

Pay Item	Pay Unit
Install Service	EA

ITEM #1019053A - AERIAL CABLE (3 NO. 2)

DESCRIPTION: This work shall consist of furnishing and installing aerial cable, with insulators and brackets, on proposed poles at the location indicated on the plans.

MATERIALS: Aerial cable shall be 7 strand aluminum containing a No. 2 AWG bare messenger with three No. 2 AWG cross-linked polyethylene insulated conductors rated at 600 volts.

CONSTRUCTION METHOD: The aerial cable shall be used as temporary circuitry to maintain nighttime roadway lighting, on the roadways within the project limits open to vehicular traffic. Aerial cable shall be attached to proposed fiberglass poles or aluminum light standards (with insulators), including all connections as indicated on the plans or as directed by the Engineer. When necessary, the aerial cable shall be relocated to maintain different illumination circuits as dictated by the construction stages. Aerial cable used for temporary lighting shall be removed once the permanent lighting is installed and operational. Removed aerial cable shall remain the property of the Contractor.

METHOD OF MEASUREMENT: This work will be measured for payment by the actual number of linear feet of aerial cable installed and accepted, including attachments.

BASIS OF PAYMENT: This work will be paid for at the contract unit price per linear foot for "Aerial Cable (3 No. 2)" of the size and voltage specified, complete in place, which price shall include, insulators, entrance cap and attachment, bracket, all materials, tools, connections, equipment, labor, and work incidental thereto. The unit cost for this item is a one-time only cost. The cost of removing and relocating the aerial cable to maintain different illumination circuits shall be included in the unit cost.

Pay Item	Pay Unit
Aerial Cable (3 No. 2)	LF

ITEM #1020030A - TEMPORARY ILLUMINATION UNIT

DESCRIPTION: Under this item the Contractor shall furnish and install a breakaway fiberglass light pole, anchors, bracket, luminaire with ballast, and necessary hardware for temporary lighting during construction, as indicated on the plans or as directed by the Engineer. At the end of the project the temporary illumination unit shall become the property of the Contractor.

MATERIALS: The pole shaft shall be fiberglass reinforced composite (FRC). The pole shaft shall be constructed by the filament winding process from thermosetting polyester resin and contain a minimum of 65 percent of "E" type fiberglass by weight. The filament windings shall be continuously applied with uniform tension and shall be placed on the pole helically at low angles to provide axial strength. Additional windings shall be placed on the pole in a circular manner to provide compressive strength. The resin is to be uniformly pigmented to match the final grey color of the finished FRC pole. The pole is to contain solid coloration throughout the entire wall thickness and is to contain ultraviolet (UV) inhibitors. The pole is to be round, tapered, hollow, and reinforced in the support arm and hardware attachment areas. The pole is to be non-conductive and chemically inert. A 2 ½" x 5" handhole shall be provided at the base of the pole shaft at approximately 18" above the finished grade line. The pole shall meet the current AASHTO LTS-2 *Street Lighting Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*, and shall be approved by FHWA for use on Federal Aid projects. Direct buried poles shall meet the latest AASHTO breakaway requirements.

The pole exterior surface is to be grey with a natural (textured) finish. The surface of the pole will be uniform for the entire length of the pole. The laminate shall contain colored pigment, the color of the final coating, and be of uniform color throughout the entire wall thickness of the pole. A coating shall be applied to the pole to maintain surface integrity against the damaging effects of sunlight and extremes in weather. The coating is to be highly weather resistant pigmented polyurethane. The coating thickness shall have minimum dry film thickness of 1-1/2 mils.

The surface shall be tested for a minimum of 5000 hours of accelerated testing in accordance with ASTM G154 (UV-A lamp 340 NM wave length, 130 degree F, cycle lamp 4 hours on 4 hours off) with the following results:

Fiber exposure:	none
Crazing:	none
Checking:	none
Chalking:	none
Color:	may dull slightly

The minimum pole weight shall be 130 lbs. The weight of each pole shall not deviate from the specified weight by more than +/- 10 lbs.

For direct buried break-away poles the butt end shall be enlarged so as to provide resistance to rotation and pull out.

Where indicated on the plans, the pole shaft shall be equipped with an anchor base with of heavy duty A356-T6 aluminum which shall be permanently bonded to the outside of the fiberglass shaft.

Each pole is to be permanently marked in characters 3/16” minimum high on a brass or stainless steel plate with the manufacturer's identification symbol, month and year of manufacture. Each pole shall be individually packaged for protection during shipping and storage. The pole shall be warranted to be free of defects in materials and workmanship for a period of three years from the date of purchase.

The top of the pole is to be pre-drilled for two 5/8" thru bolts on 9-1/2" centers starting 4 inches below the top of the pole. A 1-1/2" wire exit hole shall be centered 1/2 the distance between the two holes.

A cast aluminum removable cap shall be securely mounted to the top of the pole. The cap shall be corrosion resistant and must remain in place when subjected to the maximum wind loading for which the pole is designed.

The luminaire bracket arm shall be 12' in length (single member) of an upsweep design fabricated from tubular aluminum. The luminaire end shall have a 2-3/8" outside diameter.

Anchors shall conform to the pertinent requirements of Article M.16.04-2b, c, d, and e.

The luminaire shall conform to the pertinent requirements of Article M.15.05, and shall be high pressure sodium. The luminaire wattage shall be 250 watt or as called for on the plans. The socket shall be adjustable to provide I.E.S. light distribution type M-S-II. The ballast shall be under guarantee of the manufacturer for a period of one year commencing when the unit is installed and accepted

CONSTRUCTION METHOD: The fiberglass pole shall be set in the earth to the required depth and proper compaction of backfill provided around the pole and then attached to the anchors with guys as necessary. The bracket shall be attached to the pole and shall provide a luminaire mounting height of 35’ over the roadway or the mounting height as called for on the illumination plans (See contractor “Notes” section). The bracket and luminaire assembly shall be installed perpendicular to the center line of the roadway. When necessary, the temporary light pole and luminaire shall be relocated to maintain different illumination circuits as dictated by the construction stages.

Where indicated on the plans an anchor base type pole shall be supplied and securely bolted to the anchor bolts of the foundation and leveled with the aid of aluminum shims if necessary.

Upon completion of the project the temporary illumination unit shall be removed and shall remain the property of the Contractor.

Upon removal of the pole, the resulting excavation shall be properly backfilled to match the surrounding area.

METHOD OF MEASUREMENT: This work will be measured for payment by the number of temporary illumination units installed and accepted.

BASIS OF PAYMENT: This work will be paid for at the contract unit price each for "TEMPORARY ILLUMINATION UNIT" complete in place, which price shall include all materials, fiberglass poles, breakaway base, anchor base (when required), anchors, guys, brackets, luminaires, lamps, ballasts, hardware, connections, hauling, and all equipment, tools, labor and all work incidental thereto including excavating, augering, removal of bituminous overlay, backfilling, removal, hauling, relocation, and disposal. The unit cost for this item is a one time only cost. The cost of removing and relocating the temporary illumination unit to maintain different illumination circuits shall be included in the unit cost.

Pay Item	Pay Unit
Temporary Illumination Unit	EA

ITEM NO. 1104039A – 55’ STEEL MAST ARM ASSEMBLY
ITEM NO. 1104502A – MAST ARM ASSEMBLY, 25-1W
ITEM NO. 1104505A – MAST ARM ASSEMBLY, 35-1W
ITEM NO. 1104553A – COMBINATION MAST ARM ASSEMBLY, 30-1W
ITEM NO. 1104557A – COMBINATION MAST ARM ASSEMBLY, 50-1W

Description:
Work under this item shall consist of designing, fabricating and installing a mast arm assembly to carry traffic appurtenances (such as traffic signals, signs, cameras, etc.) of the type specified, on a prepared foundation, in accordance with the details shown on the plans, in accordance with these specifications and as ordered by the Engineer.

The color of the finish coat for Mast Arms and anchor bolt covers, handhole covers, post caps, and end caps shall be included under this item and paid for at the contract unit price each.

Materials:
The structural components of the mast arm, including camera arm, shall be made of steel with minimum yield strength of 36,000 psi. The non-structural components, such as caps and anchor bolt covers, may be made of steel or aluminum.

All structural steel greater than 0.5” thick with minimum yield strength less than 50,000 psi shall meet the notch toughness requirements for ASTM A709, Grade 36F2. All structural steel greater than 0.5” thick with a minimum yield strength equal to or greater than 50,000 psi shall meet the notch toughness requirements for ASTM A709, Grade 50F2.

High strength bolts shall conform to the requirements of ASTM A325, Type 1. Nuts shall conform to ASTM A563, grades DH, DH3, or ASTM A194, grades 2H. Circular flat, hardened steel washers shall conform to ASTM F436. The bolts, nuts and washers shall be galvanized in accordance with ASTM A153.

The anchor bolts shall conform to ASTM F1554, Grade 105. The nuts shall conform to ASTM A563, Grade DH. The washers shall conform to ASTM F436. The bolts, nuts and washers shall be galvanized in accordance with ASTM A153.

All steel components, including anchor bolts, shall be completely hot-dip galvanized, after fabrication, in accordance with ASTM A123 or ASTM A153, as applicable.

Bare copper grounding conductor shall be #8 AWG stranded bare copper wire conforming to M.15.13. The grounding bolt shall be stainless steel with a hex head.

Construction Methods:
The design and fabrication of the mast arm assembly, including its anchorage (into the foundation), shall conform to the requirements of latest AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals , including the latest interim specifications, amended as follows:

- The design wind speed shall be 120 mph. The computation of wind pressures in accordance with Appendix C is not permitted.
- ***The mast arms shall be designed to support fixed mounted traffic signals and signs.*** The wind drag coefficient for traffic signals and cameras shall be 1.2.
- ***The mast arms shall be designed for fatigue category I. The mast arms shall be designed for the wind load effects due to galloping, natural wind gusts and truck-induced gusts.*** The camera arms shall be designed for the wind load effects due to natural wind gusts. The design pressure for the truck-induced gust shall be based on a truck speed of 65 mph. Vibration mitigation devices are not permitted.
- The vertical deflection of the free end of the arm due to the wind load effects of galloping and truck-induced gusts shall not exceed 8".
- The minimum design life for mast arms shall be 50 years.
- The length of the arm members, measured from the centerline of the pole to the tip of the arm, shall be in 5'-0" increments. The minimum arm length shall be 15'-0". The maximum arm length arm shall be 55'-0".
- The maximum camera arm length shall be 15'-0".
- The maximum diameter of the pole at its base shall be 18".
- The maximum diameter of the arm at the arm-pole connection shall be 15".
- The minimum wall thickness of the arm at the pole connection and the pole shall be .3125".
- The pole shall be fabricated from multisided or ***ROUND*** tubular members. Multisided tubular members must have a minimum of 16 sides.
- The arm shall be fabricated from multisided or ***ROUND*** tubular members with a taper. Multisided tubular members must have a minimum of 16 sides.
- The camera arm shall be truss type and shall be fabricated from round tubular members. A clamp-on attachment shall be used to fix the camera arm to the pole.
- A maximum of one slip-type field splice is permitted in the arm. Slip-type field splices are not permitted in the pole. The wall thickness of the pole and arm component members shall be uniform throughout their length. The use of multiple plies (laminations) to obtain the required arm and pole thickness is not permitted. The use of shop fabricated stepped members is not permitted.
- The arm, camera arm and pole members may be fabricated with no more than 2 longitudinal seam welds.
- The longitudinal seam welds for the arm and the pole members shall have 60% minimum penetration, except longitudinal seam welds within 6" of the member ends shall be complete joint penetration groove welds. The longitudinal seam welds for the camera arm members shall have 60% minimum penetration, except longitudinal seam welds within 6" of the butt end of the member shall be complete joint penetration groove welds.
- A minimum of 25% of the partial joint penetration seam welds and 100% of the complete joint penetration seam welds shall be non-destructively tested. Partial joint penetration seam welds shall be non-destructively tested in accordance with the magnetic particle method. Complete joint penetration seam welds in members less than 5/16" thick shall be non-destructively tested in accordance with the

magnetic particle method. Complete joint penetration seam welds in members greater than or equal to 5/16" thick shall be non-destructively tested in accordance with the ultrasonic method. Longitudinal seam welds within 6” of the ends of member less than 5/16” thick shall be non-destructively tested by the magnetic particle method on both the inside and outside surfaces.

- The arm to transverse plate connection shall be made with a complete joint penetration groove weld with a backing ring attached to the plate with a continuous fillet weld. The pole to transverse baseplate connection (at the foundation) shall be made with a complete joint penetration groove weld with a backing ring attached to the plate with a continuous fillet weld. In combination mast arm assemblies with poles fabricated in 2 components, the connection plates, used to join the pole components, may be welded to the pole components with either a complete joint penetration groove weld with a backing ring attached to the plate with a continuous fillet weld or socket-type joint with 2 fillet welds. 100% of the complete joint penetration groove welds shall be non-destructively tested by the ultrasonic method. 100% of the fillet welds shall be non-destructively tested by the magnetic particle method.
- The use of stiffeners at tubular member to transverse plate connections and at the arm to pole connection is not permitted.
- The pole baseplate anchor bolt circle diameter shall be 24" or less.
- The minimum number of anchor bolts shall be 8. The minimum anchor bolt diameter shall be 2”.
- The anchor bolts shall use embedded anchorage plates to transmit loads from the pole base to the concrete foundation. The use of hooked anchor bolts is not permitted. Welding to the anchor bolts is not permitted.

The dimensions of the mast arm assemblies are shown on the traffic plans, elevations, cross-sections or in the special provisions. The arm, camera arm and pole lengths and the attachment heights shall be verified by the Contractor based on the finished grade at the site, top of foundation elevation, the locations of overhead utility cables and the traffic appurtenance mounting heights. If either the arm or pole length is inadequate, the Contractor shall notify the Engineer.

The minimum vertical clearance from the top of the finished road to the bottom of the traffic signals shall be 16'-0. The maximum vertical clearance from the top of the finished road to the bottom of the traffic signals shall be 18'-0". The traffic signals shall be installed so that the bottom of all the signals for each approach is at the same elevation.

The arm to pole connection shall be made with a ring stiffened built-up box. The camera arm to pole connection shall be determined by the Contractor. A minimum of 8 high-strength bolts shall be used to connect the arm flange plate to the built-up box connection plate. All fasteners and their components used in the connection shall be visible. The use of tapped holes in the plates of the connection is not permitted. A hole(s) shall be provided in the connection to allow wires to pass from the pole to the arm and camera arm. The sides of all other holes in the

connection shall be ground smooth and the edges rounded by grinding to prevent the wires from chafing.

The mast arm assembly shall be designed and fabricated to allow the arm to be adjusted 5° in a horizontal plane. Washers, a minimum of 5/16" thick, shall be placed between the anchor bolt nuts and the top and bottom surfaces of the pole baseplate.

A J-hook shall be welded to the inside of the pole at the top for wire handling and support.

The mast arm pole shall have a handhole centered 1'-3" from the top of the baseplate. The handhole shall be located away from traffic. The handhole shall be reinforced with frame having a minimum 7" wide by minimum 9" high clear opening. The handhole shall be provided with a cover connected to the frame with stainless steel screws. The cover shall also be attached to the frame with a stainless steel chain. The inside bottom of the frame shall have a hole tapped for the stainless steel grounding bolt.

The mast arm shall be supplied with pole and arm caps and anchor bolt covers. The caps and covers shall be attached to the mast arm with stainless steel screws.

Prior to fabrication, the Contractor shall submit working drawings and design computations to the Engineer for review in accordance with Article 1.05.02. An individual set of working drawings and computations shall be prepared for each mast arm. A single set of drawings and computations for multiple mast arms is not permitted.

Working drawings shall be submitted on 11" x 17" (Ledger/Tabloid) sheets with an appropriate border and title block. Design computations, procedures and other supporting data shall be submitted on 8 ½" x 11" (Letter) sheets.

The working drawings and design computations shall be sealed by a Professional Engineer, licensed in the State of Connecticut, who shall also be available for consultation in interpreting his computations and drawings, and in the resolution of any problems which may occur during the performance of the work. Please note that each working drawing must be sealed.

The design computations shall include, but not be limited to the following:

- the project number, town and mast arm identification number
- computations for projects in Customary U.S. units shall be provided in Customary U.S. units. Computations for projects in metric units shall be provided in both Customary U.S. units and metric units.
- references to design specifications, including interim specifications, and the applicable code section and articles
- description/documentation for all computer programs used in the design
- drawings/models of the structure, components and connections, with dimensions, loads and references to the local and global coordinate systems used (as applicable), to facilitate review of the results

- a tabulation of the section properties of the tubular members at each analyzed section. The tabulated values should include the effective width, b of multisided member, (AASHTO 5.5.2); equivalent diameter of multisided member, (AASHTO 5.6), wall thickness, t; inside bend radius, r_b of multisided member, (AASHTO 5.5.2), cross-sectional area, A; moment of inertia, I; section modulus, S; radius of gyration, r. AASHTO Table B-1 may be used to determine the section properties. If Table B-1 is used, the radius measured to the mid-thickness of the wall shall also be provided.
- results of all group loads and load combinations

The working drawings shall include complete details of all mast arm components. The drawings shall include, but not be limited to the following:

- the project number, town and mast arm identification number
- reference to the design specifications, including interim specifications
- reference to the design specifications design criteria, such as design wind speed, minimum design life, fatigue category, vehicle speed, etc.
- material specifications for all components
- material designations for the arm and pole, with an explanation of the alpha numeric characters (equivalent thickness, in inches (in millimeters), shall be provided for gage numbers)
- non-destructive weld testing requirements
- details of the location of the longitudinal seam welds in the arm, camera arm and pole
- a plan view of the anchor bolt layout relative to the orientation of the arm(s)
- anchor bolt dimensions, including embedment and projection
- permanent camber
- mast arm installation procedure, including the method to plumb the mast arm pole, and the method to tighten the anchor bolts, including bolt lubrication requirements

After fabrication and prior to shipping, aluminum identification tags shall be attached to the arm and pole members with self-tapping tamper resistant screws.

The mast arm shall be installed according to the manufacturer's specifications.

After erecting the mast arm, the mast arm shall be electrically grounded by attaching the bare copper grounding conductor to the inside of the handhole frame with a stainless steel bolt and to the ground rod with a ground clamp. The rigid metal conduit shall be electrically grounded by attaching the bare copper grounding conductor to the insulated bonding bushing and to the ground rod with a ground clamp.

The traffic appurtenances shall be located and mounted on the arm as shown on the cross-sections. Holes, if required for wires, shall be located adjacent to the appurtenances and shall be

drilled in the bottom of the arm. A rubber grommet shall be installed in each hole to protect the wires from chafing.

After installation of the traffic appurtenances, the anchor bolts nuts (leveling and top anchor nut) and washers shall be in full contact with the top and bottom surfaces of the pole baseplate and the centerline of the pole shall be plumb. The top nuts shall have full thread engagement. The distance from the bottom of the leveling nuts to the top of the foundation shall not exceed 1".

After plumbing the pole, non-shrink grout shall be placed to seal the opening in the baseplate to prevent the entrance of insects and animals.

The last character of the mast arm identification number shall be stenciled with black paint on the pole of each mast arm. The character shall be 3" high and placed approximately 1' above the top of the baseplate facing the centerline of the roadway.

The following specification shall apply when Mast Arms are specified with a color :

The default color is specified as Black Matted finish. It can vary based on specific project requirement.

The steel mast arm (shaft, arm, and base and camera arm) shall be hot-dip galvanized, conforming to the requirements of ASTM-A123. Pole Cap, bolt covers, handhole covers, bolts, washers, nuts and screws shall be galvanized, conforming to the requirements of ASTM A153. Second Coat: After galvanizing, the exterior steel surface shall be blast cleaned to Steel Structures Painting Council Surface Preparation Specification No. 6 (SSPC-SP6) requirements utilizing cast steel abrasives conforming to the Society of Automotive Engineers (SAE) Recommended Practice J827. The blast method used is a recirculating, closed cycle centrifugal wheel system with abrasive conforming to SAE Shot Number S280.

Interior surfaces (pole shafts only) at the base end for a length of approximately 610mm shall be mechanically cleaned and coated with a zinc rich epoxy powder. The coating shall be electrostatically applied and cured in a gas fired convection oven by heating the steel substrate to a minimum of 177 degrees Celsius (350 degrees Fahrenheit) and a maximum of 204 degrees Celsius (400 degrees Fahrenheit).

All exterior surfaces shall be coated with a Urethane or Triglycidyl Isocyanurate (TGIC) Polyester Powder to a minimum film thickness of 2.0 mils (0.0508mm). The coating shall be electrostatically applied and cured in a gas fired convection oven by heating the steel substrate to a minimum of 177 degrees Celsius (350 degrees Fahrenheit) and a maximum of 204 degrees Celsius (400 degrees Fahrenheit). The thermosetting powder resin shall provide both intercoat as well as substrate fusion adhesion that meets 5A or 5B classifications of ASTM D3359.

The color of the finish coat for steel mast arms, anchor bolt covers, handhole covers, post caps, and end caps shall be ***powder coated black matted finish*** conforming to Federal Specification TT-E-489.

The powder coating facilities shall be owned and operated by the pole manufacturer to ensure a quality coating system. Prior to shipment, small poles shall be wrapped in 4.8mm (0.19 inches) thick Ultraviolet inhibiting plastic backed foam. Larger poles shall be cradled in a 303mm (12 inches) rubberized foam base.

Any coating damaged prior to or during the installation of shall be repaired. Areas to be repaired shall be clean, dry, free from grease, oil, corrosion products and other contamination. If contaminated, power wash or scrub with stiff brush and clean water. Repair areas may be brushed or sprayed as appropriate. If the Contract elects to spray he must provide overspray containment. The minimum overspray containment shall conform to the requirements of SSPC Guide 6 for the Class 3A level.

All defective work shall be corrected by the Contractor at no cost to the Department.

Compliance with Regulations: The Contractor is required to meet all OSHA and EPA as well as state and local government regulations regarding worker safety and protection, hazardous waste handling and disposal through the use of appropriate containment, engineering controls, respirators, monitors, etc.

Method of Measurement:
This work will be measured for payment by the number of steel mast arm assemblies of the type specified, completed and accepted in place.

Basis of Payment:
This work will be paid for at the contract unit price each for "Mast Arm Assembly, XX-XX" or “Combination Mast Arm Assembly, XX-XX" of the type specified, complete in place, which price shall include all equipment, materials, tools and labor incidental to the design, fabrication and installation of the mast arms at the locations specified on the plans.

Pay Item	Pay Unit
55’ Steel Mast Arm Assembly	EA
Mast Arm Assembly, 25-1W	EA
Mast Arm Assembly, 35-1W	EA
Combination Mast Arm Assembly, 30-1W	EA
Combination Mast Arm Assembly, 50-1W	EA

ITEM #1105103A - 1 WAY, 3 SECTION MAST ARM TRAFFIC SIGNAL
ITEM #1105105A - 1 WAY, 5 SECTION MAST ARM TRAFFIC SIGNAL
ITEM #1105303A - 1 WAY, 3 SECTION PEDESTAL MOUNTED TRAFFIC SIGNAL
ITEM #1105400A - 1 WAY, 3 SECTION BRIDGE MOUNTED TRAFFIC SIGNAL

Description:- This item shall consist of furnishing and installing a "LED TRAFFIC SIGNAL assemblies" of the type specified at locations shown on the plans or as indicated by the Engineer in conformity with these specifications.

Article 11.05.03 - Construction Methods:

Add the following paragraph:

When LED signals are used, measure the off-state voltage of all green indications, with the lamp loads attached. An abnormally high reading may indicate a high impedance neutral or a defective load switch. If this condition exists make all necessary corrections prior to leaving the signal in operation.

Article M.16.06 - Traffic Signals

The color of the signal assemblies and hardware shall be **Black.**

Sub Article 6 - Optical Unit, Light Emitting Diode:

The Uniform/Incandescent appearance type LED circular traffic signals **latest** ITE specifications for LED circular traffic signals and published under the name **V**ehicle **T**raffic **C**ontrol **S**ignal **H**eads-**L**ight **E**mitting **D**iode Circular Signal Supplement **(VTCSH-LED).** The Countdown Pedestrian Signals shall also meet the **latest** incandescent look ITE specifications. These lamps shall be as manufactured by either Dialight or GE or City approved equal.

Some of the critical factors in this specification include:

Luminous Intensity over the full operating temperature range
Maximum intensity and luminance uniformity
Testing with duty cycle (yellow module)
Resistance to dust and moisture intrusion
Hard coating of lens and abrasion tests
Low Voltage turn-off
Turn-on and turn-off times
Failed state impedance
Use of ITE Complaint label on the product

A regulated power supply shall be engineered to protect the LED's from electrical surges and transient voltages.

The LED lamp unit supplier shall provide a warranty for Five (5) years from the date of project acceptance.

Construction Method:

- Remove standard lens, gasket and incandescent lamp from housing.
- Install new gasket on the lamp
- Insert lamp and gasket in housing and tighten holding screws.
- Make sure that the orientation of the lamp unit is proper.

Connect to 120 Volts AC terminal blocks or wire connectors.

Method of Measurement: The quantity to be paid for under this item will be the number of Signal Heads completed, installed and accepted.

Basis of Payment: This work will be paid for at the contract unit price each for "Traffic Signal Assemblies" of the type and size specified which price shall include all materials, LED Lamp Unit, miscellaneous fittings and parts, labor and work incidental thereto.

Pay Item	Pay Unit
1 Way, 3 Section Mast Arm Traffic Signal	EA
1 Way, 5 Section Mast Arm Traffic Signal	EA
1 Way, 3 Section Pedestal Mounted Traffic Signal	EA
1 Way, 3 Section Bridge Mounted Traffic Signal	EA

ITEM#1106001A- 1 WAY PEDESTRIAN SIGNAL POLE MOUNTED

ITEM#1106003A- 1 WAY PEDESTRIAN SIGNAL PEDESTAL MOUNTED

Section 11.06.02 Pedestrian Signal, Materials

Section M.16.07 C. Optical Unit

Delete 2. LED: and replace with the following:

General

- Meet requirements of current MUTCD Section 4E.
- Meet current ITE specifications for Pedestrian Traffic Control Signal Indications - (PTCSI) Part 2: Light Emitting Diode (LED).
- Meet CT DOT, 2008 - 2010 Functional Specifications for Traffic Control Equipment; Section 5D, LED Pedestrian Signal with Countdown Timer.
- Meet EPA Energy Star® requirements for LED Pedestrian Signal Modules.

Operational

- Countdown display only during the flashing Pedestrian Clearance (Ped Clr) Interval. Timer goes blank at end of flashing ped clearance even if countdown has not reached zero.

Physical

- Sealed optical module to prevent entrance of moisture and dust.
- Self-contained optical module, including necessary power supplies.
- Designed to securely fit into standard housing without the use of special tools or modifications to the housing.
- Identification information on module: manufacturer's name, model number, serial number, and date code.

Optical

- Multiple LED sources; capable of partial loss of LED's without loss of symbol or countdown message.
- Two complete self contained optical systems. One to display the walking person symbol (walk) and the hand symbol (don't walk). One to display the countdown timer digits.
- Visual Image similar to incandescent display; smooth, non-pixilated.
- Symbol and countdown digit size as shown on the plan.
- Solid hand/person symbol; outline display not allowed.
- Overlaid hand/person symbols and countdown digits arranged side by side.
- Countdown digit display color: Portland Orange in accordance with ITE requirements.
- Countdown digits comprised of two seven segments, each in a figure 8 pattern.
- Photometric Requirements: Luminance, Uniformity, and Distribution in accordance with ITE requirements.
- Color Uniformity in accordance with ITE requirements.

- Blank–Out design; symbols and digits illegible even in direct sunlight when not illuminated.

Electrical

- Operating voltage: 89 VAC to 135 VAC.
- Low Voltage Turn-Off: 35 VAC.
- Turn-On and Turn-Off times in accordance with ITE specifications.
- Combined Hand – Countdown Digits wattage: $\geq$ 20 Watts.
- Input impedance at 60 Hertz sufficient to satisfy Malfunction Management Unit (MMU) requirements.
- Two separate power supplies. One to power the walking person symbol. One to power the hand symbol and the countdown digits.
- Meet Federal Communication Commission (FCC) regulations concerning electronic noise.
- Filtered and protected against electrical transients and surges.

Warrantee

- Five years from date ownership is accepted.

Section M.16.07 F. Painting:

Third coat: Replace the first two sentences with the following:

All brackets and hardware shall be painted yellow by the manufacturer. The color shall be No. 13538, Federal Standard No. 595.

At intersections at Merritt Parkway interchanges, all brackets and hardware shall be painted dark green by the manufacturer. The color shall be No. 14056, Federal Standard No. 595.

ITEM #1107011A - ACCESSIBLE PEDESTRIAN SIGNAL AND DETECTOR (TYPE A)

Description:

Furnish and install an Accessible Pedestrian Signal and Detector (APS&D). The APS&D provides audio and tactile information to augment the visual pedestrian signal.
Type A provides a low frequency percussive tone during the walk interval and is used where there is an exclusive pedestrian phase or ≥ 10 foot separation between APS&Ds.

Material:

A. General:

- Conform to applicable sections of the current MUTCD Chapter 4E, Pedestrian Control Features as specified herein.
- All features fully operational when the traffic signal is in colors mode.
- All features non-operational when the traffic signal is in flash mode.
- Interchangeable with a non-accessible type pedestrian pushbutton with no modifications to the Controller Assembly (CA) or Controller Unit.
- Audible transducer integral with the APS&D housing, adjacent to the pushbutton.
- Operation programming method: Either or combination of:
  - Mechanically by dip switches or circuit board jumpers
  - Infrared remote-control hand-held device

B. Electrical:

- Metallic components either grounded or insulated to preclude an electrical hazard to pedestrians under all weather conditions.
- All features powered by the 110VAC Walk signal and the 110VAC Don't Walk signal so that additional conductors from the CA are not needed.

D. Audible Pushbutton Locator Tone

- Frequency: repeating tone at one (1) second intervals
- Tone duration: ≤ 0.15 seconds
- Volume:
  - Minimum setting of zero
  - Manually adjustable initial setting
  - Automatically adjusted after initial setting. Volume increased in response to a temporary increase in ambient noise and subsequently decreased with a decrease in ambient noise.
  - Maximum volume: 100 dBA which is the approximate sound pressure of a gasoline powered lawn mower nearby.
  - Automatic volume adjustment independent of other APS&Ds at the intersection.
  - May be disabled without affecting operation of other features.
- Silent only during walk interval. Active all other times.

E. Vibrotactile Arrow Pushbutton

- Pushbutton contained in a circular assembly which fits inside the housing and is attached to the housing with 4 screws.
- ADA compliant: Size: ≥ 2.0" (50) diameter, Actuation force: ≤ 5 ft-lb (22.2 N)

- Shape: Circular, raised slightly above housing so that it may be actuated with the back of a hand
- Tamper-proof, vandal-proof, weatherproof, freeze-proof, impact-resistant design and construction.
- Operation: Vibrates only during the walk interval (when the walk indication is displayed).
- Tactile Arrow:
  - Attached to surface of the button assembly by a tamperproof method.
  - Raised slightly above surface of pushbutton, minimum 0.125" (0.3)
  - Size: Length ≥ 1.5" (38), Height ≥ 1.0" (25)
  - Color: Sharp contrast to background color of pushbutton and housing

F. Audible Walk Interval

1. General:
   - Operation independent of other APS&Ds at intersection.
   - Active only during the walk interval (when the walk indication is displayed).
   - Volume:
     - Minimum setting of zero
     - Manually adjustable initial setting
     - Automatically adjusted after initial setting. Volume increased in response to a temporary increase in ambient noise and subsequently decreased with a decrease in ambient noise.
     - Automatic volume adjustment independent of other APS&Ds at the intersection.
     - Maximum volume: 100 dBA which is the approximate sound pressure of a gasoline powered lawn mower nearby.
   - Duration:
     - Default method: Automatically set by the duration of the visual walk signal display.
     - When selected: Manually set when rest-in-walk is used for a concurrent pedestrian movement.
   - Audible sounds that mimic any bird call are not allowed.

2. Type A, Percussive Tone:
   - Repeating tone at eight (8) to ten (10) ticks per second.
   - Tone frequency: Multiple frequencies with a dominant component at 880 Hz which creates a "tick - tick - tick…" sound.

G. Pushbutton Housing/Sign Frame/Sign

- One piece die cast aluminum meeting requirements of ASTM B85.
- Sign frame designed to accept 9" x 12" (230 x 300) four-hole advisory sign.
- Flat back to facilitate surface mount.
- Available brackets to either pedestal top-mount or pole side-mount on pole diameter range of 3½" (89) to 15" (380).
- Available brackets to allow mounting two (2) APS&Ds to the same 3½" (89) pole, facing ≥ 60 degrees apart, at the same height.
- Available extension bracket of a size indicated on the plan – 18" maximum.
- Wire entrance through the rear.
- Stainless steel mounting hardware.
- Color: The color shall be yellow No. 13538, Federal Standard No. 595. At intersections at Merritt Parkway interchanges, all brackets and hardware shall be painted dark green by the manufacturer. The color shall be No. 14056, Federal Standard No. 595.
- Finish: Housing/Frame and all mounting brackets either:
  1. Painted with 3 coats of infrared oven-baked paint before assembly.

  - Primer: Baked iron oxide which meets or exceeds FS TT-P-636.
  - Second coat: Exterior-baking enamel, light gray, which meets or exceeds FS TT-E-527.
  - Third coat: Exterior-baking enamel, which meets or exceeds FS TT-E-489.
2. Electrostatic powder coated after chemically cleaned.

- Sign: CT DOT Sign No. 31-0845

Construction Methods:

Install the APS&D according to the manufacturer's instructions. Position the ASP&D so the plane of the sign face is parallel to the crossing (sign is facing perpendicular) and the arrow is pointing in the same direction as the crossing, not necessarily at the ramp. Notify the Engineer if there is any discrepancy or ambiguity between the plans and field conditions that prevent placement of the ASP&D as shown on the plan. Set the minimum sound levels of the locator tone and the audible walk indication when there is little or no ambient noise as in night time operation. Set the volume of audible walk indications and pushbutton locator tones to a maximum of 5dBA louder than ambient sound. The locator tone should be audible 6' to 12' (1.8 m to 3.6 m) from the pushbutton or to the building line, whichever is less. Confirm the volume of both audible walk indication and the locator tone increases with an increase in ambient sound and subsequently decreases when the ambient noise decreases.

If programming method is remote, by an infrared hand-held device, provide one device and operation manual for each intersection where APS&D is installed.

Method of Measurement:

This work is measured by the number of APS&Ds of the type specified, installed, tested, fully operational, and accepted.

Basis of Payment:

Payment for this work is based on the installation, inspection, successful completion of the 30 day test period, and final acceptance of the Accessible Pedestrian Signal and Detector of the type specified. Payment includes the sign, mounting brackets for adjacent buttons on the same structure, extension brackets, all incidental materials, labor, tools, and equipment necessary to complete the installation. Payment also includes the warrantee, installation manual, and operation manual.

If programming method is remote by an infrared hand-held device, the total bid price of all APS&Ds includes one remote programming device and accompanying operation manual for each intersection where APS&D is installed.

Pay Item	Pay Unit
Accessible Pedestrian Signal and Detector (Type A)	Each

ITEM 1108578A – FULL ACTUATED CONTROLLER 8 PHASE (MODIFIED)

Description: This item shall consist of furnishing and installing a **FULL ACTUATED CONTROLLER 8 PHASE (MODIFIED)** for controlling the operation of any traffic signal. The cabinet to house the controller shall be completely wired and all sub-bases shall be complete with load switches and flash relays in conformity with this specification. The cabinet shall also have all necessary auxiliary equipment required to provide the sequence and timing for any traffic signal.

Material: All materials furnished, assembled, fabricated, or installed shall be new, corrosion resistant, and in strict accordance with the latest provisions set forth by the City of Stamford Specifications. All equipment furnished under this item shall be current production equipment, identical models of which are field operational.

1. Controller

The Controller shall be NTCIP compliant and shall meet or exceed NEMA TS2 -1998 specification. The controller shall be as manufactured by either **Peek or Naztec**.

The controller shall be equipped with LCD display and menu driven software which provides a user-friendly approach to programming and built-in diagnostics to evaluate the operational status. The controller shall have a flash memory which allows the user to upgrade the intersection software without any PROM replacement. The controller shall be Ethernet-enabled to allow communication across a TCP/IP network.

2. Cabinet:

Each controller assembly shall be completely wired and housed in a NEMA P-44 rigid metal cabinet with a **CT Gray Paint**. The cabinet shall be of clean-cut design and appearance and shall be substantially constructed of aluminum alloy. The base mounted cabinet shall have a single front door with #2 Corbins lock and approximately 59” high, 44” width, and 26” deep in size. An auxiliary door which shall be equipped with a lock and a police key. Door hinge pins shall be of stainless steel material. Two keys shall be furnished for each lock. When closed, all doors shall fit tightly to neoprene gasket material.

P- Cabinet Base Adapter: A cabinet base adapter shall be furnished with the P-44 cabinet. The dimensions of the adapter base shall be approximately 44”x26”x12”.

2.1. Ventilation: The Cabinet ventilation shall include an intake, exhaust, filtration, fan assembly and environmental controls. Each electric fan shall be equipped with ball or roller bearings and with a capacity of at least 100 cfm. The fan shall be mounted with the housing and be vented. The fan shall be thermostatically controller and shall be manually adjustable.

2.2. Cabinet’s Light:

The cabinet lamp circuit shall be fused. The fuse holder shall be easily accessible from the front of the cabinet. It shall not be necessary to reach into the cavity above the controller in order to access the fuse holder for the cabinet lamps.

2.3. Cabinet Power supply:
The cabinet power supply shall meet the requirements of the cabinet.
The cabinet power supply shall provide LED indicators for the line frequency, 12 VDC, 12 VAC, and 24 VDC outputs.
The cabinet power supply shall provide (on the front panel) jack plugs for access to the +24 VDC for test purposes.
One cabinet power supply shall be included with each cabinet assembly.

2.4. Cabinet Surge Protection: Each cabinet shall be provided with a surge protection device (SPD) on the AC service input. This SPD shall protect the controller and ancillary equipment from electrical surges due to lightning and utility transients.

The SPD device shall be Model No. ZoneDefender PRO-16400 as manufactured by Atlantic Scientific Corporation.

2.5. Fiber Optic Cable Housing:

The Fiber Optic Drop Cable Housing shall have the following components as manufactured by Corning or approved equal.

Single Panel Housing (16x14x5 cm)	Model #SPH-01P
Mounting Bracket	Model #SPH-01P-BKT
12 fiber SC Connector Housing	Model # CCH-CP12-91

2.6. Fiber Optic Patch Cables: The cabinet shall be equipped 6 Single Mode fiber optic patch cables to provide internal distribution to all opto-electronic equipment. The patch cables shall be factory terminated with SC Type connectors or approved connector compatible with the specified equipment complement.

2.7. Pullout Drawer: One pullout drawer shall be provided mounted under the bottom shelf in the cabinet. The drawer shall be 25mm (1 inch) high, 330 mm (13 inches) deep, 406 mm (16 inches) wide and capable of holding 18 kg (40 lbs) in weight when the drawer is extended. This drawer shall have a flip up lid to place a Laptop computer on top when extended while protecting any documentation in the drawer when the cabinet door is open.

2.8. Police Door: A switch to control the change from automatic control to flashing operation and vice versa. The controller shall continue to operate when in flash from this switch. A switch to control the change from automatic control to manual operation and vise versa. A manual cord not less than 1.82m/6 foot long, equipped with a rubber cover hand switch, will also be provided and be accessible from the police door. Manual Control will be accomplished by activation of the manual control enable circuit in conjunction with the interval advance circuit. Signal-on-off

switch this switch shall override all flash switches, disconnecting power to the traffic and pedestrian signals the signal switch shall not shut off the controller power

2.9. Model 200 Solid State Switch Pack: A 3-circuit solid-state load switch with input and output LED's shall control Signal light circuits. Each circuit shall be independent of the other two and within its own metal package. This package shall be attached to the interior wall of the load switch to allow for heat dissipation during operation the load switch shall plug into the load switch rack that is modular and expandable per the functions of the BIU. "RENO A & E Model LS-200 or City approved equal." 16 load switches shall be provided.

2.10. Model 204 Flasher Unit: The flasher shall be a solid-state device, producing 50 and 60 flashes per minute with a 50 percent duty cycle. The flasher mechanism shall be mounted on a plug-in base with a plug-in mounting. "RENO A & E Model FL-200 or City approved equal". 2 flashers shall be provided.

2.11. Malfunction Management Unit: This specification sets forth the minimum requirements for a shelf-mountable, sixteen channel, LCD display, solid state Malfunction Management Unit (MMU). The MMU shall meet the following specification:

No circuit cuts shall be allowed on circuit boards in any of the equipment supplied. Any wire jumpers included on circuit boards shall be placed in plated through holes that are specifically designed to contain them. Jumpers that are tack soldered to circuit traces or are added to correct board layout errors are not acceptable.
MMU shall have an Ethernet connector and shall be connected to the switch.

All IC's with 16 or more pins shall be mounted in machine-tooled sockets. All sockets shall have two-piece, machined contacts and closed end construction to eliminate solder wicking. The outer sleeve shall be brass with tin or gold plating and tapered to allow easy IC insertion. The inner contact shall be beryllium copper sub plated with nickel and plated with gold. All sockets shall have thermoplastic bodies meeting UL Specification 94V-0. Other high quality sockets may be acceptable but must have prior approval of the Traffic Operations Division Signal Operations Engineer. Sockets meeting alternate specifications shall be submitted in writing with the bids. Zero insertion force sockets will not be allowed.

The design shall allow for removal or replacement of a circuit board without unplugging or removing other circuit boards.

The unit shall be designed so that one side of each board can be completely accessible for troubleshooting and testing the unit while it is still operating. This may be accomplished with extender boards or cables. This need apply to only one circuit board at a time.

No more than two circuit boards shall be attached to each other to constitute a circuit assembly. Attaching hardware shall use captive nuts or other acceptable method to secure the boards together. Alternate methods shall be submitted in writing with the bids. The boards shall be designed so that the purchaser can test and operate the controller unit with the boards separated.

If this specification is used to support the purchase of a complete controller assembly, the unused red circuits shall be connected to the AC Line in the controller cabinet.

A RS232 port shall be accessible from the front panel of the MMU. The RS232 port shall be compatible with a PDA device that provides the following information:

Programming Report
Analyzer Report
History Report
Clear Report Logs
Download Real-Time Clock

A RS232 Communication Cable shall be supplied in interface the MMU to the controller.

Each Malfunction Monitoring Unit shall have a unique serial number that is permanently and neatly displayed on the face of the unit. If this serial number is not on the face of the unit, then an additional temporary label that is neatly printed or typed shall be affixed to the MMU. The MMU supplied must be the Enhanced model with RS232 communication or City approved equal. 1 MMU shall be provided.

2.12. Bus Interface Units:

Each cabinet assembly shall contain 4 Bus Interface Units required for proper operations. One Traficon compatible BIU units shall be provided.

Each BIU shall have the capability of operating 16 detector inputs or 8 channels of load switches.

No circuit cuts shall be allowed on circuit boards in any of the equipment supplied. Any wire jumpers included on circuit boards shall be placed in plated through holes that are specifically designed to contain them. Jumpers that are tack soldered to circuit traces or that are added to correct board layout errors are not acceptable.

For easy maintenance, Critical Components shall be socket mounted; Dual-in-line (DIP) devices shall be mounted in military specification sockets, a part #8xx-AG11D. All sockets shall have two-piece, machined contacts and closed end construction to eliminate solders wicking. The outer sleeve shall be brass with tin or gold plating and tapered to allow easy I.C. insertion. The inner contact shall be beryllium copper sub-plated with nickel and plated with gold. All sockets shall have thermoplastic bodies meeting UL Specification 94V-0. Each I.C. socket contact shall be plated with at least 50 microns of gold.

2.13. Detector Rack:
The detector rack shall be designed to support four channel detector cards
The detector rack shall support thirty-two detector inputs.
The detector rack shall support two BIU slots

The detector rack shall support two slot for an optical preempt card either two dual channel cards or one four channel card.

4 two channel Loop Detector cards shall be provided.

2.14. Quad Channel Detector Sensing Unit: The Inductive loop detector and all other detection devices shall be provided under other items. These units shall plug directly into the detector rack.

2.15. Preemption Phase Selector: The preemption phase selector is specified and paid under the phase selector item. The unit shall plug directly into the cabinet.

2.16. Power Distribution Assembly: Circuit Breakers shall be listed by UL or ETL. The trip and frame sizes shall be plainly marked (marked on the breaker by the manufacturer), and the ampere rating shall be visible from the front of the breaker. Contacts shall be silver alloy and enclosed in an arc-quenching chamber. Overload tripping shall not be influenced by an ambient air temperature range of from – 18 degrees C to 50 degrees C. The minimum Interrupting Capacity shall be 5,000 Amperes, RMS when the breaker is secondary to a UL approved fuse or primary circuit breaker and both breakers in concert provide the rated capacity.
A solid-state contactor shall be supplied and shall be rated at 75 amps. An indicator light shall be visible from the front of the unit.

2.17. Technician Panel: A panel shall be provided to test 32 vehicle detector inputs and 4 pedestrian detector inputs for purpose of trouble shooting and testing the cabinet and controller

2.18. Model 430 Flash Transfer Relay: The Flash Transfer Relay shall be Model 430.
8 Flash Transfer Relay shall be provided.

2.19. Door Ajar Alarm Switch: A door ajar alarm switch shall be installed. The switch shall be of heavy duty, spring- loaded design with single pole normally closed contacts. The switch circuit shall be closed whenever the door is open at an angle of 15 degrees or more. The door ajar switches shall only be used to support the door ajar alarm function; they shall not be used to support any other function (such as cabinet illumination or conflict monitor interlocking).

The switch shall be wired to 2-point barrier style terminal block on the input side of the cabinet. One point of the terminal block shall also be connected to logic ground and the other to cabinet door alarm input. The other point of the terminal strip shall be connected to controller logic ground.

2.20. 120 VAC Outlets: The controller cabinet shall be equipped with 2 separate 4 gang outlet boxes (total 8 outlets) with 2 separate 15 AMP breakers.

2.21. Construction Methods: The controller, mounted in the controller cabinet shall be installed at the locations shown on the plans.

2.22. Programming: Each programmable field hardware component including, but not limited to, local controller, malfunction management unit, detector amplifier, lamp failure monitor, shall

be initially programmed by the supplier based on information provided by the City of Stamford Traffic Engineer. One hard copy of the programming data shall be left in each control cabinet and one hard copy shall be delivered to the City.

2.23. Ducts:
All conduits in the foundation shall be completely sealed with flexible waterproof duct seal material approved by the Engineer.

2.24. Cabinet Door:
The cabinet door shall be open as specified in the plans. If the plans do not indicate this information, the contractor shall confirm with the Engineer regarding the orientation of the cabinet.

A cabinet door alarm shall be enabled to permit monitoring from central.

2.25. Cabinet Grounding: All controllers shall be effectively grounded using a 16mm (5/8 inch) by 3 meter (10 foot) minimum copper clad steel rod with #8 AWG solid, bare, tinned copper wire attached to the controller cabinet and to the ground rod by a square head bolt clamp.

Maximum resistance between the grounding electrode and any point in the grounding system shall not exceed 5 ohms. If resistance is greater than 5 ohms, contractor shall increase length of ground rod and take other remedial action may be required to attain specified resistance. Temporary remedial measures (such as wetting the soil) shall not be permitted. The Contractor should document resistance of each ground rod to a reference ground. A test plan shall be submitted for review by the Engineer.

Neutral shall be bonded to ground at point of service with minimum #6 copper jumpers.

2.26. Connection of Miscellaneous Cables: All wiring connected to terminal blocks, flashers, relays, switches, radio interference suppresser, etc., shall be identified by use of insulated pre-printed tags over the wire including, but not limited to signal control wires, loop detector lead-in, etc. The wire markers shall carry the legend in plain words with sufficient details so that a translating sheet will not be required.

Cabinets shall be wired to accept and implement all of the features of the specified equipment.

2.27. Illuminated Street Name Signs Service Panel: A blank side mounted service panel shall be installed with terminal blocks and a separate circuit breaker to accommodate wiring at least 6 illuminated street name signs.

2.28. Video Detection System Service Panel: A blank side mounted panel shall be installed with terminal blocks and a separate circuit breaker to accommodate wiring at least 4 video detection cameras.

3. External 2400 baud Modem:

A 2400 Baud external modem shall be provided with RS 232 cable for connection to the TS2 controller. The modem shall be an FSK type and be equipped with a stand-alone chassis and power supply. The modems must be compatible with the field modems currently utilized on the Stamford system. This modem shall be Model 404SA as manufactured by GDI Corp. These modems operate a 2400 baud utilizing an FSK approach at frequencies of 4400 and 2200 hz. The modem shall be equipped with a 9PIN RS232 connector and a suitable cable of at least 4' in length must be provided to connect directly to the RS232 port of the controller. The modem shall also be equipped with a four wire lead-in cable utilized to connect to the transmit and receive pairs of the communication cable terminated on the interconnect panel.

4. 100 Base-TX Communications:

This setup shall include two(2) Ruggedcom hardened managed switches with part # RS900-Hi-N-C2-C2-TX-XX with 7 100base TX ports and 2 100base single mode FX ports. No SFP units shall be required to connect 2 fibers to receive and 2 fibers to transmit. All connecting cables for all the ports on these two units shall be supplied.

5. Interconnect Cable Termination Panel:

An interconnect cable termination panel shall be installed on the left inside wall of the controller cabinet. This panel shall consist of 3 rows of 22 pole double screw barrier strips with plated brass, corrosion resistance number 6-32 pan head screws. All active pairs shall be protected by Gas Tube lightning suppression equivalent to the two wire Siemens SVP (Surge Voltage Protector) B1-G90/20.

6. Uninterruptible Power Supply System:

It shall include the following components as manufactured by Alpha Technologies. 120 VAC, Novus FXM 2000 output power module with SNMP interface in a S4 Cabinet with generator outlet. Automatic Transfer Switch and Generator Transfer Switch shall be supplied along with 20V/30A failsafe bypass switch, cable kits, and four Valve Regulated Lead Acid 215 GXL gel cell batteries with non prorated 6 year full replacement warranty. The surge protection device shall be a Model No. 16100 as manufactured by Atlantic Scientific Corporation. This unit shall be installed and wired in the UPS cabinet as recommended by the manufacturer.

7. Manuals:

The Supplier shall secure from the manufacturer a comprehensive service controller.
Six (6) paper prints of the cabinet wiring diagram the entire field connection chart shall be left blank. A comprehensive parts list, detailing all replaceable components as to manufacturer part number, and commercially available part number, and manufacturer's net price each, shall be provided. This list may be referenced from the drawings supplied with the equipment.

8. Guarantee:

The supplier shall secure from the manufacturer a guarantee for the equipment for a period of twelve (12) months, which time shall commence from the date of delivery. If a unit is found to be defective during this twelve month period, it will be the responsibility of the contractor to assume the cost of shipping the controller to and from the factory, supplying parts and making repairs at no cost to the City of Stamford.

Method of Measurement: The NEMA TS2-TYPE 1 Actuated Controller and NEMA P-44 Traffic Control Cabinet will be measured as the number of complete units furnished and installed in accordance with the Contract Documents.

Basis of Payment: The unit price bid for each NEMA TS2 TYPE 1 Actuated Controller and NEMA P-44 Traffic Control Cabinet shall include the cost of furnishing and installing all material, labor, manufacture training, materials, tools, and equipment necessary to complete the work. Payment for all miscellaneous hardware, cabling, necessary documentation and testing shall be included under this item.

Pay Item	Pay Unit
FULL ACTUATED CONTROLLER 8 PHASE (MODIFIED)	Ea.

ITEM 1108644A – TRAFFIC MANAGEMENT SYSTEM CABINET

Description:

This work includes the furnishing and installing of outdoor equipment cabinets as shown on the Drawings and detailed in this specification.

Materials:

1. General:

   1.1. The Traffic Management System Cabinet (TMSC) shall serve as an environmental enclosure for the field equipment. The TMSC shall be installed at camera sites as shown on the plans. The TMSC shall be 24”W x 30”D x 67”H with 19” rack rails mounted inside the cabinet for mounting the following equipment:

   - Ethernet Port Sharing Device supplied as part of item # 1108628A
   - Optical Video/Data Transmitter supplied as part of item #1108704A
   - Single Mode Fiber Optic Media Converter for connecting VMS controller to the input panel in the TMSC, if required, supplied as part of item #1108662A - Single Mode Fiber Optic Media Converter. The Contractor shall refer to the detailed estimate sheet and fiber diagrams for determination for Fiber Optic Media Converter.
   - Local camera control connection, local traffic flow monitor connection, if required, provided as part of item #1112210A (Camera Assembly) and item #1113059A (Traffic Flow Monitor).
   - Input wiring panel with all appropriate surge suppression devices, terminal blocks and power supplies.
   - Power distribution panel rack/panel assembly.

   1.2. Publications listed below form a part of these Specifications to the extent referenced. The publications are referred to in the text by the basic designation only.

   - National Electrical Manufacturers Association (NEMA Standard 250)
   - Underwriters Laboratories UL50 and UL508
   - National Electrical Code – Most recent edition
   - 170 Traffic Signal Control Hardware Specification FHWA-1 P:-78-6

2. Traffic Management System Cabinet (TMSC):

   2.1. The TMSC shall meet the NEMA 3R standard. The TMSC shall be 24”W x 30”D x 67”H with 19” rack rails mounted inside the cabinet. The TMSC shall be fabricated

with “S” flanges in the top ventilation to prevent forced snow, ice and road salt from entering the enclosure.

2.2. The TMSC shall operate from an 115VAC +/- 10%, 60 Hz power source.

2.3. The TMSC shall be an enclosure suitable for outdoor mounting on a concrete foundation.

2.4. The TMSC shall meet the requirements as specified in Chapter 12 of the Type 170 Traffic Signal Control Hardware Specification FHWA-1 P-78-6 as modified by this Specification.

2.5. The TMSC shall be furnished with front and rear doors possessing securing brackets, each door equipped with a Conn-2 lock (tumbler-type). One (1) key shall be furnished for each cabinet installed. When closed, both doors shall fit tightly to a neoprene gasketing material. The door hinge pins shall be made of stainless steel. The hinge pins shall be the length of the door. The door hinges and securing brackets shall be made of stainless steel and bolted so doors may be changed without the need to cut welds.

2.6. The TMSC shall be supplied with internal EIA standard 19” racks as specified in the Drawings. The 19” racks shall be installed on both the front and rear door access points.

2.7. The TMSC shall have one rack mounted shelf that extends the complete width and depth of the cabinet. The shelf shall be adjustable in height and shall have rails to extend outwards. The shelf must be able to support a laptop computer when fully extended outward.

2.8. The TMSC shall be equipped with adequate heating as required for cabinet components and ventilating system to maintain inside temperature between +5 to +60 degrees C at any time. The heating and ventilating system shall include an electric heater, fan and replaceable filter mounted on the intake vent. The ventilation fan assembly shall be of adequate size to circulate air in the cabinet and controlled by an adjustable thermostat. The fan and cabinet are to be located so as to direct the bulk of the airflow throughout the entire cabinet. The fan motor shall have a suppresser across it equal to or better than 0.1 μf/47 ohm protection @ 600v. All points on the thermostat and fan at which 110 VAC are present shall be insulated to prevent electric shock.

2.9. The TMSC shall be equipped with an enclosed, 19” rack mounted electric strip heater and blower with a rating of approximately 800 watts at 120 VAC. The enclosure shall house the strip heater and blower in which air shall be drawn in across the strip heater and exhausted out from the blower. The enclosure shall feature an internal thermal cut-off that will shut off the heater should the exhaust area become obstructed. The ventilation fan and strip heater with blower shall be controlled by a high-low adjustable

thermostat which can be set to ensure the cabinet interior temperature remains between +5° C and +60° C under average weather conditions. The strip heater with blower thermostat shall have an adjustable low temperature range down to at least 0°C. The heater shall be wired directly to the AC circuit breaker reserved for the heaters.

2.10. The TMSC shall be equipped with an outdoor rated LED lamp with a 100 watt incandescent output equivalent rating mounted and wired such that the lamp comes on when either front or rear door is opened. The lamp shall be directly wired to AC.

2.11. The following electrical devices shall be provided on a hinged 19" EIA power distribution rack-mounted assembly in the TMSC. The hinged power distribution assembly shall be rack mounted on the opposite side of the ITS equipment. The hinged rack assembly chassis shall be constructed of aluminum and have a clear anodized finish. The hinged power assembly shall be able to swing out to provide clear access to rack mounted equipment for serviceability. A catalog cut of the power distribution assembly must be submitted for review and approval of the Engineer as part of the shop drawing review process.

2.11.1. One (1) 40 Amp main service input circuit breaker

2.11.2. Eight (8) 15 Amp load circuit breakers

2.11.3. Power bus

2.11.4. Ground bus

2.11.5. Neutral bus

2.11.6. Three (2) 20 Amp duplex 120 VAC power receptacles. In addition, one (1) GFCI duplex receptacle shall be included for tools and test equipment purposes. The electronic equipment to remain in the cabinet shall not be connected to the GFCI receptacles unless directed by the Engineer.

2.11.7. An EDCO ACP-340 surge suppression device shall be provided on the load side of the main circuit breaker. The protector shall be installed on the rack/panel mounted power assembly.

2.12. The TMSC shall have a heavy plastic envelope which will contain cabinet wiring diagrams, schematics, etc. The envelope shall be securely fastened to the inside of the front cabinet door. The envelope shall be 12" (300 mm) x 18" (455 mm) or larger.

2.13. The TMSC shall be fabricated from sheet aluminum providing it is rigid and has a

minimum thickness of 3.17 mm. All outside surfaces shall be cleaned and finished. The outside surface appearance shall be brushed aluminum.

2.14. The TMSC shall be suitable for an outdoor installation on a concrete foundation and provide adequate environmental protection for the devices housed in the cabinets for year-round operation.

3.0 Input Wiring Assembly and Surge Suppression:

3.1 A rack mounted input wiring assembly measuring approximately 16”x19” shall be provided for each traffic management system cabinet. The assembly shall serve as the termination point for all communication and low-voltage power wiring to the CCTV cameras, traffic flow monitors (if required), variable message signs (if required) and other field equipment specified in the contract and shown on the plans. In addition, the assembly shall serve as a mounting location for surge suppression devices, low-voltage AC and DC transformers, and equipment cables that connect to devices in the traffic management system cabinet such as OVDT’s, Ethernet port-sharing devices, fiber-optic media converters, etc.

3.2 The input wiring assembly shall be rack mounted on the backside of the TMSC above the power distribution panel. The assembly shall be hinged to provide access to rack mounted equipment. All cables shall be securely trained and fastened to allow free swinging of the wiring assembly and prevent fraying or damage. The panel shall swing out to provide access to rack mounted equipment for serviceability.

3.3 All terminal positions and devices on the wiring panel assembly shall be clearly marked and identified

3.4 The following types of voltage transient/surge suppression shall be provided and installed on the wiring panel assembly. Each surge suppression device shall be supplied and installed in an appropriate socket that is fastened to the wiring panel assembly.

- Coaxial CCTV cable input – EDCO CX-06-BNCY-I
- Traffic Flow Monitor power – EDCO PHC060 (one unit for every two (2) TFM’s)
- Traffic Flow Monitor data communications – EDCO LCDP-030 (one unit for every TFM). This is only needed for TFM’s that are connected to the cabinet using category 6 cable.(Ethernet circuit)
- Variable Message Sign with direct connect communications – EDCO LCDP-030 (one unit for every VMS) This is only needed for VMS’s that are connected to the cabinet using category 6 cable (Ethernet circuit)

- CCTV camera data communications – EDCO PC642C-008 LC Two (2) EDCO devices may be required if Manchester data communications is used for local camera control. (RS-422 circuits)
- CCTV camera power – EDCO PHC060.
- Digital CCTV communications (For future use) – EDCO CAT6-POE

3.5 All field terminations, interconnections and wiring cable connections shall be made using terminal block strips except for Ethernet communications. Crimp-on spade lugs shall be installed on all cabling for easy connection and removal. All wiring connections shall be as short as possible to minimize signal loss and reduce transients.

3.6 Cables installed between surge suppression devices and cabinet equipment (such as OVDT's, CICU, etc.) may be made directly from the output terminals of the EDCO surge suppression units.

3.7 Transformers that supply low-voltage power shall be rack mounted on the wiring assembly panel.

4.0 Manufacturer's Qualifications:

4.1 The Manufacturer shall have a minimum of five (5) year's experience in the design, manufacture, and testing of TMSC of the type and size specified here in. The cabinets shall be manufactured according to world class quality standards. The manufacturer shall be ISO 9001 certified.

5.0 Warranty:

5.1. All equipment supplied under these items shall be warranted for parts by the vendor against defects and failures, which may occur through normal use for a period of one (1) year from the date of installation. A copy of the warranty shall be presented to the Engineer before installation of the equipment.

Construction Methods:

1. Submittals:

As part of Section 1.06 (Control of Materials) for this project, the Contractor shall submit the following documentation:

1.1. Detailed shop drawings, wiring diagrams, equipment cabinet front elevation drawings,

and equipment installation drawings indicating supports and appurtenances required for proper installation in Visio 2007 format

1.2. Schematic showing wiring panel assembly including panel dimensions, locations of terminal blocks, surge suppression, transformers, cables, including wiring labels, etc. in Visio 2007 format.

1.3. Product data and cut sheets, operating and maintenance manuals. Information regarding materials, finishes and accessories.

2. As-built Documentation:

2.1. As part of the project as-builts, the Contractor shall provide the following information:

2.1.1. Test procedures and test results.

2.1.2. The Contractor shall submit with the documentation for the TMSC item four (4) copies of the "as-built" equipment manuals. The equipment manuals shall include technical information, wiring diagrams and schematics, hookup prints, parts list and a troubleshooting guide.

3. Delivery, Storage, and Handling:

3.1. The Contractor shall deliver, store, handle and install all materials and equipment in such a manner as not to degrade quality, serviceability or appearance.

3.2. The Contractor shall be responsible for storage of the materials and equipment prior to installation in a clean, dry location free from construction dust, precipitation and excess moisture.

3.3. The Contractor shall be required to replace any damaged materials and equipment, as determined by the Engineer, at no additional cost to the Department.

3.4. All materials shall be delivered in the manufacturer's original unopened protective packages. All materials shall be stored in their original protective packaging and protected against soiling, physical damage, or wetting, before installation. All equipment shall be protected during transportation and until installation against damage and stains.

4. Installation:

4.1. The Contractor shall install the TMSC on the foundation per the manufacturer's requirements. Connect all cables for power and fiber. Install all equipment listed in this

specification and other equipment as required to power and communications cables/connectors. All communication cables must be terminated by the approved ITS integrator.

4.2. Install the rack mounted optical video/data transmitters, Ethernet port sharing devices and fiber-optic media converters in the field equipment cabinets in accordance with the equipment manufacturer's recommendations.

4.2. Install and connect field fiber optic cable and all other inter-equipment cabling required to fully interconnect the equipment as shown on the Drawings.

4.3. Install and connect the video/data transmitter, Ethernet port sharing device, fiber optic data media converter power supplies to the existing 120 VAC receptacles reserved for the equipment in the cabinet.

4.4. The optical fiber path for each video link shall have been tested and verified in accordance with the plans prior to the equipment installation.

4.5. Power distribution assembly components shall be mounted such that they are readily accessible. All hazardous voltage points shall be covered to prevent inadvertent contact. The circuit breakers shall be labeled.

4.6. Install and connect equipment on wiring panel assembly such as equipment transformers, surge suppression, cabling with spade lugs and/or connectors, surge suppression, etc.

4.7. Install and connect the hinged wiring panel assembly inside traffic management system cabinet. All wiring shall be neat and firm and in conformance with the current National Electrical Code. Any work performed by the Contractor for the utility installation shall be in accordance with P.U.C.A and State of Connecticut Department of Transportation Form 816. The Contractor shall obtain the necessary utility specifications prior to any service work.

4.8. All wiring to the hinged power distribution assembly shall be harnessed so that the panel may be moved to facilitate field repairs on the panel. AC+ signal power shall be brought to an accessible terminal. Logic Ground, AC-, and Chassis Ground must be tied to a common point in the cabinet and grounded. The cabinet shall be wired such that the removal of two jumper wires will completely isolate all said grounds from one another. The AC+ service wire shall be wired direct to the line side of the main circuit breaker.

4.9. All power cables and communication cables connected within the TMSC shall be neatly trained along the rail racks.

4.10. The Contractor shall neatly train all optical patch cords and pigtails together when

routing them along the same path and shall neatly train them along the support rails in the camera control equipment cabinet. The contractor will provide rack mounted cable management when needed or as directed by the engineer.

4.11. The fibers shall be carefully managed and connected to a 19" rack mounted patch panel with six SC fiber connectors.. The fiber cable sheath shall be sealed to provide a moisture barrier at the termination point.

4.12. No cables shall be installed with a sweep-bend radius less than the manufacturer's minimum recommended bending radius.

5. Testing:

5.1. The Contractor shall be responsible for all testing and documentation required to establish approval and acceptance of this Item.

5.2. Pre-Installation Testing:

5.2.1. The Contractor shall be required to perform quality control testing on one (1) of the cabinets and all of the thermostats and heating/cooling assemblies prior to delivery.

5.2.2. The Contractor shall submit test procedures and documented test results to the Engineer. The test procedures shall document the nature of test activities to be performed.

5.2.3. The test procedures shall be submitted to the Engineer prior to initiation of the testing. The procedures will be returned to the Contractor within two (2) weeks indicating either "accepted" or "make corrections noted".

5.2.4. In the case that corrections are required, the Contractor shall submit revisions within one (1) week.

5.2.5. Four (4) copies of the final test procedures shall be submitted to the Engineer prior to commencement of testing. The testing and test procedures shall include, but not be limited, to the following:

- Visual Inspection: The Contractor shall perform detailed visual inspection to confirm that the following aspects of the cabinet are in compliance with the requirements of this specification:

- General appearance: cabinet dimensions, finish, locks and door handles, door frames, latching mechanism, door hinges, bolts, louvered vents and filters, gaskets, and lifting eyes.

- Interior insulation, side panels, equipment rack.

- Electrical components: power distribution assembly, conductors, color coding, terminal blocks, heater operation and mounting, fan ventilation area, trouble lamp.

5.2.6. The Contractor shall perform visual test of the following components: service light, power distribution assembly, fan, heater, main power disconnect and thermostat.

5.2.7. The Contractor shall refer to the testing and documentation of the materials and equipment listed under these items to the testing and documentation for other pertinent items contained in this contract.

5.3. Proof-of-Performance Testing – The contractor shall energize each cabinet and confirm proper operation of heaters, fans, thermostats and service lights.

5.4. Installation Testing - Upon complete installation of all field equipment (including camera assemblies, TMSC, OVDT's, PSD’s, media converter - VMS) an operational test shall be performed by the Contractor and demonstrated to the Engineer to verify proper installation and operation. The test shall verify the proper operation of the field equipment installation.

5.5. 30-day Operational Testing - Upon successful completion of the installation test and approval by the Engineer, a 30-day System Operational Test for each TMSC site shall commence. During the course of this test, the system must function continuously in accordance with the specifications for the duration of the test. If a malfunction occurs within the stated time frame, the Contractor shall make all necessary repairs to the system and re-establish proper operation. Upon approval of the Engineer, the 30-day test will begin anew. The system must operate for a full thirty (30) consecutive days without malfunction before the system will be accepted by the Engineer. The Contractor shall refer to "Notice To Contractor – 30 Day System Operational Test" for additional testing requirements. The Contractor shall coordinate the 30-day System Operational Test with other pertinent items in this contract.

5.6 Ground Test

5.6.1 All cabinet grounding systems when completed in place shall have a resistance to ground of not more than that shown in the table below as determined in the following manner:

1. Temporarily connect a 10 ampere load between the AC+ side of the equipment cabinet fuse and the ground system. It should be assured that the applied power voltage is 120 volts AC at the time of the test.
2. Disconnect the power company AC neutral from the ground system.
3. Connect a voltmeter between the power company AC neutral and the ground system.

Cabinet Insulated	Voltmeter Reading (Volts)	Equivalent Resistance (Ohms)
Model 170 Type	20	2.0

4. If the voltmeter reading is higher than the appropriate voltage shown in the above table under the 10 ampere load, the grounding system has an unacceptable resistance to ground. Additional grounding including electrical bonding of underground metallic conduit, may be necessary in order to meet the requirements of this test.
5. The results of this test shall be recorded and provided to the Engineer for each cabinet installed prior to acceptance and 30-test operational testing.

5.6.2 Insulation Resistance Testing – An insulation resistance test at 500 volts DC shall be made on each circuit between the circuit and ground. The insulation resistance shall not be less than 10 megohms on each circuit.

Method of Measurement:

This item shall be measured for payment by the actual number of equipped Traffic Management System Cabinets supplied.

Basis of Payment:

The work to be done under this item shall be paid for at the Contract unit price each for Traffic Management System Cabinet of the type specified, which price shall include all materials, devices, hardware, termination panels, rack-mounted fiber patch panel, rack-mounted power assembly, rack-mounted wiring panels, surge suppression/transient protection, terminal strips, cable management, cables, connectors, tools, equipment, labor and incidentals necessary to complete this work.

ITEM 1108704A - OPTICAL VIDEO/DATA TRANSMITTER

Description:

This work includes the furnishing and installing optical video/data transmitters (OVDT's) as shown on the Drawings and detailed in this specification. This Item specifies the requirements for the video and data fiber-optic communications system to be furnished and installed at the Traffic Management System Cabinet (TMSC), Item No. 1108644A or the Traffic Management System Mini-Hub Cabinets (TMSMHC), Item No. 1108645A as shown on the Drawings and detailed in this Specification Section.

Optical Video/Data Transceivers (OVDT) are used in the TMSC for transmission of combined video, pan-tilt-zoom (PTZ) control, Traffic Flow Monitor (TFM) data, and variable message sign (VMS) data. A matching Optical Video/Data Transceiver (OVDR) is installed in the TMSMHC or Bridgeport Operations Center. Single Mode Fiber Data Modems are used for transmission of data from the VMS cabinets to the TMSC or TMSMHC.

Materials:

1. Publications:
   1.1 Publications listed below form a part of these specifications to the extent referenced. The publications are referred to in the text by basic designation. All video and data transmission hardware shall be compliant with the following standards, to the extent applicable.

   1.2 Electronics Industries Association (EIA):

   1.3 EIA-170 Electrical Performance Standards for Monochrome Television Studio Facilities.

   1.4 TIA-526-3-89 Fiber Optic Terminal Equipment Receiver Sensitivity and Maximum Receiver Input.

   1.5 TIA-455-32A-90/Fiber Optic Circuit Discontinuity.

   1.6 EIA/TIA-232-E Interface Between Data Terminal Equipment and Data Circuit Termination Equipment Employing Serial Binary Data Interchange.

   1.7 EIA/TIA-250-C-Short Haul Electrical Performance for Television Transmission Systems.

   1.8 EIA-310-C Racks, Panels, and Associated Equipment.

   1.9 EIA-359-A Colors for Color Identification and Coding.

   1.10 EIA-422-A Electrical Characteristics of Balanced Voltage Digital Interface Circuits.

1.11 EIA/TIA-455-A Standard Test Procedures for Fiber Optic Fibers, Cable Transducer Sensors, Connecting and Terminating Devices and Other Fiber Optic Components.

1.12 EIA-455-6B Cable Retention Test Procedure for Fiber Optic Cable Interconnecting Devices.

1.13 EIA-485 Standard for Electrical Characteristics of Generators and Receivers for use in Balanced Digital Multipoint Systems.

2. Optical Video/Data Transmitter (OVDT):

2.1. The OVDT shall transmit one (1) video signal and three (3) full duplex asynchronous data signals from the Traffic Management System Cabinet (TMSC) to the Bridgeport Operations Center (BOC) using one (1) single mode optical fiber. The OVDT shall be manufactured by Meridian Technologies Inc., Model No. PT-700IR-V4S/4S-3C, or equivalent subject to approval by the Engineer.

2.2. The OVDT shall be from the same manufacturer and compatible with the existing Optical Video/Data Receiver (OVDR) Meridian Model No. PR-700IR-V4S/4S-3C installed at the Bridgeport Operations Center (BOC).

2.3. The video signal transmission shall employ digital or analog transmission technology.

2.4. The OVDT shall employ automatic gain control (AGC) circuits, cable equalization and other features to minimize or eliminate any required field electrical or optical adjustments.

2.5. OVDT optical fiber connections shall be compatible with the single mode fiber-optic cable connectors and the fiber-optic interconnect panel connectors. Adapters will not be allowed by the Department. The OVDT shall interface to the single mode fiber cable using an ST connector.

2.6. The video signal performance specification for the transmission and reception is measured from the transmission input to the transmission output as per the testing criteria defined in EIA/TIA-250-C.

2.7. All circuit boards shall be conformally coated.

2.8. Video Transmission Specifications:

- Video Input: 1 Volt peak-to-peak, 75 ohm
- Video Bandwidth: 5 Hz to 7 MHz @ -3dB
- Video Signal-to-Noise Ratio: Equal to or greater than 67 dB at maximum optical attenuation
- Differential Gain: <2% typical
- Differential Phase: <1.5 ° typical
- Tilt: <0.5% maximum
- Wavelength: 1310/1550 nm
- Output Power: -7 dBm
- Receiver Sensitivity: -36 dBm
- Optical Loss Budget: 29 dB
- Operating Temperature: -40 to +165 degrees F (-40 to +74 degrees C)
- Operating Humidity (Relative): 0 to 95% non-condensing
- Encoding: 10 or 12 bit linear
- Sampling Rate: 15 MHz (minimum)
- Cable Equalizer (3000 feet): >30 dB @ 10 MHz

2.9. The data transmission channels shall be fully compliant with the data format and transmission speed requirements of the field devices to which they are to be connected. This includes the data signals required for full CCTV camera pan-tilt-zoom (PTZ) control and ancillary status return signals.

2.10. Data Transmission Specifications:

- Data Circuits Available 3 full duplex
- Aggregate Data Rate DC to 300 Kbps
- Data Format RS-232, RS-422, or RS-485 (NRZ, RZI, Manchester, bi-phase); fully compliant with the terminal equipment and intended application
- Bit Error Rate 10^{-9} or less

2.11. Data port 1 shall be designated for Pan-Tilt-Zoom (PTZ) control signals (RS-422), data port 2 shall be designated for Variable Message Sign (VMS) data (RS-422), and data port 3 shall be designated for Traffic Flow Monitor (TFM) or Port Sharing device data

(RS-232).

2.12. OVDT's shall be hot-swappable, with LED status monitoring, BNC video connector, high density DB-9 data connectors, and power indicator.

2.13. Transient suppression equipment shall have no adverse effect upon the video or data transmission performance.

3. Installation and Environmental Requirements:

3.1. Optical Video/Data Transmitter:

3.1.1. The OVDT shall be configured for rack-mounting in the TMSC. Covers shall be provided for unused card slots.

3.1.2. All modules and assemblies shall be clearly identified with name, model number, serial number and any other pertinent information required to facilitate equipment maintenance.

3.1.3. All external connections shall be made by means of connectors attached to a wiring harness or cable. The connectors shall be keyed to preclude improper hookups.

3.1.4. Connectors for copper data cable shall be high density D-type connectors compatible with the video and data fiber-optic transmission equipment.

3.1.5. All wires and cables to and from the connectors shall be color-coded and/or appropriately marked.

3.1.6. Equipment shall operate from 115 VAC plus/minus 10 percent, 60 Hz power. The equipment operations shall not be adversely affected by transient voltages, voltage harmonic distortion, voltage unbalance, surges and sags normally experienced on commercial power lines.

4. Manufacturer's Qualifications:

4.1. Optical Video/Data Transmitter:

4.1.1. The Manufacturer shall have a minimum of five (5) year's experience in the design, manufacture, and testing of Video and Data Fiber Optic Transmission Equipment is required. The system shall be designed and manufactured according to world class quality standards. The manufacturer shall be ISO 9001 certified.

5. Warranty:

5.1. All equipment supplied under these items shall be warranted for parts by the vendor against defects and failures, which may occur through normal use for a period of one (1) year from the date of installation. A copy of the warranty shall be presented to the Engineer before installation of the equipment.

Construction Methods:

1. Submittals:

As part of Section 1.06 (Control of Materials) for this project, the Contractor shall submit the following documentation:

1.1. Detailed shop drawings, wiring diagrams, equipment cabinet front elevation drawings, and equipment installation drawings indicating supports and appurtenances required for proper installation.

1.2. Schematic showing wiring panel assembly including panel dimensions, locations of terminal blocks, surge suppression, transformers, cables, etc.

1.3. Product data and cut sheets, operating and maintenance manuals. Information regarding materials, finishes and accessories.

2. As-built Documentation:

2.1. As part of the project as-builts, the Contractor shall provide the following information:

2.1.1. Test procedures and test results.

2.1.2. The Contractor shall submit with the documentation for the TMSC item four (4) copies of the "as-built" equipment manuals. The equipment manuals shall include technical information, wiring diagrams and schematics, hookup prints, parts list and a troubleshooting guide.

3. Delivery, Storage, and Handling:

3.1. The Contractor shall deliver, store, handle and install all materials and equipment in such a manner as not to degrade quality, serviceability or appearance.

3.2. The Contractor shall be responsible for storage of the materials and equipment prior to installation in a clean, dry location free from construction dust, precipitation and excess moisture.

3.3. The Contractor shall be required to replace any damaged materials and equipment, as determined by the Engineer, at no additional cost to the Department.

3.4. All materials shall be delivered in the manufacturer's original unopened protective packages. All materials shall be stored in their original protective packaging and protected against soiling, physical damage, or wetting, before installation. All equipment shall be protected during transportation and until installation against damage and stains.

4. Installation:

4.1. Install the rack mounted optical video/data transmitters in the TMSC in accordance with the equipment manufacturer's recommendations.

4.2. Install and connect field fiber optic drop cable and all other inter-equipment cabling required to fully interconnect the equipment as shown on the Drawings.

4.3. Install and connect the video/data transmitter power supply to one of the existing 120 VAC receptacles reserved for communications in the cabinet.

4.4. The optical fiber path for each video link shall have been tested and verified in accordance with the plans prior to the OVDT installation.

4.5. All power cables and communication cables connected shall be neatly trained along the rail racks.

4.6. The Contractor shall neatly train all optical patch cords and pigtails together when routing them along the same path and shall neatly train them along the support rails in the camera control equipment cabinet.

4.7. No cables shall be installed with a sweep-bend radius less than the manufacturer's minimum recommended bending radius.

5. Testing:

5.1. The Contractor shall be responsible for all testing and documentation required to establish approval and acceptance of this Item.

5.2. Pre-Installation Testing:

5.2.1 The Contractor shall submit test procedures and documented test results to the Engineer. The test procedures shall document the nature of test activities to be performed.

5.2.2 The test procedures shall be submitted to the Engineer prior to initiation of the testing. The procedures will be returned to the Contractor within two (2) weeks indicating either "accepted" or "make corrections noted".

5.2.3 In the case that corrections are required, the Contractor shall submit revisions within one (1) week.

5.2.4 Four (4) copies of the final test procedures shall be submitted to the Engineer prior to commencement of testing.

5.2.5 The Contractor shall refer to the testing and documentation of the materials and equipment listed under these items to the testing and documentation for other pertinent items contained in this contract.

5.3. Proof-of-Performance Testing – The contractor shall energize each cabinet and confirm proper operation of heaters, fans, thermostats and service lights.

5.4. Installation Testing - Upon complete installation of all field equipment (including camera assemblies, TMSC, OVDT's, PSD, VMS) an operational test shall be performed

by the Contractor and demonstrated to the Engineer to verify proper installation and operation. The test shall verify the proper operation of the field equipment installation.

5.5. 30-day Operational Testing - Upon successful completion of the installation test and approval by the Engineer, a 30-day System Operational Test for each TMSC site (including OVDT and port sharing devices) shall commence. During the course of this test, the system must function continuously in accordance with the specifications for the duration of the test. If a malfunction occurs within the stated time frame, the Contractor shall make all necessary repairs to the system and re-establish proper operation. Upon approval of the Engineer, the 30-day test will begin anew. The system must operate for a full thirty (30) consecutive days without malfunction before the system will be accepted by the Engineer. The Contractor shall refer to "Notice To Contractor – 30 Day System Operational Test" for additional testing requirements. The Contractor shall coordinate the 30-day System Operational Test with other pertinent items in this contract.

Method of Measurement:

This item shall be measured for payment by the actual number of equipped Optical Video/Data Transmitter units.

Basis of Payment:

The work to be done under this item shall be paid for at the Contract unit price each for Optical Video/Data Transmitter of the type specified, which price shall include all materials, OVDT, hardware, termination panels, rack-mounted power assembly, wiring panels, surge suppression/transient protection, terminal strips, cables, connectors, tools, equipment, labor and incidentals necessary to complete this work.

Pay Item	Pay Unit
Optical Video/Data Transmitter	EA

ITEM #1108724A - PHASE SELECTOR

ITEM #1112410A - DETECTOR (TYPE A)

ITEM #1113550A - DETECTOR CABLE (OPTICAL)

SYSTEM DESCRIPTION:

The emergency vehicle traffic signal priority control system shall enable designated vehicles to remotely cause the traffic signal controller to advance to and/or hold a desired traffic signal display by using existing controller functions. The control shall be activated at a minimum distance of 1,800 feet along an unobstructed "line of sight" path. The control shall not terminate until the vehicle is within 40 feet of the detector or at the intersection.

The system shall consist of the following components:

A. Vehicle Emitter which shall be mounted on the emergency vehicle and shall transmit optical energy signals only in the forward direction.

B. Phase Selector (minimum 2 channel) which shall cause the signal controller to advance to and/or hold the desired traffic signal display for the emergency vehicle.

C. A pre-emption system chassis, which shall house two phase selectors.

D. Optical Detector which shall be mounted on or near a traffic signal and shall receive the optical energy signals generated by the Vehicle Emitter.

Detector (Type A), 1 Direction, 1 Channel

E. Detector Cable (Optical).

System Operation:

A. The operating sequence shall be initiated when the optical detector receives the required optical energy signal from the Emitter.

B. The phase selector shall cause the traffic signal controller to advance to and/or hold the desired traffic signal display for the emergency vehicle.

C. The phase selector shall cause the controller to advance to and/or hold the desired traffic signal display even if the optical energy signals cease before the desired display is obtained.

D. The phase selector shall allow the traffic signal controller to resume normal operation within ten seconds after optical energy signals cease if the optical energy signals cease after the desired traffic signal display is obtained.

E. The phase selector shall not respond to optical energy signals from an emergency vehicle if it is already processing optical energy signals from another emergency vehicle.

System Components:

A. Vehicle Emitter:

There are no vehicle emitters included in this contract.

B. Optical Detector:

The optical detector receives the high intensity optical pulses produced by the emitter. The optical detector shall recognize and be fully compatible with the type(s) of Emitters used by the municipality. These optical energy pulses are transformed by the detector into appropriate electrical signals which are transmitted to the phase selector. The optical detector is mounted at or near the intersection in a location which permits an unobstructed line of sight to vehicular approaches. The units may be mounted on signal span wires, mast arms or other appropriate structures.

1. Shall be of solid state construction.

2. Shall operate over an ambient temperature range of minus 30^{O} F. to plus 165^{O} F.

3. Shall have internal circuitry potted in a semi-flexible compound to ensure moisture resistance.

4. Shall operate in 5 to 95 % humidity.

5. Shall have a cone of detection of not more than 13 degrees. The detector and/or phase selector shall not sense a pre-emption signal from an emitter outside this cone.

C. Phase Selector:

The phase selector supplies power to and receives electrical signals from the optical detector. When detector signals are recognized as a valid call, the phase selector causes the signal controller to advance to and/or hold the desired traffic signal display. This is accomplished by activating the pre-empt input to the controller.

The phase selector is capable of assigning priority traffic movement to one of two channels on a first-come, first-serve basis. Each channel is connected to select a particular traffic movement from those normally available within the controller. Once a call is recognized, "commit to green" circuitry in the phase selector functions so that the desired green indication will be obtained even if optical communication is lost. After serving a priority traffic demand, the phase selector will release the controller to follow normal sequence operation.

1. Shall include an internal power supply to supply power to the optical detectors.

2. Shall have minimum two-channel operation with the capability of interfacing with an additional phase selector for expansion of channels of operation.

3. Shall have adjustable detector range controls for each channel of operation, from 40 feet to 1800 feet.

4. Shall have solid state indicator lights for power on and channel called.

5. Shall operate over an ambient temperature range of minus 30^{O} F. to plus 165^{O} F.

6. Shall operate in 5 to 95 % humidity.

D. Pre -Emption System Chassis:

1. Card cage/slot shall provide all the necessary hardware and harnessing required to allow simple wiring of phase selector to detector outputs and controller inputs.
2. Shall have harness to carry 115VAC and card outputs.
3. Shall include terminal block/strip for connecting the detectors.

E. Detector Cable (Optical):

1. 3-Conductor cable with shield and ground wire.
2. AWG #20 (7x28) stranded.
3. Individually tinned copper strands.
4. Conductor insulation: 600 volt, 167^{O} F.
5. 1 Conductor-yellow; 1 Conductor-blue; 1 Conductor-orange.
6. Aluminized mylar shield tape or equivalent.
7. AWG #20 (7x28) stranded uninsulated drain wire
8. DC resistance not to exceed 11.0 ohms per 1000 feet.
9. Capacitance from one conductor to other two conductors and shield not to exceed 48 pf/ft.
10. Jacket: 600 volts, 176^{O} F., minimum average wall thickness – 0.045” .
11. Finished O.D.: 0.3” max.

System Interface:

System shall be capable of operating in a computerized traffic management system when appropriate interfacing is provided by the computer supplier.

General:

The Contractor shall furnish the manufacturer the phasing diagrams indicating controller sequence and timing.

The Contractor shall secure from the manufacturer a guarantee for the equipment for a period of sixty (60) months, which time shall commence from the date of delivery. Manufacturer shall certify upon request that all materials furnished will conform to this specification. The manufacturer or his designated representative shall be responsible for determining and setting all required range and emitter intensity for the emergency vehicle operation.

Construction Methods:

All equipment except the vehicle emitter assembly shall be installed and wired in a neat and orderly manner in conformance with the manufacturers' instructions. The vehicle emitter assembly shall be delivered to a designated town representative. Installation of the vehicle emitter assembly shall be the responsibility of the town.

Traffic signals owned and maintained by the State that have optical pre-emption equipment owned and maintained by the town shall have an Auxiliary Equipment Cabinet (AEC) attached to the controller cabinet. The optical pre-emption equipment shall be housed in the AEC. Traffic signals owned and maintained by the town do not require an AEC to house the pre-emption equipment.

Detector cables shall be continuous with no splices between the optical detector and the AEC.

Detector locations shown on the plan are for illustration purposes only. Exact location shall be determined by the contractor or the designated representative for the best possible line of sight.

If not present in an existing traffic controller cabinet, the following items shall be installed and connected, in conformance with the current Functional Specifications for Traffic Control Equipment, "D" Cabinet Requirements (Pre-emption Type):

- Controller "D" harness and adapter.
- Pre-emption termination panel with terminal block and relay bases.
- Pre-emption disconnect switch, mounted on the emergency switch panel (on inside of cabinet door).
- Pre-emption test buttons, mounted on the pre-emption termination panel.

All connections from the phase selector to the "D" harness and to the cabinet wiring shall be made at the termination panel. The termination panel shall have AC+ Lights, AC-, and a switched logic ground. The switched logic ground feeds all the pre-empt inputs to the phase selector. When switched off by the pre-emption disconnect switch, the traffic controller shall not be affected by pre-empt calls from the optical pre-emption system. A minimum of two test buttons shall be provided. If there are more than two pre-empt runs, a button for each shall be installed. A chart or print out indicating the program steps and settings shall be provided along with the revised cabinet wiring diagrams.

Test the Pre-emption System at the semi-final inspection According to the following Guidelines:

1. Notify the system owner/user, such as the municipal fire chief or public works director, of the scheduled inspection

2. Request a fire department representative and an emergency vehicle, which has an emitter to conduct the test. If not available, the contractor shall provide an emitter.

3. In the presence of the Engineer and the municipal representative, test each pre-empted approach with the emergency vehicle. Test the following items of the system:

* Confirm that the emitter activates the phase selector and the phase selector activates the correct pre-emption input to the controller.

* Confirm adequate range. The traffic signal must be pre-empted to green sufficiently in advance of the emergency vehicle arrival. The vehicle emitter shall initiate pre-emption at a minimum distance of 1800 FT.

* Confirm there are no false calls. Keep the emitter active as the emergency vehicle passes through the intersection. No other optical detectors shall sense the strobe.

4. Document the test. Provide the Engineer and, upon request, the municipality copies of the test results.

   If a malfunction is found or the system needs adjustment (such as range, emitter intensity, or detector location), schedule a follow-up test. Repeat the above steps for all approaches that did not pass.

   All adjustments such as emitter intensity, phase selector range, sensitivity, detector placement, shall be made at the intersection by the contractor so that the optical pre-emption operates correctly with other major manufacturers' equipment currently owned by the town.

Method of Measurement:

Optical Detectors and Phase Selectors will be measured for payment by the number of each supplied, installed and accepted. System Chassis will not be measured for payment separately. Detector Cable (Optical) will be measured by the number of linear feet supplied, installed and accepted.

Basis of Payment:

Payment for Optical Detectors, Phase Selector and Detector Cable (Optical) will include the item unit cost, including all manufacturer's required mounting hardware and the cost of installation and supervision by the manufacturer or his designated representative, including travel and subsistence, and all materials, equipment and labor incidental thereto. Payment for termination panel, “D” harness, test buttons, program chart (or print out), revised cabinet wiring diagrams and System Chassis shall be included in the item PHASE SELECTOR.

Pay Items	Pay Units
Phase Selector	Ea.
Detector (Type A)	Ea.
Detector Cable (Optical)	L.F.

ITEM NO. 1111201A – TEMPORARY DETECTION (SITE NO. 1)

Description:

Provide a Temporary Detection (TD) system at signalized intersections throughout the duration of construction, as noted on the contract plans or directed by the Engineer. TD is intended to provide an efficient traffic-responsive operation which will reduce unused time for motorists travelling through the intersection. A TD system shall consists of all material, such as pedestrian pushbutton, conduit, handholes, cable, messenger, sawcut, loop amplifier, microwave detector, Video Image Detection System (VIDS), Self-Powered Vehicle Detector (SPVD), etc. that is needed to achieve an actuated traffic signal operation.

Materials:

Material used for TD is either owned by the Contractor that is good working condition or existing material that will be removed upon completion of the contract. Approval by the Engineer is needed prior to using existing material that will be incorporated into the permanent installation. New material that will become part of the permanent installation is not included or paid for under TD.

Construction Methods:

This item includes furnishing, installation, relocating, realigning, and maintaining the necessary detection systems as to provide vehicle detection during each phase of construction. If not shown on the plan, program the TD modes (pulse or presence) as the existing detectors or as directed by the Engineer. If the TD method (loops [saw cut or preformed], SPVD, microwave, VIDS, or other) is not shown on the contract plan it may be the Contractor's choice. The method chosen for TD must be indicated on the TD Plan submission.

The traffic signal plan-of-record, if not in the controller cabinet will be provided upon request. Ensure the controller phase mode (recall, lock, non-lock) and phase timing are correct for the TD. Adjust these settings as needed or as directed by the Engineer.

At least 30 days prior to implementation of each phase of construction submit a TD proposal to the Engineer for approval. Submit the TD proposal at the same time as the Temporary Signalization plan. Indicate the following information for each intersection approach:

- Phase Mode
- Temporary Detection Method
- Area of Detection
- Detector Mode

Submit the proposed temporary phase timing settings and the TD installation schedule with the TD proposal. See the example below.

Example Proposed Temporary Detection and Timing

Site 1

Warren, Rt. 45 at Rt. 341, Location #149-201

Approach	Phase	Phase Mode	TD Method	Area of Detection	Det Mode
Rt. 45 NB	***2***	***Min Recall***	***VIDS***	***150' from Stop Bar***	***Pulse***
Rt. 45 SB	***2***	***Min Recall***	***SPVD***	***150' from Stop Bar***	***Pulse***
Rt. 341	***4***	***Lock***	***Microwave***	***30' from Stop Bar***	***Pulse***

Temporary Phase Timing Settings:

Phase	Min	Ped	Ped Clr	Ext	Max 1	Max2	Yel	Red
2	***20***	***0***	***0***	***6***	***45***	***60***	***4***	***1***
4	***14***	***7***	***9***	***3***	***27***	***35***	***3***	***1***

Scheduled TD: ***July 4, 2011***

Site 2

Scotland, Rt. 14 at Rt. 97, Location #123-201

Approach	Phase	Phase Mode	TD Method	Area of Detection	Det Mode
Rt. 15 WB Left Turn	***1***	***Non-Lock***	***VIDS***	***5' in front to 10' Behind Stop Bar***	***Presence***
Rt. 14 EB	***2***	***Min Recall***	***Existing Loop***	***150' from Stop Bar***	***Pulse***
Rt. 14 WB	***6***	***Min Recall***	***VIDS***	***150' from Stop Bar***	***Pulse***
Rt. 97	***4***	***Lock***	***Loop, Pre-formed***	***20' from Stop Bar***	***Pulse***

Temporary Phase Timing Settings:

Phase	Min	Ped	Ped Clr	Ext	Max 1	Max2	Yel	Red
1	***5***	***0***	***0***	***2***	***12***	***18***	***3***	***0***
2 & 6	***24***	***0***	***4***	***4***	***26***	***36***	***4***	***1***
4	***14***	***7***	***9***	***3***	***27***	***35***	***3***	***1***

Scheduled TD: ***July 4, 2011***

When at any time during construction the existing vehicle detection becomes damaged, removed, or disconnected, install TD to actuate the affected approaches. Install TD sensors and make operational prior to removing existing detection. TD must be operational throughout all construction phases.

Provide to the Engineer a list of telephone numbers of personnel who will be responsible for the TD. If the TD malfunctions or is damaged, notify the Engineer and place the associated phase

on max recall. Respond to TD malfunctions by having a qualified representative at the site within three (3) hours. Restore detection to the condition prior to the malfunction within twenty-four (24) hours.

If the Engineer determines that the nature of a malfunction requires immediate attention and the Contractor does not respond within three (3) hours following the initial contact, then an alternative maintenance service will be called to restore TD. Expenses incurred by the State for alternative service will be deducted from monies due to the Contractor with a minimum deduction of $500.00 for each service call. The alternate maintenance service may be the traffic signal owner or another qualified Contractor.

TD will terminate when the detection is no longer required. This may be either when the temporary signal is taken out of service or when the permanent detectors are in place and fully operational.

Any material and equipment supplied by the Contractor specifically for TD will remain the Contractor's property. Existing material not designated as scrap or salvage will become the property of the Contractor. Return and deliver to the owner all existing equipment used as TD that is removed and designated as salvage.

Method of Measurement:

Temporary Detection is measured as a percentage of the contract Lump Sum price. Fifty percent (50%) shall be paid when Temporary Detection is initially set up, approved, and becomes fully operational. Fifty percent (50%) shall be paid when Temporary Detection terminates and all temporary equipment is removed to the satisfaction of the Engineer.

Basis of Payment:

This work will be paid at the contract Lump Sum price for "Temporary Detection (Site No.)". The price includes furnishing, installing, relocating, realigning, and maintaining the necessary detection systems and all incidental material, labor, tools, and equipment. This price also includes any detector mode setting changes, timing or program modifications to the controller that are associated with TD. All Contractor supplied material that will remain the Contractor's property will be included in the contract Lump Sum price for "Temporary Detection (Site No.)." Any items installed for TD that will become part of the permanent installation will not be paid for under this item but are paid for under the bid item for that work.

Pay Item	Pay Unit
Temporary Detection (Site No. X)	L.S.

ITEM 1111407A – CAMERA VIDEO DETECTION SYSTEM

Description: The work under this item shall consist of furnishing and installing Camera Video Detection System of type as shown on the plans or as directed and in accordance with these specifications:

Required Submittals

Shop Drawings:

Submit 3 copies of shop drawings for the Camera Video Detection System and all hardware accessories in accordance with these specifications and the contract general requirements.

Materials: All items and materials furnished shall be new, unused, current production models installed and operational in a user environment and shall be items currently in distribution.

The video vehicle detection system shall be the latest version of GridSmart Detection system as manufactured by Aldis Corp.

This system shall include the following equipment:

- The detection system components shall include all the components to make the detection system operate and support the field conditions. The main components of the system shall include one Dual Camera Processor unit, two Camera Domes, two Flir cameras from Aldis to detect vehicles travelling under the bridges, all input/output cables, Two Candy Cane and self-leveling brackets and other miscellaneous hardware to complete the installation.
- GridSmart Vehicle and Pedestrian Data collection modules.
- Gridsmart Realtime Data Module.
- Gridsmart Auto Reports and Alerts Module.
- Each of the candy cane bracket shall be supplied with 2 Pelco Triton brackets with cable mounts.
- An outdoor rated TFT-LCD display unit with VGA connector, VGA cable, a shelf mount stand, and power supply.
- A Linksys wireless Router for NEMA cabinet use and a USB mouse and a keyboard.

Warranty and Training:

All the components shall be warranted for ***three (3) years from the date of final acceptance*** and all the software (including detection, pedestrian data collection, Turning Movement data collection) shall be upgraded for 3 years at no additional cost to the City.

The camera video detection system shall be warranted against manufacturing defects in materials and workmanship. It shall also be warranted for any manufacturer's hardware upgrades during this period irrespective of the functionality during this period. A written warranty shall be provided by the vendor for repair and/or replacement of all the components in this item. The

camera video detection supplier shall provide all documentation necessary to maintain and operate the system.

Construction Methods: The product manufacturer or supplier of the camera video detection system shall supervise the installation and the testing of the video equipment. The contractor shall install, make fully operational, and test the camera video detection system to operate the intersection drawings and this specification. The detection equipment shall be installed either in an existing or in a new controller cabinet. In TS1 cabinets the processor unit shall be wired to receive all the required inputs and outputs. All the equipment shall be wired in the cabinet in a neat manner.

The camera position should be carefully adjusted to accommodate the field conditions such as any existing utility lines and other hardware blocking the view or any sun or lighting related issues. The camera mounting location and position shall accommodate error free detection under all lighting conditions. When required based on the intersection geometry, sun shade due to buildings, any trees or items blocking the view of one of the approaches the second camera installation may be needed and will be decided at the time of installation by the Engineer. Any unused components shall be returned to the City in original boxes.

Method of Measurement: The quantity to be paid for under this item will be the number of completed, installed and accepted Camera Video Detection Systems of the type specified. Each of the systems shall include all the listed components, cables, and connectors.

Basis of Payment: This work will be paid for at the contract unit price each for "Camera Video Detection System" of the type specified, which price shall include all materials, connectors, cables, tools, labor, training and work incidental thereto.

Pay Item	Pay Unit
Camera Video Detection System	EA

ITEM 1112210A - CAMERA ASSEMBLY

DESCRIPTION:

The "camera assembly" item shall consist of furnishing and installing an outdoor dome assembly with integral CCTV color camera and motorized lens, receiver/driver (if required), local camera control at the TMSC appropriate interconnect wiring, at the locations shown on the plans. The equipment to be provided shall include any ancillary or incidental items including any code-translators, code-distributors, data converter units, camera controller units, cables, connectors and power supplies required at each video switcher site or camera location to make a complete and fully operating video surveillance system.

MATERIALS:

Manufacturer Requirements:

The Contractor shall ensure that all camera features, functions and performance specified herein are supported by the Vicon VPS-1300 video switcher system and Vicon V1411J-DVC keyboard without loss of features, functions, performance and response time.

The Camera Assembly shall be Vicon Industries Model No. SVFT-PRS35 or latest Vicon Model approved by the Engineer.

Note: Due to the market changes in the CCTV industry, the Contractor should contact the Department to verify manufacturer qualifications.

The pressurized enclosure shall be manufactured by the camera manufacturer or approved by the camera manufacturer for use with the camera.

Demonstration/Evaluation:

The Contractor, as part of this item, shall furnish and install a sample camera assembly for ConnDOT review and approval. The demonstration camera assembly shall undergo testing for the purpose of testing programmable functions and compatibility with the Vicon switcher. The demonstration unit shall be delivered to ConnDOT after the Engineer has reviewed the camera assembly shop drawings and indicated acceptance for delivery of the demonstration unit. Approval of the Camera Assembly item is contingent on acceptance of the demonstration camera.

The demonstration camera shall be a standard item from the manufacturer's catalog – experimental or "prototype" equipment will not be allowed. The demonstration unit shall consist of the camera assembly, dome enclosure, local camera controller, code translators/converters, junction box, documentation and all control cables and connectors required for testing specification compliance. All equipment shall be delivered to Mr. Robert Kennedy (860-594-3458) at the DOT Highway Operations Center in Newington, CT. The

Contractor shall coordinate the setup of the demonstration unit at an existing Camera Lowering Device location with Mr. Kennedy and provide a minimum of two (2) hours of on-site training on camera operation.

The Engineer shall have 30 days from the date of delivery for evaluation. Failure of the demonstration unit to meet the specifications will result in rejection of the camera assembly shop drawing. The Contractor shall not order camera assembly equipment until the evaluation is completed and shop drawings have been approved. Upon completion of the evaluation process, the Contractor shall make arrangements with Mr. Campbell for removal of the demonstration unit**.**

Camera Assembly

1.1 The motorized dome shall have internal CPU-circuitry and provision for external programming via standard RS-422/485 protocol. This circuitry shall provide for an external power supply input, four alarm inputs, one relay output and communications wiring.

1.1 Alarm inputs shall be individually programmable for their functional state (enabled or disabled), reporting state (report on or off), active state (high or low), acknowledge mode (manual, momentary or automatic), automatic acknowledge dwell time control, set and reset action (action when triggered or reset) and displayed title text. The relay output shall be programmable for its power-on state (on or off), output type (momentary or latching) and displayed title text.

1.2 Programmable titling shall be provided for the camera and every preset position, alarm, relay, and sector. Titles shall be enabled or disabled individually or globally. The overall position of the titles and display frame position shall be programmable. The capability to fade titles after a programmable time shall be provided.

1.3 There shall be 79 programmable preset positions available, each having a variable preset solve speed of 1 sec (nominal) and accuracy of 0.1°. The dome's 360 degree view shall be programmable for a maximum of 16 sectors. Each sector shall have the capability to be blanked out (no video display). The number and size of sectors shall be programmable and have a custom title.

1.4 There shall be eight tours available with 32 steps per tour. Tour steps shall include preset positions with speed control, relay control, alarm acknowledge, save/recall camera status, repeat tour, call another tour, call an autotour and dwell timing control. There shall be two autotours available with 256 pan, tilt and zoom functions per autotour. Timing shall be dynamic or as is actually programmed with the joystick and push buttons.

1.6 Pan and tilt functions shall be externally controlled, continuously variable and programmable to be enabled or disabled manual pan limits shall be

programmable. There shall be an autopan feature and it shall be programmable for its functional settings (enabled, disabled speed, limits). Maximum manual pan and tilt speeds shall be programmable. Maximum pan speed shall be 360 degrees/sec and maximum tilt speed shall be 150 degrees/sec. Pan and tilt speeds shall also be scalable to the zoom setting. The zoom function speed shall be externally controlled using three settings, low, medium and high.

1.7 The camera-lens module shall be a 1/4 inch, high-resolution color type. Camera sensitivity at 40 IRE, f/1.6 shall be 0.005 fc (0.05 lux) sensitivity (auto ½ s, IR on). The lens on the camera shall have a maximum optical zoom setting of 35X day/night and a maximum digital zoom setting of 12X for a total zoom setting of 420. Lens focal length shall be 3.4-119 mm for the 35X day/night cameras with a maximum aperture of f/1.4. The digital zoom shall be programmable for its functional setting (enable/disable). An autoiris function with a manual override feature and an auto-focus function with functional setting control (enable/disable) shall also be provided. The 35X cameras shall feature wide dynamic range to provide the highest quality image with excellent contrast. Additionally, the 35X shall offer image stabilization.

1.8 The camera shall provide high level, programmable functions. The autoiris and AGC shall be adjustable. The shutter speed shall be automatic or manual. The automatic shutter speed shall work with an auto exposure feature. This feature can be set to operate with a fully automatic shutter speed or a fixed, selectable, linear speed. These features are called exposure priority or shutter priority. All color cameras shall have white balance gain using red and blue scales. Backlight compensation shall be programmable for its relative setting using a tuning value scale. Video line locking shall be provided with an internal crystal clock or a programmable vertical phase scale.

1.9 The housing shall be mounted using a 1-1/2 inch NPT threaded fitting.

1.10 A real time clock and scheduler shall be available on all models. Up to 64 events shall be able to be scheduled for action at a programmed time of day. Events that may be scheduled include a preset, turning a relay on or off, enabling or disabling an alarm, and calling a tour or an autotour.

1.11 16 individual zoom-scalable programmable privacy masks shall be available.

1.12 Programmable azimuth and compass display shall be available on 35X models. The compass shall be programmed for absolute North and shall display 8 compass headings (N, NE, E, SE, S, SW, W, NW). Pan and tilt degrees shall be displayed with a 1° resolution.

1.14 The capability to flip (invert) the video image shall be available on the day/night cameras. This feature is useful when mounting units in an inverted position. All pan/tilt and compass displays are automatically adjusted for the inverted image.

Auto Baud detection shall be provided on all models operating in RS-422/RS-485 communication mode. Baud rates supported shall be 4800, 9600 and 19,200 bps. All units shall have automatic detection and correction of the receive polarity (commands into the dome). The polarity of the transmit signals (responses from the dome) shall be programmable.

1.15 Absolute position control shall be provided on all models operating in RS-422/RS-485 communication mode. Pan and tilt direct control resolution shall be to 0.125 degrees and zoom direct control resolution shall be 0.125X magnitude. The capability to adjust the target iris level shall be provided using the absolute position control feature.

1.16 All models shall support interfacing to selected competitors' control systems without the need for optional internal or external translator modules. Selection of available competitors' protocols shall be provided via DIP switch settings on the unit.

1.17 The day/night camera shall be NTCIP 1103 compliant. (National Transportation Communications for ITS Protocol).

1.18 Multilanguage menu system shall be provided, including English, Spanish, French and Italian.

Camera Assembly Performance Requirements

2.1 The equipment supplied as part of this item, including dome enclosure and internal assembly, shall meet the following performance requirements:

- Minimum ambient temperature range of -29 to +165 degrees F (-34 to +74 degrees C) .
- Relative humidity of 0 to 90 percent, non-condensing.
- Minimum protection against 120 mph (193 Km/hour) sustained winds

2.2 The operation of CCTV equipment dome type shall not be affected by transient voltages, surges, and sags normally experienced on commercial power lines. CCTV field hardware and related electronic components shall not be adversely affected by wind driven rain, salt in the air or ice buildup.

Camera Assembly Items

3.1 An integral Solid State Digital (DSP6) color camera sensor shall be furnished as part of each camera assembly. **The camera shall be capable of auto - sensor/manual selection of black and white and color operational modes through the same camera lens.** The camera shall be capable of selecting the color or black and white mode by removing the Infra Red filter based on the ambient light (lux) level setting. The removal of the IR filter shall be repeatable. The automatic mode shall be controlled by a light sensor located within the dome assembly. The automatic sensor control shall have a built in delay for switching the IR filter to prevent "toggle" under false conditions. The sensor shall automatically switch the IR filter when the ambient light level falls below 1.0 lux or 0.5 lux. The camera shall also have backlight compensation control.

3.2 The camera shall be capable of automatically reestablishing video and data communications upon the restoration of communications or power to the cameras. The maximum lux level requirements shall be considered using a resulting image on the video monitors at the Department's Operations Center. The cameras shall meet or exceed the following requirements:

Note: Due to the market changes in the CCTV industry, the Contractor should contact the Department to verify camera features and performance.

Camera

• Color System	NTSC Standard
• Image Sensor	¼", blemish free, interline transfer, CCD color image sensor, B/W selectable by removal of IR filter
• Scan	NTSC; 2:1 interlace, 525 lines 60 fields/sec.
• Resolution - Color	540 TV lines horizontal

Lens

• Focal Length	3.4 to 119 mm, 35x optical zoom with 12x digital zoom
• Aperture	f / 1.4
• Field of View (H)	55.8 degrees, 1.7 degrees tele
• Focus	Automatic, with user adjustable Manual override
• Iris	automatic and manual control, with automatic power-down closure

Features

• Shutter Control	On/Off Control with minimum six selectable positions (manual and/or auto)
• Presets	79
• Preset speed	1 second nominal

• Area/Zones/Boundaries	16
• Blankout/Privacy Zones	16
• On Screen Text	translucent white or approved other color, min. 16-character alphanumeric titling
• Password Protection	user programmable, min 3 characters
• Line Lock	On/off control
• White Balance	On/Off or Automatic through-the-lens or manually controlled by the operator.
• Overexposure Protection	The camera shall have built-in circuitry to signal the lens to appropriately adjust the iris opening to prevent any damage to the camera when pointed directly at strong light sources, including the sun.

Electrical

• Signal-to-Noise Ratio	50 dB typical
• Video Output	1 Volt p-p, 75 Ohms impedance, BNC connector
• Power	24 VAC power supplied from the input panel in control cabinet; 25 watts maximum; frequency of 50 or 60 Hz
• Surge Protection	Manufacturer provided or recommended lightening protection provided for video, power and data lines
• Data Format	RS-422, or RS-485, Data and video shall utilize separate cables

Mechanical

• Housing Diameter	9.5 in. (241 mm)
• Dome Diameter	6.0 in. (152 mm)
• Housing Height	7.3 in. (185 mm)
• Total Height	10.2 in. (259 mm)
• Weight	12.0 lb. (5.4 kg)
• Construction	Plastic, cast aluminum: trim ring, cast zinc/aluminum.
• Color	White housing and sunshield; black trim ring.

Pan – Tilt Drive

• Pan-Tilt Drive	Internal, powered by DC servo motors or AC micro stepping motors or drive system approved by the Engineer

• Pan travel	continuous 360 degrees with sealed slip ring design
• Tilt travel	>90 degrees
• Tilt range	90 degrees down from horizontal with automatic flip near vertical vertex
• Speed	Manual - minimum 1 to 60 degrees/second Target - >280 degrees/second

Electrical (dome enclosure)

• Voltage	18 - 30 VAC,: 24VAC nominal 50/60Hz
• Power Consumption	44 Watts
• Surge Protection	Manufacturer-provided or recommended lightening protection provided for video, power and data lines.

Camera Assembly Pressurized Dome Enclosure

4.1 The pressurized dome shall be an alternate mounting configuration for a camera dome. It shall be a completely self-enclosed, sealed housing in a pressurized dry nitrogen gas environment. It shall be IP67 rated and provide an ideal climate for the camera dome with respect to temperature, humidity and water and dust ingress.

4.2 The housing shall be constructed of lightweight aluminum with a UV resistant polyethylene plastic exterior and provide a lower dome constructed from distortion-free clear impact-resistant polycarbonate.

4.3 The housing shall have two (2) mounting configurations, wall mount and 1-1/2 inch NPT schedule 40 pipe thread mount. The trim ring/lower dome assembly shall be attached to the housing with a safety cord.

4.4 The pressurized housing shall use a Schraeder type valve to ensure its seal. There shall be a compressed O-ring in the trim ring to assure the seal. The enclosure shall be backfilled with dry nitrogen gas to 5 psi nominal. A relief valve shall provide gas release at 5 - 7 psi and a normally closed (NC) low-pressure switch shall close when the pressure falls to 1 psi nominal. The scheme shall meet a leak rate not to exceed 2.0 psi per year. This scheme shall also meet standard IP67 for full protection of components due to water ingress. The pressurized dome shall utilize a 23-pin pressure-rated connector to bring all signals from the interior to the exterior including power, video, communication, alarms and relays.

4.5 The pressurized dome shall provide electrical surge protection. Surge protection shall be provided on the video and power connector.

4.6 The pressurized housing shall be 10.2 inches (259 mm) high and 9.5 inches (241 mm) in diameter. It shall weigh 7.5 lb (3.4 kg) and 12.0 lb (5.4 kg) with the camera dome installed.

Local Camera Controller

1.1 Means shall be provided to perform all camera control functions locally within the field equipment cabinet for each dome camera. Activation of local camera control shall disable remote camera control. The Contractor shall provide one of the following methods of implementing local camera control:

- A special purpose, 48 cm (19") EIA, rack-mounted panel within the traffic controller cabinet. A separate switch control shall be provided for each control receiver within the cabinet.
- An AC-powered local camera controller unit Vicon Model No. V1411J-DVC keyboard that can be plugged into the data cable of the input panel within the traffic management system/mini-hub cabinet. The controller shall be disconnected from the junction box and interface wiring when not in use. A minimum of one (1) camera controller shall be provided to the Engineer in new and working condition for each ten (10) or less "camera" assemblies.

Camera Cable Assemblies

1.2 The Contractor shall furnish and install all cable and connectors, and make all connections between equipment as required to provide the specified operation. A camera cable assembly shall consist of a camera control cable carrying power for the camera and control lines for the lens and pan-tilt operations, and a video cable that carries the video signal generated by the camera. Specifications of all cable assemblies, including connectors, shall be submitted to the Engineer as part of the shop drawings for review and approval.

6.2 The Contractor shall supply and install interconnection wiring between the camera assembly/lowering device assembly and the equipment installed at the termination point in the Traffic Management System Cabinet or Mini-Hub Cabinet.

6.3 The Contractor shall supply and install interconnection wiring between the camera assembly and the wiring panel assembly installed in the Traffic Management System Cabinet or Mini-Hub Cabinet. The twisted pair cable shall be Belden Part Number 9733 or approved equal. The twisted pair cable shall be an eleven- (11) pair 7x32 stranded conductor. The conductor shall be a 24 AWG with the wires made of TC – Tinned Copper. The insulation shall be Foam Polyethylene with an insulator diameter of 0.061 in. The cable shall meet operating temperature of –20 C to + 80 C with a maximum pulling tension of 180lbs. and a min. bending radius of 5.75 in. The cable shall meet NEC/UL CM, with UL flame test UL 1685 UL Loading

6.4 The coax cable shall be Belden Part Number 7915A or approved equal. The conductor shall be a Series 6 conductor with a solid stranding. The cable shall be

18 AWG with the conductor material being made of BC – Bare Copper. The conductor diameter shall be 0.040 in. The insulation shall be a gas injected Foam Polyethylene with an insulator diameter of 0.180 in. The outer shield shall be Duobond Plus™). The outer shield type shall be Tape/Braid/Tape. The tape shall be bonded aluminum foil-polyester tape – aluminum foil. The braid shall be aluminum. The tape shall cover 100% of the cable. The braid shall cover 77% of the cable. The outer jacket material shall be PVC – polyvinyl chloride. The overall nominal diameter shall be 0.275 in. The cable shall meet operating temperature of –40 C to + 80 C with a maximum pulling tension of 91lbs. with a min. bending radius of 5.75 in. The cable shall meet NEC/UL CM, with UL flame test UL 1685 UL Loading.

6.5 All wiring shall conform to the camera assembly manufacturer's requirements. All DC logic control conductors shall be shielded from conductors carrying AC power to prevent electrical noise from interfering with control. The interconnect wiring shall be protected with surge suppression.

Spare Equipment

1.1 A minimum of one spare camera assembly shall be included for every ten (10) camera assemblies provided. For example: If 7 cameras are installed, one (1) spare is provided. If 11 cameras are installed, two (2) spares are provided, etc.

1.2 The spare camera assembly shall be the same manufacturer and model provided for the camera assemblies installed on the poles.

1.3 The spare camera assembly shall include all necessary materials including but not limited to camera, enclosure, code converters, cables, etc. to replace any camera assembly requiring service.

1.4 The Contractor is allowed to use the spare camera assembly to replace defective camera assemblies during the equipment operations period. The Contractor shall replace the defective camera assembly at no additional cost to the Department.

1.5 The Contractor shall provide to the Department a properly operating spare camera assembly at the end of the equipment operations item.

CONSTRUCTION METHODS:

1.0 Camera Assembly

1.1 All assemblies, including camera, lens, pan-tilt unit, enclosures and receiver/drivers, shall be assembled and factory tested prior to delivery to the job site.

1.2 The assemblies shall be delivered to the job site as complete units, and installed on new poles or mount as shown on the plans or as directed by the Engineer. Assemblies shall be mounted directly to the lowering device, supporting bracket attached to the steel span pole or mount as indicated on the plans or as Directed by the Engineer. The camera assembly shall be mounted in such a way that all designated areas are available for viewing by operating the pan, tilt and zoom functions.

1.3 The Contractor shall design the required mounting adapters and hardware required to attach the camera assembly to the supporting bracket. Pole-mounted adapters shall be electrically bonded to the support bracket and pole. Camera assemblies shall be electrically bonded to the mounting adapter.

1.4 The Contractor shall fill the enclosure with nitrogen gas as per the manufacturer's recommendation.

1.5 The Contractor shall pay particular attention to protection of the camera assembly dome enclosure glass face during installation. It is important that any clear surfaces not be scratched or marred. If any damage is observed by the Engineer, the Contractor will be required to replace the affected equipment at no cost to the State.

1.6 The Contractor shall clean all equipment during installation as required by the manufacturer. This is especially important for clear surfaces which must be free of any static electricity that can attract dust. The Contractor shall coat the exterior side of any clear surfaces with a water-resistant chemical, if use of such chemical is approved by the manufacturer.

1.7 All programming for all camera assemblies shall be conducted by an Integrator that is certified by the camera manufacturer**.** The Contractor shall submit certified integrator qualifications, including contact names and previous experience, to the Engineer as part of the catalog cut submittal.

1.8 The Integrator shall program each camera to fully utilize the capabilities of all programmable features to the satisfaction of the Engineer, including night time and other varying light conditions. The Integrator shall be responsible for coordinating the integration dates and times with the Engineer. The Integrator shall demonstrate to the Engineer that all programming features are included as specified.

1.9 The Contractor shall complete all camera programming at least two working days after the successful establishment of video and data communications between the camera site and the DOT Bridgeport Operations Center. The

Contractor/Integrator shall contact Mr. Scott Campbell at (2033) 696-2681 or (860) 594-3441 to coordinate the completion of all programmable features. Upon completion of the program features, the Contractor/Integrator shall record the program settings for each camera assembly and submit two copies to the Engineer for review and approval.

2.0 Local Camera Controller Installation

3.1 If a shelf-mounted local camera controller is used, the Contractor shall install the controller in the traffic cabinet and furnish and install all necessary cables to interface the camera controller with the junction box, video camera output signal and power source.

3.2 If a manufacturer's keyboard is used for local camera control, the Contractor shall be responsible for purchasing a keyboard that is utilized for programming and configuring camera operation. Use of the keyboards provided as part of this contract item will not be allowed.

3.3 The Contractor is responsible for the purchase and supply of a video monitor and any other equipment required for on-site programming and configuration.

Camera Cable Assembly Installation

4.1 The Contractor shall supply and install all required interface cables between the camera assembly, junction box, local camera controller and the power source. All cables shall be routed between the camera assembly via the inside of the camera pole or in a conduit. A ground wire shall be provided between the camera assembly and the traffic controller cabinet.

4.2 Wiring shall run continuous from source to destination. No splices will be allowed. Coaxial cables shall be installed without damaging the connectors, insulation or jacket. The coaxial cables shall not be kinked or bent tighter than the manufacturer's recommended bending radius. Sufficient slack cable shall be provided for equipment movement. All cabling shall be secured with tie-wraps and protected from physical damage. All interconnecting wiring and connectors shall meet all necessary standards with regard to voltage, current and environmental ratings. All electrical cable shall meet the requirements of the National Electrical Code.

3.0 Camera Assembly Tests

3.1 The Contractor shall be responsible for the provision of all testing and documentation required to obtain approval and acceptance of the production,

installation and operation of these materials, equipment and the overall system. The Contractor shall test each camera assembly as shown on the plans as described herein or as directed by the Engineer.

3.2 The Contractor shall test all cables for continuity, short circuits or grounds. Tests on cables with connectors attached (connectorized) shall be performed after installation. The Contractor shall perform system integration testing to ensure that the video interface and camera interconnect wiring functions properly and complies with all relevant standards when used in operation with all other devices installed under this contract or the procurement contract.

- Verification of installation of specified cables and connections between camera assembly and the traffic controller cabinet.
- Local operation of all CCTV equipment, exercising the pan, tilt, zoom, focus, iris opening, shutter control, power on/off and all other functions described herein this specification while observing the video picture on a portable monitor.
- Demonstration of camera sensitivity at low light levels to meet the specified requirements.
- Demonstration of pan/tilt speed and extent of movement to meet the specified requirements.
- Measurement of video signal level at the field equipment cabinet with VM700 video testing equipment.
- Verify that video output from the camera is a 1-volt peak-to-peak, composite NRSC signal.
- Random test of at least two installed camera to verify camera enclosure environmental resistance.
- Preset test to ensure camera consistently goes to the proper preset position.

3.3 Whenever any unit of equipment fails to pass the assembly tests, the Contractor shall correct the deficiencies, either by repair or replacement, at his expense (including freight costs) as required to comply with the testing requirements. Upon notification by the Contractor that the deficiencies have been corrected, the equipment shall be re-tested. All camera assembly testing and any re-testing shall be performed in the presence of the Engineer or his designated representative. The Contractor shall provide all test results to the Engineer in writing seven working days after the completion of each individual camera assembly test.

Factory Tests

3.4 All camera equipment furnished by the Contractor shall be tested and subjected to a nominal 72-hour burn-in period at the factory. The factory tests shall be in accordance with the manufacturer's standard procedures and quality assurance program.

3.5 The Contractor shall provide the Engineer with a copy of the manufacturer's test procedures and quality assurance procedures for information. If the Engineer determines that these procedures are not adequate, the Engineer may require that the Contractor conduct additional tests prior to installation. The Contractor shall provide documentation certifying and showing that each item supplied has passed factory inspection, burn-in and testing.

Central Control Tests

3.6 The central control tests shall demonstrate that all equipment furnished by the Contractor has been installed properly and operates as a fully functional CCTV surveillance system using the existing ConnDOT video camera control system. Prior to initiating the central control tests, all camera assembly tests specified in (a) herein shall have been successfully conducted by the Contractor in the presence of the Engineer or his designated representative.

3.7 In the event that any Contractor-provided component of the CCTV surveillance system malfunctions or operates below the level specified, the Contractor shall be required to determine and correct the problems, including repair or replacement of equipment, at no cost to the Department. The Contractor shall respond with a qualified technical representative on site to determine and correct any problems within 24 hours following notification by the Engineer. The central control tests shall resume upon correction of the problem. In the event a malfunction is the result of equipment not installed by the Contractor (e.g., power service, etc.), the central control tests will be suspended until these problems are corrected by others.

Daytime Tests

3.8 All central control and monitoring equipment shall be tested from the ConnDOT Highway Operations Center facility during daytime hours. The Contractor shall contact Mr. Robert Kennedy (860-594-3458) to arrange and coordinate the testing procedure. The tests shall include, but not be limited to the following:

- Operation of all newly installed camera assemblies from the central controller, exercising the pan, tilt, zoom, focus, presets, iris opening and all other functions and features described herein this specification while observing the video picture on the local monitor.

- Display of each camera on a designated video monitor to verify proper operation and picture quality from each camera.

3.9 The Contractor shall correct any operational problems encountered with the video camera system during this test.

Nighttime Tests

3.10 A second central control test shall be performed during the hours of darkness to verify proper operation of the auto iris lenses, shutter control and the absence of video signal noise. This test shall be conducted in the presence of the Engineer or his designated representative at the Highway Operations Center. The test shall include the following as a minimum:

- Operation of all newly installed camera assemblies from the central controller, exercising the pan, tilt, zoom, focus, presets, iris opening and shutter control functions while observing the video picture on the local monitor.

- Display of each camera on a designated video monitor to observe both the brightest and darkest scenes available from each camera location.

3.11 The Contractor shall correct any operational problems encountered with the video camera system during this test.

4.0 Additional Tests

4.1 The Contractor shall refer to Notice To Contractor – 30 Day System Operational Test for additional testing requirements.

METHOD OF MEASUREMENT:

The work to be measured for payment under this item shall be the number of Camera Assemblies of the type specified, installed, completed, tested and accepted.

BASIS OF PAYMENT:

This work shall be paid for at the contract unit price for each "Camera Assembly" of the type specified, which price shall include all equipment including camera, lens, code distributors-translators-converters, dome pan-tilt mechanism, enclosures, receiver/drivers, local camera controller, interconnect wiring, mountings, cabling and connectors, testing, and all labor, materials, tools, equipment, transportation, storage and other incidentals necessary to complete the work.

Pay Item	Pay Unit
Camera Assembly	EA.

ITEM # 1112214A - IP VIDEO CAMERA ASSEMBLY

DESCRIPTION:

The Video camera assembly shall consist of environmental outdoor pendant dome with heater/blower, and a 32X low light day/night camera with a clear bottom dome.

MATERIALS:

Camera Assembly

Axis IP Camera Dome Model No.	Q6045-E MkII/Q6000E
Axis Weatherized Dome with Mounting Plate	25733
Axis Goose neck Wall Mount Bracket	25736
Axis Pole Mount Adaptor	21896
Axis Pendant Kit for Q6045-E	5502-431

Construction Methods:

The camera shall be installed as per manufacturer's specifications. The contractor shall install the Power supply in the pole mounted video cabinet or in the traffic signal controller cabinet and complete the network cable connections to the camera.

Method of Measurement:

This item will be measured for payment by the number of camera domes installed and accepted.

Basis of Payment:

Payment for IP Video Camera Assembly shall include all the materials, including all manufacturers' required mounting hardware, cost of installation, and all materials, power supply, all cables, equipment and labor incidental thereto.

Pay Items	Pay Units
IP Video Camera Assembly	EA.

ITEM 1112217A – CAMERA LOWERING DEVICE ASSEMBLY TYPE B

Description:

Work under this item shall consist of furnishing and installing a camera lowering system on a steel pole of the height specified on the plans. The camera lowering device and camera pole shall be fabricated in accordance with the details shown on the plans, in accordance with these specifications and as ordered by the Engineer and shall be mounted on a prepared foundation.

Materials:

The camera lowering system shall be designed to support and lower a standard closed circuit television camera, lens, housing, PTZ mechanism, cabling, connectors and other supporting field components without damage or causing degradation of camera operations. The lowering system shall consist of a 70' (21m) camera pole, suspension contact unit, divided support arm, and a pole adapter for attachment to a pole top tenon, conduit mount adapter, pole top junction box, and camera connection box. **The construction of the camera lowering device shall be the [MG]² Model CLDMG2-HYP**

CAMERA POLE

The pole may be round or may have 16 or more sides. It shall be of the diameter specified on the plans. If a multi-sided pole is chosen, the distance between outside faces of parallel sides shall be the same dimension as the specified outside diameter of the round pole. Both shall be tapered from top to bottom as shown on the plans.

The pole, base plate, top plate, tenon, tenon plate and handhole frames and covers shall be made of steel with minimum yield strength of 36,000 psi. All steel pole sections shall be of the same grade. The yield strengths of the plates welded to the pole at the top and bottom may be different than the yield strength of the pole.

The pole and base plate are considered fracture critical and should be noted as such on the fabrication drawings.

Charpy V-notch sampling is required for the pole and base plate regardless of material thickness. The testing shall conform to AASHTO T 266 (ASTM E23). The minimum energy absorbed shall be as follows:

- 25 ft-lb at -30 degrees F for steel with a specified yield strength of 50 ksi and lower
- 35 ft-lb at -30 degrees F for steel with a specified yield strength greater than 50 ksi

High strength bolts shall conform to ASTM A325, Type 1. Nuts shall conform to ASTM A563-DH, zinc coated or ASTM A194, Grade 2H, zinc coated as specified in ASTM A325. Washers shall conform to ASTM F436, zinc coated. Compressible washer-type direct tension indicators may be used and shall conform to ASTM F959 Type 325.

Stainless steel bolts shall conform to ASTM A193, series 300.

Chain for connecting the handhole cover to the handhole shall be stainless steel of sufficient strength to support the weight of the cover.

Where "Silicone Joint Sealant" is specified on the plans, a primer will also be required for proper adhesion of the joint sealant to the steel. The following Primer and Silicone Joint Sealant or approved equals shall be used:

> Dow Corning 1200 Prime Coat and Dow Corning 790 Silicone Building Sealant, manufactured by the Dow Corning Corporation, Midland, Michigan 48686-0994.

All steel components shall be completely hot-dip galvanized, after fabrication, in accordance with AASHTO M111 (ASTM A123) and AASHTO M232 (ASTM A153) as applicable.

Mechanical galvanizing of bolts shall conform to ASTM B695, Class 50.

Zinc-rich field primer for touch up shall conform to the requirements of ASTM A780. The use of aerosol spray cans will not be permitted. The color of the primer shall match the color of the galvanized surface as nearly as possible. Areas that do not match shall be recoated with the correct color primer at no additional expense to the State. Aluminum paint will not be allowed.

Closed cell elastomer for sealing handhole covers and for sealing the space between the foundation and base plate shall conform to ASTM D1056, Grade 2A2 or 2A3 and shall have a pressure-sensitive adhesive backing on one side for adhesion to steel. Closed cell elastomer contained within the anchor bolt pattern shall not interfere with the anchor rod leveling nuts and shall not block the opening in the base plate.

Certified test reports and Material Certificates will be required in accordance with Article 1.03.07 for hot-dip galvanizing to specify galvanizing has been tested and performed in accordance with AASHTO M111 (ASTM A123). Certified test reports and Material Certificates will be required for all structural steel components.

Tenon Design Requirements:

The Contractor is responsible for the design and details of the tenon and tenon plate at the top of the camera pole, the connection of the tenon plate to the pole top plate and all connections and openings required to attach and operate the lowering device. He shall coordinate the design of the tenon and tenon plate with Section - 2 Camera Lowering Device Assembly, of this specification. Dimensions and details shown on the plans are for the purpose of establishing a detailing concept for the connection of the tenon plate to the pole.

The design and fabrication of the tenon and tenon plate, shall conform to the requirements of AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals – 2001 (Fourth Edition), including the latest interim specifications. The Contractor shall incorporate the following information into the design:

- The design wind speed shall be 120 mph. The computation of wind pressures in accordance with Appendix C is not permitted.
- The minimum design life shall be 50 years.
- The structure shall be designed for fatigue category I and for the wind load effects due to natural wind gusts. Vibration mitigation devices are not permitted.
- The minimum thickness of the pole tenon shall be ¼".
- The minimum thickness of the tenon plate shall be 3/8".

Shop Drawings:
Prior to fabrication, the Contractor shall submit shop drawings to the Engineer for review in accordance with Article 1.05.02. Drawings shall be submitted for each camera pole to be installed. **Data for multiple sites may not be presented in a table and submitted along with "typical" details.** An identifier for each pole is noted on Site Plans or Location Plans and shall be used to identify each set of drawings and computations.

Shop drawings shall be submitted on 11" x 17" (Ledger/Tabloid) sheets with an appropriate border and title block. Procedures and other supporting data shall be submitted on 8 ½" x 11" (Letter) sheets. Electronic submissions of portable document files (.pdf) are acceptable.

Deviations from any criteria noted on the plans or in this specification will not be considered for approval unless a request for change is submitted in writing to the District Engineer. Requests for change should be submitted and approved before preparing shop drawings. The request should include a reason for the proposed change. Shop drawings that do not conform to the contract plans and special provisions and prepared without written permission for the change may be rejected. Such a rejection gives no cause for a delay claim.

The shop drawings for each site shall contain the following information:

- The project number, town and camera pole identification number or Site Number
- Overall pole height and height of each pole section
- Cross sectional shape of pole (round or specify number of sides)
- Outside distance between parallel faces and width of flats at the top and bottom of each pole section (if member is multi-sided)
- Inside bend radius at angle points, if multi-sided member
- Wall thickness of each pole section
- Connection of pole to base plate (fillet welded socket connection or full penetration groove weld with a continuously welded backer bar). The following criteria shall be addressed:
    - The fabricator shall cut inside the specified opening in the base plate and grind to match the outside dimension of the pole.
    - The separation between the base plate and the pole within the socket shall not exceed 1/16" in order to assure sufficient fillet weld as specified in AWS D1.1, Section 5.22, "Tolerance of Joint Dimensions."
- Groove welds at the base of poles less than 5/16" thick shall be ultrasonically tested in accordance with AWS D1.1, Annex K, as specified in Article 6.20.1. A

5/16” thick wall thickness may be substituted at no extra charge to avoid the need to use Annex K for full penetration weld inspection procedures

- Details and location(s) of the longitudinal seam welds in the pole, including designation of the penetration depth of the welds at the pole ends and within the length of the pole
- Welding process, electrodes, weld designations and non-destructive testing requirements
- Length of slip type field splice
- Diameter or distance across flats at the top and bottom of each pole section. Adequate tolerance should be allowed for the thickness of galvanizing, so the slip type field splice is adequate.
- Details of reinforced handholes and covers and their location on the pole (both vertical and angular orientation)
- Locations and diameters of holes in the pole wall for traffic flow monitor cables
- Tie-offs, grounding lug hole and other attachments
- Base plate details, including length, width and thickness, as well as anchor rod holes and other openings.
- A plan view of the pole and base plate showing the orientation of the anchor rod holes in relation to the hand hole at the base of the pole
- Pole top plate details, including length, width and thickness, as well as bolt holes and other openings
- Tenon and tenon plate, including length, width and thickness of tenon plate, as well as tie-offs, bolt holes and other openings. Coordinate dimensions with the manufacturer of the lowering device
- A copy of camera lowering device assembly support arm and pole connection details (to show compatibility with tenon)
- Material specifications for all components, including fracture critical designations on the pole and base plate
- Minimum Charpy impact values for the steel pole and base plate
- Fabrication details of all components, including method of fabrication, when applicable
- Galvanizing requirements

Working Drawings:
Prior to fabrication, the Contractor shall submit erection drawings to the Engineer for review in accordance with Article 1.05.02. An individual set of drawings shall be prepared for each height camera pole.

Working drawings shall be submitted on 11" x 17" (Ledger/Tabloid) sheets with an appropriate border and title block. Design computations, procedures and other supporting data shall be submitted on 8 ½" x 11" (Letter) sheets.

The working drawings and design computations shall be sealed by a Professional Engineer, licensed in the State of Connecticut, who shall also be available for consultation in interpreting

his computations and drawings, and in the resolution of any problems which may occur during the performance of the work. Please note that each working drawing must be sealed.

Erection drawings shall include the following:

- The project number, town and camera pole identification number
- Overall pole height and location of slip type field splice
- Pole installation and erection procedure, including
  - lifting weight
  - crane size and placement
  - location where pole will be assembled
  - method of pulling pole sections together
  - proposed sequence of conduit and cable installation in pole, cable tie-off, etc.
  - method of lifting pole (including strongbacks, if required)
  - method of securing the base during tilt-up
  - proposed orientation of arm and handhole relative to traffic
  - method of turning pole to the proposed orientation
  - placement of elastomeric seal inside anchor rod circle
  - method of positioning leveling nuts in preparation for setting the pole (include minimum and maximum clear space between leveling nuts and foundation)
  - anchor rod and nut lubrication requirements
  - anchor rod nut tightening sequence, including degree of tightening

Bolting pole sections together to secure them during erection and lifting holes in the steel pole will not be permitted and may be cause for rejection of the pole. A suggested pole erection sequence is included in the camera pole plans.

CAMERA LOWERING DEVICE ASSEMBLY

The lowering system shall consist of a suspension contact unit, divided support arm, and a pole adapter for attachment to a pole top tenon, conduit mount adapter, pole top junction box, and camera connection box. **The construction of the camera lowering device shall be the [MG]² Model CLDMG2-HYP**

The divided support arm and receiver brackets shall be designed to self-align the contact unit with the pole centerline during installation and ensure that the contact unit cannot twist under design wind conditions.

Round support arms are not acceptable.

The camera lowering device shall be designed in accordance with AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals – 2009 (Fifth Edition), including the latest interim specifications.

The lowering device manufacturer shall furnish independent laboratory testing documents certifying adherence to the stated wind force criteria identified in the CAMERA POLE section

below utilizing, as a minimum, the effective projected area (EPA), the actual EPA or an EPA greater than that of the camera system to be attached.

The camera lowering device to be furnished shall be the product of the manufacturers with a minimum of two (2) years of experience in the successful manufacturing of such systems. The lowering device provider shall be able to identify a minimum of three (3) previous projects where the proposed system has been installed successfully for over a one-year period of time each.

Suspension Contact Unit

The suspension contact unit shall have a load capacity 600 lbs. with a 4 to 1 safety factor.

There shall be a locking mechanism between the fixed and moveable components of the lowering device. The movable assembly shall have a minimum of 2 latches. This latching mechanism shall securely hold the device and its mounted equipment. The latching mechanism shall operate by alternately raising and lowering the assembly using a winch and lowering cable. When latched, all weight shall be removed from the lowering cable. The fixed unit shall have a heavy duty cast tracking guide and means to allow latching in the same position each time. The contact unit housing shall be weatherproof with a gasket provided to seal the interior from dust and moisture.

The prefabricated components of the lift unit support system shall be designed to preclude the lifting cable from contacting the power or video cabling. The lowering device manufacturer shall provide a conduit mount adapter for housing the lowering cable. This adapter shall have an interface to allow the connection of a contractor-provided 1.25 inch PVC conduit and be located just below the cable stop block at the back of the lowering device. The Contractor shall supply and install the internal conduit in the pole as required by the Engineer and/or lowering device provider. **The only cable permitted to move within the pole or lowering device during lowering or raising shall be the stainless steel lowering cable. All other cables must remain stable and secure during lowering and raising operations.**

The female Socket contact half of the connector and the male contact block half shall be made of thermosetting synthetic polymer known as Hypalon or Neoprene. The female brass socket contacts and the male High conductivity brass pin contacts shall be permanently molded into the polymer Hypalon or Neoprene body. The current carrying male contacts shall be at least 1/8 inches in diameter. The attached wire leads from both the male and female contacts shall be permanently molded in the polymer Hypalon or Neoprene body. There shall be a maximum total of (14) fourteen contacts for each complete disconnect unit. The camera utilized shall be capable of performing all of its necessary functions on 14 contacts or less. Two of the Pins shall be longer than the other male pins so that they will make first and break last providing optimum grounding performance. The current carrying and signal wires shall be constructed of 18 AWG rubber coated stranded wire. The contacts shall be self-wiping with a shoulder at the base of each male contact so that it will recess into the female block, thereby giving an environmental seal when mated. Male Pin contacts shall be mounted to lower portion of disconnect unit.

Camera Junction Box

The camera junction box shall be of two piece clamshell design with one hinge side and one latch side to facilitate easy opening. The general shape of the box shall be cylindrical to minimize the EPA. The Camera Junction Box shall be cast aluminum with stabilizing weights on the outside of the box to increase room on the interior. The box shall be capable of having up to 40 pounds of stabilizing weights. The bottom of the Camera Junction Box shall be drilled and tapped with a 1-1/2" NPT thread to accept industry standard dome housings and be able to be modified to accept a wide variety of other camera mountings. The junction box shall be gasketed to prevent water intrusion. The bottom of the box shall incorporate a screened and vented hole to allow airflow and reduce internal condensation. If utilizing a CCTV dome housing, it must be furnished from the camera factory with an epoxy sealed connection flange at the point of connection of the dome to the CLD junction box to ensure that there is no moisture migration from the CLD junction box into the dome.

Pulleys

All pulleys for the camera lowering device and portable lowering tool shall have sealed, self-lubricated bearings, oil tight bronze bearings, or sintered bronze bushings.

Cables and Connectors

The lowering cable shall be a minimum 1/8" diameter stainless steel aircraft cable with a minimum breaking strength of 1740 pounds with (7) strands of #19 wire each.

All electrical and video coaxial connections between the fixed and lowerable portion of the contact block shall be protected from exposure to the weather by a waterproof seal to prevent degradation of the electrical contacts. The electrical connections between the fixed and movable lowering device components shall be designed to conduct high frequency data bits and one (1) volt peak-to-peak video signals as well as the power requirements for operation of dome environmental controls.

The Power/Signal cable provided by the contractor/camera provider per the requirements of the camera shall be in the lengths as noted on the plans for each camera site. See Item No. 1112210A Camera Assembly for requirements pertaining to the camera power/signal cables. Further, the power signal cable shall be delivered to the lowering device manufacturer and prewired to the lowering device at the lowering device manufacturer prior to arrival at the jobsite. The coaxial video connection for the CCTV Camera shall be made from twisted pair to BNC with a manufactured off-the-shelf connector.

Other Materials

The interface and locking components shall be made of stainless steel and or aluminum. All external components of the lowering device shall be made of corrosion resistant materials, powder coated, galvanized, or otherwise protected from the environment by industry-accepted coatings to withstand exposure to a corrosive environment.

The Camera Manufacturer shall provide weights and /or counterweights as necessary to assure that the alignment of pins and connectors are proper for the camera support to be raised into

position without binding. The lowering unit will have sufficient weight to disengage the camera and its control components in order that it can be lowered properly.

The Camera Manufacturer shall provide the power and signal connectors for attachment to the bare leads in the camera junction box.

The Camera Manufacturer shall provide a mounting flange sufficient for mounting their respective camera assembly to a standard 1.5 inch NPT female, or other suitable method approved by the Engineer, at the bottom of the Camera connection box.

Lowering Tool

The camera-lowering device shall be operated by use of a portable lowering tool. The tool shall consist of a lightweight metal frame and winch assembly with cable as described herein, a quick release cable connector, an adjustable safety clutch and a variable speed industrial duty electric drill motor.

This tool shall be compatible with accessing the support cable through the hand hole of the camera pole. The lowering tool shall attach to the pole with one single bolt. The tool will support itself and the load assuring lowering operations and provide a means to prevent freewheeling when loaded.

The lowering tool shall have a reduction gear to reduce the manual effort required to operate the lifting handle to raise and lower a capacity load. The lowering tool shall be equipped with a positive locking mechanism to secure the cable reel during raising and lowering operations. The lowering tool shall be provided with an adapter for operating the lowering device by a portable drill using a clutch mechanism.

The lowering tool should be capable of lowering and raising the camera assembly for a 70’ pole within a five-minute time period. The lowering tool shall be available from ConnDOT Highway Operations for use on the project.

Construction Methods:

CAMERA POLE

The Contractor is responsible for reviewing the site conditions at each pole location as soon as possible. He shall immediately notify the Engineer of concerns such as conflicts with overhead utilities, trees, the presence of drainage swales, buried facilities, etc. that could make installation undesirable, extremely difficult or even impossible.

Pole Fabrication

A maximum of one telescopic, slip-type field splice is permitted in the pole. The minimum length of this splice shall be 1.5 times the inside diameter of the exposed end of the female section.

Poles shall be fabricated in accordance with the dimensions and tolerances listed in ASTM A595. Each pole will be inspected for straightness at the fabrication shop and again upon delivery to the site where it will be installed. Deviations from the allowable tolerance are cause for rejection.

The pole top plate shall have slotted holes that allow field adjustment of the arm/camera orientation up to 360 degrees. A tenon shall be welded to a separate tenon plate - NOT to the pole top plate. The tenon plate shall be bolted to the pole top plate. The tenon shall have standard size mounting holes as shown on the plans for the mounting of the camera-lowering device assembly. The tenon shall be of dimensions necessary to facilitate camera lowering device component installation. A slot in the tenon shall be parallel to the pole centerline as shown on the plans for mounting the lowering device.

Traffic appurtenances shall be located and mounted on the pole as shown on the Traffic Flow Monitor (TFM) plans. A ½" diameter hole shall be located on the traffic side of the pole 12" above the detector, whose height is noted on the TFM plans. A rubber grommet shall be installed in the hole to protect the wire from chafing and to prevent moisture from entering.

A handhole of the size detailed on the plans shall be placed at the level of the ½" diameter TFM monitor cable hole facing away from oncoming traffic.

Handhole Requirements:

- The camera pole shall have handholes that are detailed and located as shown on the plans.
- The handhole shall be provided with a cover connected to the frame with stainless steel bolts.
- A neoprene gasket shall be adhered to the inside of the handhole cover such that the gasket makes contact with the frame and seals the opening against intrusion of water.
- The cover shall be attached to the frame with stainless steel bolts as shown on the plans. Coupling nuts shall be welded to the inside face of the handhole frame to receive the handhole cover bolts. The cover shall be trial-fitted in the shop before being galvanized. All bolts shall be threaded into the coupling nuts simultaneously and the cover shall fit tightly to the handhole frame with the elastomeric seal in place.
- A stainless steel chain shall connect the handhole cover and the handhole frame.
- The handhole frame shall accommodate a winch-anchoring bolt to secure the lowering device attachment. A drilled and tapped hole is specified on the plans. The female threads shall be re-tapped after galvanizing, if necessary, for compatibility with the bolt.
- The exposed edges of the handhole shall be ground smooth and rounded by grinding.

Welding Requirements:

All welding shall conform to the following requirements:

- AASHTO/ANSI/AWS D1.5 Bridge Welding Code, Section 12 – Fracture Control Plan (FCP) for Nonredundant Members. The provisions of this section, although written for bridges, shall apply to the camera pole and the base plate and all welds to those components.

- AWS D1.1 Structural Welding Code - Steel as supplemented by Section 12 of AASHTO/ANSI/AWS D1.5 Bridge Welding Code.
- The pole members may be fabricated with no more than 2 longitudinal seam welds.
- The longitudinal seam welds for the pole members shall have 60% minimum penetration, except longitudinal seam welds within 6" of the member ends shall be complete joint penetration groove welds. At the slip-type splice, the longitudinal seam welds on the female section of telescopic splices shall be complete penetration groove welds for a length equal to 1.5 times the inside diameter of the exposed end of the female section plus 6".
- A minimum of 25% of the partial joint penetration seam welds and 100% of the complete joint penetration seam welds shall be non-destructively tested.
- Partial joint penetration seam welds shall be non-destructively tested in accordance with the magnetic particle method.
- Complete joint penetration seam welds shall be non-destructively tested in accordance with the ultrasonic method.
- Poles: the pole-to-transverse base plate connection may be made with a fillet welded socket connection with two fillet welds or a complete joint penetration groove weld with a backing ring attached to the plate with a continuous fillet weld.
- If a complete joint penetration groove weld is chosen for tube walls less than 5/16" thick, ultrasonic testing of the weld shall be performed in accordance with Annex K of AWS D1.1, as specified in Article 6.20.1.
- 100% of complete joint penetration groove welds shall be non-destructively tested by the ultrasonic method.
- 100% of fillet welds shall be non-destructively tested by the magnetic particle method.
- The joint between the backing ring and tubular member shall be sealed with silicone sealant at the top of the backing ring.

All welding, drilling of holes and any other fabrication practices that would damage the galvanized coating shall be completed prior to galvanizing the post.

After the post has been completely fabricated, welds ground smooth, flux and spatter removed, they shall be hot-dip galvanized in accordance with AASHTO M111 (ASTM A123). All pieces shall be galvanized in a single dip. Double-dipping will not be accepted.

All damaged areas of the galvanizing shall be properly prepared and touched-up. "Damaged" does not include mishandling or deliberate welding or drilling. Such deliberate destruction of the galvanized finish may be cause for rejection of the member. Damaged zinc shall be touched-up in accordance with ASTM A780. Spray aerosol cans of zinc rich primer will not be permitted. Zinc paint shall match the color of the galvanizing as nearly as possible. The Engineer may order additional touch-up if he deems it appropriate. Aluminum paint will not be permitted.

Fabricated materials shall be packed with sufficient dunnage and padding to protect finished surfaces. Poles shall be stored in a manner that does not dent or permanently bend the wall of the pole or permanently bend the pole along its axis.

Pole Installation

See the camera pole drawings for a suggested erection procedure. The Contractor is fully responsible for developing a workable erection procedure.

The Contractor is responsible for the proper orientation of the camera pole and arm. The station and offset of the pole shall be as shown on the CCTV\TFM plans or as directed by the Engineer.

The camera pole shall be electrically grounded by attaching one end of a bare copper grounding conductor to the ½" ground tap using an exothermic weld. The rigid metal conduit shall be electrically grounded by passing the ground conductor through an insulated bonding bushing attached to the conduit. The conductor shall terminate at the ground lug connection at the handhole.

Ensure that the handhole covers are securely installed before leaving the pole unattended.

In the void between the top of the concrete foundation and underside of the base plate a ring of closed cell elastomer shall be placed to seal the opening in the base plate completely. Closed cell elastomer shall fit inside the anchor bolts, but allow clearance for tightening. The elastomer shall be compressed approximately 10% to 20% when the base plate is in its final position.

The following installation procedure is critical to preventing fatigue failure of the anchor rods with UNC threads:

1. The anchor rod double leveling nuts shall be pre-set to expose as few threads as possible below the nuts, while forming a level line in all directions across the top of the top leveling nuts. A sufficient number of threads should be exposed below the leveling nuts to allow the nuts to be adjusted when plumbing the installed pole. The installation will be considered unacceptable if 1 ½" or more of threads are exposed below the bottom nut.
2. The anchor rod leveling nuts and washers shall be in full contact with the bottom surface of the base plate when the centerline of the pole is plumb.
3. Once the leveling nuts have all been brought into full contact with the bottom of the base plate, the nuts above the base plate may be tightened to snug-tight. Snug tight is equivalent to the full effort of a workman on a 12" wrench.
4. The nuts shall then be turned an additional one-third turn beyond snug-tight.
5. The leveling nuts shall be retightened to ensure that full contact has been made.
6. Bring all double nuts in contact with the tightened nuts and turn until snug-tight.

Note: Nut rotation is relative to the anchor rod. The tolerance is plus 20 degrees.

The camera lowering device assembly shall be installed according to the manufacturer's specifications. The camera will be installed after the pole has been erected. To facilitate the camera installation, lower the control cable to the ground, attach the camera and raise it into position.

CAMERA LOWERING DEVICE ASSEMBLY

The Contractor shall install the lowering device and pole on the span pole foundation in the location(s) as shown on the plans.

The Contractor shall utilize an authorized representative from the lowering device manufacturer to assist with the assembly and testing of the first lowering system onto the pole assembly. The manufacturer shall furnish the Engineer documentation certifying that the electrical contractor has been instructed on the installation, operation and safety features of the lowering device. The contractor shall be responsible for providing applicable maintenance personnel “on site" operational instructions.

The Contractor shall install two (2) - 1.25 inch PVC conduits inside the camera pole between the tenon assembly and camera pole handhole. One conduit will be installed to contain the stainless steel aircraft lowering device control cable. The second conduit will be used to contain the twisted pair camera control and coax video cable. The camera control cable shall be contained inside of the 1.25 inch PVC conduit and the camera coax video cable shall be secured with plastic cable ties to the outside the PVC conduit. The TFM communication cable shall not be contained inside a PVC conduit.

The Contractor shall be responsible for installing and coordinating the CCTV and TFM cables between the lowering device and the pole installation per the manufacturer’s recommendations. All Contractor personnel involved in terminating communication cables for the above listed items shall meet or exceed the above referenced installation qualifications and shall be approved by the Office of Highway Operations. See the special provision “Notice to Contractor – Installation Qualifications”.

The Contractor shall contact the Engineer prior to installation of each lowering device assembly to determine the appropriate pole top tenon angle to use for optimum camera visibility. The Contractor shall then adjust the angle of the lowering device and pole top tenon as required.

The Contractor shall connect all power, video and data cables as required to fully operate the lowering device and camera assembly.

The camera lowering device assembly shall be mounted on the Camera Pole as dictated by the camera lowering device installation manual and the onsite representative. The lowering device assembly components, wiring and cabling shall be tested for proper signal continuity prior to installation of the pole on the foundation supports and anchor bolts.

The Contractor shall obtain a lowering device tool, an adjustable safety clutch and variable speed, heavy-duty reversible drill motor from ConnDOT Highway Operations for use on the project. The Contractor shall be responsible for the care and handling of the lowering device tool. Any damage to the ConnDOT lowering device tool, adjustable safety clutch and variable speed, heavy-duty reversible drill motor shall be repaired or replaced by the Contractor at no cost to the State.

Upon completion of the pole installation on the foundation, the unit shall be tested with a replica of the actual CCTV unit for the lowering device system functionality. The system shall be tested in the presence of the manufacturer's representative and Engineer.

Method of Measurement:

This work will be measured for payment by the number of camera lowering device and steel camera pole assemblies of the height specified, furnished, installed, tested, completed and accepted in place.

Basis of Payment:

This work will be paid for at the contract unit price each for "Camera Lowering Device Assembly Type B", complete in place, which price includes the steel camera pole, tenon, base plate and all attachments, camera lowering device assembly, PVC conduit, suspension contact unit, pulleys. cables, connectors, and all equipment, materials, coordination, design, fabrication, tools, labor testing, manufacturer representation and incidentals thereto.

Anchor rods, nuts, and washers and anchor plates will be included for payment in the item "Traffic Control Foundation Span Pole – (Type _)." The foundation type shall be as indicated on the plans.

Pay Item	PayUnit
Camera Lowering Device Assembly Type B	EA

ITEM 1112241A - FIBER OPTIC CABLE SPLICE ENCLOSURE

Description:

This Item shall consist of furnishing and installing splice enclosures to interconnect optical fibers between two or more fiber optic cable segments.

Materials:

A. Applicable Publications
   1. Publications listed below form a part of these specifications to the extent referenced. The publications are referred to in the text by basic designation. All Fiber Optic Communication System hardware shall be compliant with the following specifications: Electronics Industries Association (EIA):

      a. TIA-526-3-89 Fiber Optic Terminal Equipment Receiver Sensitivity and Maximum Receiver Input.
      b. TIA-455-32A-90/Fiber Optic Circuit Discontinuity.
      c. EIA-310-C Racks, Panels, and Associated Equipment.
      d. EIA-359-A Colors for Color Identification and Coding.
      e. EIA-TIA-455-A Standard Test Procedures for Fiber Optic Fibers, Cable Transducer Sensors, Connecting and Terminating Devices and Other Fiber Optic Components.
      f. EIA-455-6B Cable Retention Test Procedure for Fiber Optic Cable Interconnecting Devices.
      g. TIA/EIA–598–A Optical Fiber Cable Color Coding.

B. Fiber Optic Splice Enclosure
   1. The Splice Enclosures shall accommodate from 60 to 168 fiber splices. Each splice enclosure shall have a splice tray organizer capable of holding 12 to 18 splice trays. The organizer shall provide access to and removal of individual splice trays and permit selective splicing to allow one or more fibers to be cut and spliced to branch cable(s) without disrupting other fibers.

   2. The Contractor shall install Splice Enclosures of a capacity that they are capable of handling of 24 fibers more than the current fiber count at any given splice location as shown on the Drawings.

   3. The Splice Enclosure shall fit within the space allocated for it as shown on the plans and to operate within the environment in which it is to be installed.

   4. The Splice Enclosure shall protect the fiber optic cable splices from mechanical damage, shall provide strain relief for the cable, and shall be resistant to salt corrosion. The enclosure shall be waterproof and airtight, and shall be manufactured of non-corroding materials.

5. The Splice Enclosure shall be designed for a temperature range of -30° C (-22° F) to +70° C (158° F). The splice enclosure shall be capable of performing in a cable vault or pull box, environment where total and continuous submersion in water is to be expected.

6. All materials in the enclosures shall be non-reactive and shall not support galvanic cell action. The outer enclosure shall be compatible with the other enclosure components, splice trays, and cables. The end plate shall consist of two sections and shall have the capacity for a minimum of two cable entries on each end.

7. All Splice Enclosures shall employ re-usable sealing materials allowing multiple re-entrances without replacing any component. Access to the splice enclosures shall be accomplished without the use of special tools or devices. The splice enclosure shall employ a latching mechanism for entrance to the internal components of the enclosure.

8. All environmentally exposed components of the Splice Enclosures shall be UV light resistant.

9. All splice trays shall be lined to provide a contrasting a contrasting background for splicing colored fibers or as approved by the Engineer.. The splice trays shall include clear snap-on covers and tie wraps to secure the buffer or transport tubes to the tray. The splice trays shall be of adequate size to prevent induced attenuation due to fiber bending.

10. Each splice tray shall be capable of accommodating a minimum of 12 fusion splices for the single mode fiber cable of the type selected.

11. The splice tray shall have features that retain the fiber loops and control the bend radius. The splice tray cover shall be clear plastic to allow for inspection of the fibers without opening the tray.

12. Vinyl markers shall be supplied to identify each fiber to be spliced within the enclosure. Each splice shall be individually mounted and mechanically protected on the splice tray.

C. Cable Racking Hardware

1. Cable racking hardware shall be made of a high performance polymer: Each splice enclosure shall be supported in the pullbox by a medium duty rack capable of supporting a minimum load of 445 Newtons. Racks shall not be less than 150mm in length. Medium duty racks shall have 100mm arms minimum. At splice points, the pullbox shall have a horizontal rack capable of supporting, and holding securely in place, a splice closure.

D. Warranty
   1. All equipment supplied for this shall be warranted for parts by the vendor against defects and failures, which may occur through normal use for a period of one (1) year from the date of installation. A copy of the warranty must be presented to the Engineer before installation of the equipment.

Construction Methods:

A. Installation
   1. Splice Enclosures shall be installed as shown in the Drawings. Unless otherwise specified, outdoor type Splice Enclosures shall be installed within vaults or pull boxes located adjacent to CCTV cameras and at fiber optic cable reel-end splice locations as shown on the Drawings.

   2. The installations shall include all required components including sealing kits, cable racking hardware and mounting hardware to achieve an environmentally secure permanent installation.

   3. The Contractor shall supply all materials, tools, equipment and labor including but not limited to fan out kits, connectors, trays, splice enclosures, and any other incidentals necessary to complete the installation of the fiber optic cable splice enclosure.

   4. The Splice Enclosure shall be secured to the interior of the cavity of the vault or pullbox on cable racking hardware using tie-wraps.

   5. The Outdoor Splice Enclosure shall be mounted in such position to allow the cable to enter and exit the enclosure without exceeding the cables minimum bending radius. Sufficient cable shall be coiled in the vault or pull box to allow the Splice Enclosure to be removed from the vault for current and future splicing and cable repairs. The Contractor shall install mounting hardware within the pullbox or splice location to support the splice enclosure and the splice enclosure shall be securely fastened in place. In no cases shall the splice Enclosure be allowed to rest on the bottom of the pullbox or vault.

   6. After the splice trays are placed inside the enclosure, the enclosure shall be sealed using a procedure recommended by the manufacturer that will provide a waterproof environment for the splices. Encapsulant shall be used to ensure water resistance. The individual fibers shall be looped one full turn within the Splice Enclosure to avoid micro bending.

   7. Care shall be taken at the cable entry points to ensure a tight salt resistant and waterproof seal is made which will not leak upon aging. It is acceptable to have multiple cables enter the fiber optic cable Splice Enclosure through one port as long as all spaces between the cables are adequately sealed.

8. All splices shall be protected with a thermal shrink sleeve and shall be labeled in the splice tray with permanent vinyl markers. Butt ends shall also be labeled to identify the destination of the fiber.

9. The splices shall be fabricated using modern, high quality fusion type splicing equipment. All splicing equipment shall be in good working order, properly calibrated, and meeting all industry standards and safety regulations. Cable preparation, Enclosure installation, and splicing shall be accomplished in accordance with accepted and approved industry standards.

10. Optical fibers shall be spliced as noted on the plans using the fusion type and the maximum splice loss shall not exceed 0.10 dB per splice in each direction. The Contractor shall test all splices for signal loss.

11. Each splice shall be tested for tensile strength by applying a force of not less than 200 grams.

12. All splices shall be arranged neatly in splice trays, supported and protected with a suitable splice protector.

13. Only the fibers required to be spliced to Drop Cables at the CCTV Camera and Mini-Hub locations shall be severed and spliced. Where required, the buffer tube splitting tool recommended by the manufacturer shall be used to open the correct buffer tube. Unsevered fibers in an open buffer tube shall be coiled in the splice tray. When buffer tubes do not need to be opened, at least 4.0 m of unopened buffer tubes shall be coiled in the fiber optic Splice Enclosure.

14. Drop cable entrances to the splice enclosures shall adhere to the manufacturer's recommendations for the type of cable.

15. In order to reduce the overall number of splices required, the cable shall be installed in the maximum continuous reel length provided by the manufacturer, or as shown on the plans, or as approved by the Engineer. Factory splices will not be permitted. Prior to ordering the fiber optic cable, the Contractor shall be required to submit a detailed cable layout plan showing the proposed reel lengths and splice points.

16. Fiber identification shall be in accordance with the tables and schedules provided in the Contract Drawings.

17. Upon completion of the splicing operation, all waste material shall be deposited in suitable containers, removed from the job site, and disposed of in an environmentally acceptable manner.

B. Submittals

1. Submit:

    a. Functional block diagrams, cable diagrams, and point to point cabling details.
    b. Product data, installation manuals, materials, system configuration options and features, and accessories.
    c. Shop Drawings shall be completely dimensioned and shall indicate the intended installation method and details.
    d. Specifications for all assemblies and subassemblies (eg. High Density Frames, Splice Housings, Connector Panels, Underground Splice Enclosures and associated Splice Trays).
    e. Installation and maintenance manuals for all equipment.

C. Testing
    1. Testing shall be performed to demonstrate that all furnished and installed equipment complies with the requirements of each item, and shall be conducted using Manufacturer recommended procedures, materials and test equipment.

D. Delivery, Storage, and Handling
    1. The Contractor shall deliver, store, handle and install all materials and equipment in such a manner as not to degrade quality, serviceability or appearance.

    2. The Contractor shall be responsible for storage of the materials and equipment prior to installation in a clean, dry location free from construction dust, precipitation and excess moisture.
    3. Contractor shall be required to replace any damaged materials and equipment, as determined by the Engineer, at no additional cost to the owner.

Method of Measurement:
Work under these items shall be measured for payment by the actual number of "Fiber Optic Cable Splice Enclosures" of the type specified, installed, tested, operating and accepted in place.

The Contractor shall note that the required racking in the pullboxes and the vaults is included in the splice Enclosure item.

Basis of Payment:
The work to be done under this item shall be paid at the Contract Price each for "Fiber Optic Cable Splice Enclosure" which price shall include all materials, hardware, termination panels, labor, cables, connectors, tools, equipment and incidentals necessary to complete this work.

The Contractor shall note that the required racking in the pullboxes and the vaults is included in the splice enclosure item.

Pay Item	Pay Unit
Fiber Optic Cable Splice Enclosure	Ea.

ITEM 1112250A – EQUIPMENT OPERATIONS

Description:

The purpose of this item is to provide the necessary services required to maintain the Incident Management System (IMS) equipment existing and newly installed, operating to the manufacturer's specifications, so as to provide a means to monitor, detect and manage incidents as they occur on the highway. The work included in this item for the existing IMS equipment will commence upon receiving the Notice to Proceed for this contract. The work included in this item for newly installed IMS equipment will commence upon completion of the 30 Day Operational Test

Materials:

All materials utilized to maintain and repair the Incident Management System (IMS) shall be in conformance with the specifications of this project or shall be in conformance with the specifications of the Procurement Contract, or as recommended by the manufacturer. The existing or newly installed IMS equipment shall include but not be limited to the operation of the CCTV Camera, Traffic Management System Cabinets (TMSC), and Optical Video/Data Transceivers (OVDT/OVDR).

The Contractor shall provide all the cables, connectors, tools, replacement equipment and labor necessary to successfully maintain the equipment.

The Contractor shall be able to use replacement parts available from the State of Connecticut inventory in order to expedite the repair process. As soon as possible and to the State's satisfaction, the Contractor shall provide replacement equipment to be re-entered into the State's inventory.

The Contractor shall provide documentation certifying the manufacturer's repair or replacement of the spare equipment upon return of the equipment to the Department.

Construction Methods:

Certification:
The Contractor shall provide the State with evidence satisfactory to the State that they fully understand the purpose for which the equipment is intended and they are qualified and capable of fulfilling all provisions of this item. The Contractor as well as individual personnel performing this work shall be certified by all manufacturers of the equipment to be maintained as being capable of maintaining the equipment and also capable of obtaining and installing the necessary spare parts to keep the system on-line. The Contractor, prior to the commencement of the start of the equipment operations, shall be required to submit training certificates for all of the pertinent equipment.

Response Time:

The Contractor shall service and maintain the newly installed IMS equipment at the conclusion of the 30 Day Operational Test for each section and the existing IMS equipment as allowed by the Engineer. All IMS equipment shall be serviced and maintained on a twenty-four (24) hour a day, seven days a week basis. The Contractor shall provide a suitable means of communication between them and the Bridgeport Operations Center (BOC). This shall include a twenty-four (24) hour telephone number, a fax number for emergency purposes and a fax number for daily communications and log activities. Repairs shall commence not more than 8 hours after notification and shall be completed within 24 hours of notification.

The Contractor shall keep a neat and accurate log book of all the malfunctions reported with the date and time that the information was received and the nature of the problem. The log book shall be submitted to the Engineer monthly or upon request by the Engineer. The Contractor shall include in the log book the time that each unit is checked for proper operation, the condition of each unit checked, and the date and time each unit was restored to proper operation or replaced.

Work performed under this item shall conform to the latest National Electrical Code standards, local electrical codes, and Department of Transportation installation requirements. The Contractor shall conform to these requirements as specified herein.

Any IMS equipment that has been damaged through the Contractors own actions shall be repaired and/or replaced by the Contractor at no cost to the State.

Method of Measurement:

This item shall be measured for payment as provided under Article 1.09.04 – Extra and Cost Plus Work.

The sum of money shown on the estimate and in the itemized proposal as “Estimated Costs” 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 figures will be disregarded and the original price will be used to determine the total amount bid for the contract.

Basis of Payment:

This work will be paid on a cost-plus basis according to Article 1.09.04 – Extra and Cost Plus Work. Warranties in effect for newly installed equipment associated with CCTV Cameras, Traffic Management System Cabinets (TMSC), Traffic Management System Mini-Hub Cabinets (TMSMHC), Optical Video/Data Transceivers (OVDT/OVDR), Traffic Flow Monitors (TFM) and Highway Advisory Radio (HAR). operation shall be honored by the suppliers of the equipment. Contractor or sub-contractor will be responsible for securing warranted equipment and installation. There will be no payment for materials included under a manufacturers warrantee. Labor costs only will be reimbursed on a cost plus basis.

If warranties have expired, any equipment and labor that must be repaired will be paid on a cost plus basis.

Pay Item	Pay Unit
Equipment Operations	MO.

ITEM # 1113023A 12 STRAND FIBER OPTIC SINGLE MODE DROP CABLE
ITEM # 1113028A 48 STRAND FIBER OPTIC SINGLE MODE CABLE
ITEM # 1113042A 96 STRAND FIBER OPTIC SINGLE MODE CABLE

Description: Under these items, the Contractor shall furnish and install the required fiber optic cables for a complete cable plant in accordance with the contract documents and as ordered by the Engineer.

The contractor shall furnish and install the fiber optic interconnect including the fiber optic trunk cable, and all necessary components required to form a complete cable interconnect system and shall conduct acceptance tests for this interconnect under this specification.

The passive components that shall be provided under this specification include the following:

Aerial Slack Storage Racks

Other passive components that are required to form a complete communication system include (1) terminators and (2) moisture and water sealants and cable caps for below grade applications. The components supplied shall be commercially available components whose specifications indicate state-of-the-art capability for the application. The contractor shall furnish, install, splice, and test all of the fiber optic cables. All equipment for installation, splicing, and testing shall be provided by the Contractor. All fibers in the fiber optic cable shall be spliced and/or terminated in designated equipment as specified in the Contract Documents or as ordered by the Engineer.

Materials:

Single Mode Fiber Optic Trunk Cable:

The single mode fiber optic cable to be provided shall be a loose, flexible buffer tube cable design as specified herein. The fiber optic cable shall be suitable for outside duct, aerial, and direct buried installations, and for indoor use when installed in accordance with NEC Article 770 and local building code requirements. All cables shall consist of the number of fibers as specified on the plans.

The cable shall meet the requirements of REA 7 CFR 1755.900 at a minimum, and shall be new, unused and of current design and manufacture. The cable shall be “ALTOS” Double Jacketed all-Dielectric Cable as manufactured by Corning or equal. The single mode fiber shall have 10 Gigabit Ethernet performance.

Cables shall be packaged wound on wood spools or reels. All reels shall be the property of the contractor and is responsible for the return or disposal of the reels that the cable is shipped on. The diameter of the drum shall be minimum 20 times the diameter of the cable. Each reel shall contain only one continuous length of cable. Labels shall be attached to the reel showing length, cable identification name and number and date of manufacture.

The outer end of the cable shall be securely fastened to the reel head so as to prevent the cable from becoming loose during the transit. End seals shall be applied to each end of the cable to prevent the intrusion of moisture into the cable.

Documentation shall accompany each reel documenting the tested attenuation of each cable fiber in db/km. This attenuation shall be $\leq$ 0.4 db/km @1310 nm and $\leq$0.3 db/km @ 1550 nm.

The fiber optic cable rip cords shall be made from either standard Telco nylon material or from braided Kevlar. No unbraided Kevlar shall be accepted.

Cable jacketing shall be permanently labeled approximately every two feet with cable manufacturer's name, cable type, fiber count, manufacturing date and incremental cable length.

Fiber optic drop cable:

Fiber optic drop cables shall be installed in conduit, and overhead between the Interconnect cable and equipment cabinet as shown on the plans. They shall be spliced to the appropriate fiber within approved spliced closures in handholes or as specified in the plans. The jacket of drop cable shall be rated to handle the outdoor use with UV protection.

Optical Requirements: The fiber optic drop cables shall have identical optical characteristics as the single mode fiber optic cable specified above.

Material Requirements: The drop cable shall have identical physical configuration as the single mode fiber optic cable specified above. The fiber optic drop cable shall contain one buffer tube with twelve (12) fibers, as shown on the plan. The drop cable shall be able to withstand a minimum of 100 lbs. of tensile strength during installation.

The drop cable shall be fusion spliced to the appropriate trunk fiber in a splice closure and the other end shall be terminated in a fiber optic distribution enclosure supplied under a separate contract item. The manufacturer shall factory test the cable assembly with the connectors and provide results to the Engineer for approval prior to field installation.

The drop cable shall be sufficient length to be installed as shown on the plans, with a minimum of 3 meters of slack provided in the handhole or as shown on the plans.
The contractor shall follow the the drop cable manufacturer's recommendation in the installation of the drop cables, including the individuals breakout fibers.

Fiber Optic Connectors and Splices: The single mode optical fiber connectors shall be SC Type meeting the specifications and performance requirements stated below:

Strain Relief: The connector shall provide a strain relief mechanism for coupling the aramid strength members to the connector.

Index Matching Material: The use of index matching material between connector end faces to enhance performance shall not be permitted.

Intermateability: The connector shall be designed in such a manner to properly mate with connector assemblies and adapters of the same type. The connector supplied shall be compliant to the applicable current version of the intermateability standard, TIA/EIA-604. Connectors shall be supplied from the same Manufacturer.

Intermateability of Angled Connectors: The connector end face for an angled connector shall be designed to have a nominal angle of 8^{o} from perpendicular.

Connector Keying: The connectors shall be keyed to prevent rotation of the connector end faces relative to each other during installation or mating.

Product Marking: At a minimum, the connector shall have the connector type and the connector manufacturer's unique identification mark on the connector itself. These shall be permanent markings intended to last the life cycle of the product.

Aerial Slack Storage Rack: The contractor shall furnish and install aluminum loops to store fiber optic cable slack at locations specified on the plans, aerial splice enclosures or as ordered by the Engineer with a length of slack cable approved by the Engineer. The unit shall maintain the minimum bending radius of the optical cable. The size of the storage racks shall be sufficient to meet the requirements of the fiber optic cable specifications.

Quality Assurance Provision: All optical fibers shall be proof tested by the fiber manufacturer to a minimum load of 0.7 GN/m^2 (100 kpsi).
All optical fibers shall be attenuation tested. The attenuation of each fiber shall be provide for each reel of cable furnished.
The cable manufacturer shall be ISO 9001 registered.

Environmental Requirements: The cable shall function within the specifications over the following temperature ranges:

Shipping/Storage -	-50°C to 70°C
Installation:	-30°C to 70°C
Operation:	-40°C to 70°C

Construction Details: Prior to the installation of the fiber optic cable, the Contractor shall submit his proposed cable plant design to the Engineer for approval. The cable plant design shall include the following at a minimum:

Catalog cuts and shop drawings for all cable, connectors, splice equipment, splice enclosures, splice trays and cable installation and test equipment.
Locations of all proposed splices.

Fiber Optic Cable: The fiber optic cable installation techniques and procedures shall be specified by the cable manufacturer and shall be such that the optical and mechanical characteristics of the cables are not degraded at the time of installation.

Experience Requirements: Personnel involved in the installation, splicing and testing of the fiber optic cable shall meet the following requirements:

A minimum of seven (7) years experience in the installation of fiber optic cables, including fusion splicing, terminating, and testing single mode fibers.
Shall have installed at least five (5) communication systems where fiber optic cables in aerial/outdoor conduits and the systems are in continuous satisfactory operation for at least two (2) years. The Contractor shall submit as proof, photographs or other supporting documents, and the names, addresses and telephone numbers of the operating personnel who can be contacted regarding the fiber optic systems.
Personnel performing Splicing shall have been trained and certified by the manufacturer of the fiber splice equipment and material to be used, in fiber optic splicing procedures. Proof of this training must be submitted to the Engineer for approval.
Installers shall have been trained and certified by the manufacturer of the fiber optic cable to be used, in fiber optic cable installation and handling procedures. Proof of this training must by submitted to the Engineer for approval.
Personnel involved in testing shall have been trained and certified by the manufacturer of the fiber optic cable test equipment to be used, in fiber optic cable testing procedures. Proof of this training must be submitted to the Engineer for approval.

Installation: All fiber optic cables to be installed in a new or existing conduit, duct facility or overhead shall be pulled as a unit. The Contractor shall take every precaution to ensure the cable is not damaged during storage, delivery and installation. The cable shall not be pulled along the ground or over or around obstructions. The cable shall not be stepped on by workmen, nor run over by vehicles or equipment. All cable shall be inspected and approved by the Engineer prior to installation. All cables shall be pulled in conduit and along a cable messenger with a cable grip designed to provide a firm hold on the exterior covering of the cable. Heat shrinkable end caps shall be placed on the cable ends. Conduit ends shall be sealed with a urethane compound after the cable installation. When existing overhead traffic signal interconnect cables are in place, the new fiber optic cable shall be attched to this interconnect cable using a 15 to 20 year UV rated tie wraps at 18” of spacing. The contractor can also use industry approved lashing methods with a 20 year life.

When installing cable in existing conduits which already have cables within them, the Contractor shall take every precaution to not damage the existing cables. Should the Contractor cause damage to the fiber optic cable, or any existing cables, he shall immediately notify the Engineer and the affected owner. Corrective action will be made by the cable owner. The cost to repair damages caused by the Contractor’s wrong full actions shall be deducted from the money owed to the Contractor and paid to the cable owner for cable repair purposes.

The cable pulling operation shall be performed such that a minimum bending of the cable shall occur in the unreeling and pulling operations. Entry guide chutes shall be used to guide the cable into the pull-box conduit ports. Lubricating compound shall be used to minimize friction. Corner rollers (wheels), if used, shall not have radii less than the minimum installation bending radius of the cable. A series array of smaller wheels can be used for accomplishing the bend if the array is specifically approved by the cable manufacturer. The pulling tension shall be continuously

measured and it shall not be allowed to exceed the maximum tension specified by the manufacturer of the cable, breakaway swivels must be used to insure cable tensile strength not being exceeded. The pulling system shall have an audible alarm that shall sound whenever a pre-selected tension level is reached. Tension levels shall be recorded continuously and shall be given to the Engineer upon request.

The Contractor shall determine the number of pull boxes that the fiber optic trunk line can be continuously pulled through while maintaining the tension requirements. The number of pull boxes and their locations shall be submitted to the Engineer for approval. The Contractor may be required to install the cable one pull box at a time. The direction of the cable pull shall be determined by the Contractor and shall require the approval of the Engineer.

The central strength member and aramid yarn shall be attached directly to the pulling eye during cable pulling. “Basket grip” or “Chinese finger” type attachments to the cable outer jacket will not be permitted. A breakaway swivel with a cable manufacturer approved tensile rating shall be used on all pulls.

Cable slack of 30 feet shall be provided in pull boxes.

Cable shall be lashed to messenger in accordance with the cable manufacturer’s guidelines. For those locations where cable is being installed on new or existing messenger, or signal spans, the Contractor shall notify in advance all other pole owners and utilities involved.

The sag of aerial cable shall match that of the next lower communication cable. In no case shall aerial communication cable be allowed to sag into or near existing cables. At each aerial splice enclosure and at each signalized intersection along cable installation route the Contractor shall leave 150 feet of slack cable using aerial slack storage racks.

Splicing Requirements: All optical fibers shall be spliced to provide continuous runs. Splices shall be allowed in locations shown on the plans.

All splices shall use the fusion technique. Fusion splicing equipment shall be provided by the Contractor and shall be clean, calibrated and specifically adjusted to the fiber and environmental conditions at the start of each shift. Splicing tools and procedures, shall be approved by the cable manufacturer as being compatible with the cable type being delivered.

Each spliced fiber shall be packaged in a protective sleeving or housing. Bare fibers shall be completely recoated with a protective RTV, gel or similar substance, prior to application of the sleeve or housing, so as to protect the fiber from scoring, dirt or microbending.

Splice losses shall not exceed 0.10 dB. If a splice is measured to exceed 0.10 dB during the splicing process, it shall be remade until its loss falls below 0.10 dB @ 1310 nm. Each attempt shall be recorded for purposes of acceptance.

All splice losses shall be recorded in tabular form and submitted to the Engineer for approval. An optical time domain reflectometer (OTDR) shall be used to record splice loss, and chart

recordings of the “signature” and shall be submitted with the splice data with a record of all OTDR settings and the OTDR locations written on the trace.

Termination Requirements: Connectors shall be field mountable and shall not exceed 0.50 dB loss rating @ 1310 nm. This loss characteristic shall be maintained for a minimum of 500 connections (with periodic cleaning). Connectors will be qualified and accepted on the basis of connector-to-connector mating using similar fibers.
Unused optical fibers shall be properly protected with sealed end caps.

Documentation Requirements: Four (4) complete sets of operation and maintenance manuals shall be provided. The manuals shall, as a minimum, include the following:

Complete and accurate as-built schematic diagrams showing the fiber optic cable plant and locations of all splices.
Complete performance data of the cable plant showing the losses at each splice joint and each terminal connector.
Installation, splicing, terminating and testing procedures.
Complete parts list including names of vendors.
Complete maintenance and trouble-shooting procedures.

One (1) month prior to installation, four (4) copies of the Contractors Installation Practices shall be submitted for approval. This shall include installation methods, list of installation equipment, and splicing and test equipment. Field quality control procedures shall be detailed as well as procedures for corrective action.

Testing Requirements: The following tests shall be conducted. All tests shall be conducted in accordance with the approved test procedures. The Contractor shall submit test procedures and forms for approval to the Engineer.

Pre-Installation Tests: The fiber optic cable shall be tested at the storage site prior to installation. Each optical fiber in the cable shall be tested from one end with an OTDR with wavelength (1310 and 1550 nm) and fiber type. Testing shall check for continuity, length, anomalies, and attenuation. Each measurement shall be recorded with color, location, and type of fiber measure. In the event that a meaningful measurement cannot be made from one end, it shall be performed from the opposite end of that fiber.

Post-Installation Tests: After installation, each optical fiber in the cable shall be tested again for loss characteristics. Both directions of operation of the fiber shall be tested with an OTDR with wavelengths 1310 and 1550 nm.

After each fiber splice and connector installation, the cable shall be tested with an OTDR and the data shall be submitted to the Engineer as a basis for acceptance.

Subsystem Tests: The Contractor shall conduct approved fiber optic network subsystem tests after the integration of the fiber optic terminal equipment to the fiber optic network. The tests, as a minimum, shall demonstrate the capability of the fiber optic cable to transmit the specified

signals. The tests shall run continuously for a minimum of twenty four (24) hours without any network outage. Approved data forms shall be completed and turned over to the Engineer for review as the basis for acceptance/rejection.

If a subsystem fails because of any components in the subsystem, the particular components shall be corrected or replaced with other components and the tests shall be repeated.
If a component has been modified as a result of the subsystem test failure, a report shall be prepared and delivered to the Engineer prior to testing.

Method of Measurement: The quantity of single mode fiber optic cable and fiber optic drop cable to be paid will be measured for payment as the number of meters actually furnished and installed.

The quantity of fiber optic cable splice enclosures to be paid will be measured as the number of splice enclosures actually furnished and installed.

Basis of Payment: The unit price paid per meter for Single Mode Fiber Optic Cable and Fiber Optic Drop Cable shall include the cost of furnishing, installing, connecting and testing the fiber optic cable of the type specified. The price shall also include furnishing all labor, tools, materials, documentation, equipment, storage, transportation, and other incidentals necessary to complete the work.

Pay Item	Pay Unit
12 Strand Fiber Optic Single Mode Drop Cable	LF
144 Strand Fiber Optic Single Mode Interconnect Cable	LF
Fiber Optic Splice Enclosure	EA

ITEM #1113604A - OPTICAL FIBER CABLE, SINGLE MODE LOOSE BUFFER TUBE CABLE, 6 FIBER
ITEM #1113621A - OPTICAL FIBER CABLE, SINGLE MODE LOOSE BUFFER TUBE CABLE, 72 FIBER

Description:
This Item specifies the requirements for furnishing, installing in conduit or aerial between utility poles, splicing, and connectorizing fiber optic cables. As part of this item, the Contractor shall install a pull tape in specific conduits within the contract limits of work, as necessary to install the fiber optic cable. The specific areas where pull tape may be required are delineated in the Construction Methods section of this specification.

Materials:
A. General:

1. Outdoor fiber optic cable shall be installed in conduit or aerial between utility poles, spliced as required and terminated in Camera-Hub Cabinets, as shown on the Drawings.

2. Two-fiber Drop Cable shall be utilized to interconnect the mainline bypass communications cable with the equipment within the CCTV Camera Hubs and between the CCTV Camera Hubs and the Variable Message Sign Controllers, as shown on the Drawings.

3. The fiber optic cable, splices, connectors and interconnect panels shall meet all requirements stated in this Specification.

4. **All optical fiber cables used in this project shall be manufactured by Corning Incorporated, and splice-compatible with the Department's existing Siecor SMF/DS dispersion-shifted fiber optic cable. Optical fiber cable installed for this project shall be dielectric, dry-filled, loose-tubed, duct-type.**

B. Applicable Publications:

1. Publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation. All Fiber Optic Communication System hardware shall be compliant with the following specifications:

Electronics Industries Association (EIA):

a. EIA-310-C Racks, Panels, and Associated Equipment.
b. EIA-359-A Colors for Color Identification and Coding.
c. EIA-422-A Electrical Characteristics of Balanced Voltage Digital Interface Circuits.
d. EIA-TIA-455-A Standard Test Procedures for Fiber Optic Fibers, Cable Transducer Sensors, Connecting and Terminating Devices and Other Fiber Optic Components.
e. EIA-455-6B Cable Retention Test Procedure for Fiber Optic Cable Interconnecting Devices.

f. EIA-485 Standard for Electrical Characteristics of Generators and Receivers for use in Balanced Digital Multipoint Systems.
g. TIA/EIA-598-A Optical Fiber Cable Color Coding.

2. USDA Rural Utilities Service (RUS) 7 CFR 1755.900.

3. ANSI/ICEA Standard for Fiber Optic Outside Plant Communications Cable, ANSI/ICEA S-87-640-1992.

4. UL-listed OFNR

5. CSA-listed FT-4

C. Outdoor Fiber Optic Cable Requirements:

1. The cable shall be an accepted product of the United States Department of Agriculture Rural Utilities Service (RUS) 7 CFR 1755.900 and meet the requirements of the ANSI-ICEA Standard for Fiber Optic Outside Plant Communications Cable, ANSI/ICEA S-87-640-1992.

2. The Outdoor Fiber Optic Cable shall be stranded tight tube cable with the required number of fibers as shown in the Contract Drawings.

3. The Contractor shall provide manufacturer's documentation certifying that the Outdoor Fiber Optic Cable complies with the following performance requirements:

   a. When tested in accordance with FOTP-3, "Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic Components," the change in attenuation at extreme operational temperatures of -40 ºF and 158 ºF (-40°C and +70°C) shall not exceed .24 dB/mile (0.15 dB/km) at 1550 nm for single mode fiber.

   b. When tested in accordance with FOTP-82, "Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable." a 3 foot (one-meter) length of unaged cable shall withstand a 3 foot (one-meter) static head or equivalent continuous pressure of water for cable end.

   c. When tested in accordance with FOTP-81, "Compound Flow (Drip) Test for Filled Fiber Optic Cable", the cable shall exhibit no flow (drip or leak) of filling and/or flooding material at 158 ºF (70°C).

   d. When tested in accordance with FOTP-41, "Compressive Loading Resistance of Fiber Optic Cables," the cable shall withstand a minimum compressive load of 125 lbf/in (220 N/cm) applied uniformly over the length of the sample. The 125 lbf/in (220 N/cm) load shall be applied at a rate of 0.1 inch (2.5 mm) per minute. The load shall be maintained for a period of 1 minute. The load shall then be decreased to 63 lbf/in (110 N/cm). Alternatively, it is acceptable to remove the 125 lbf/in (220 N/cm) load entirely and apply the 63 lbf/in (110 N/cm) load within five minutes at a rate of 0.1 inch (2.5 mm) per minute. The 63 lbf/in (110 N/cm) load shall be

maintained for a period of 10 minutes. Attenuation measurements shall be performed before release of the 63 lbf/in (110 N/cm) load. The change in attenuation shall not exceed 0.15 dB at 1550 nm for single-mode fibers and 0.30 dB at 1300 nm for multimode fiber.

e. When tested in accordance with FOTP-104, "Fiber Optic Cable Cyclic Flexing Test," the cable shall withstand 25 mechanical flexing cycles around a sheave diameter not greater than 20 times the cable diameter. The change in attenuation shall not exceed 0.15 dB at 1550 nm for single mode fiber.

f. When tested in accordance with FOTP-25, "Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies," except that the number of cycles shall be two at three locations along a 3 foot (one meter) cable length and the impact energy shall be at least 3.25 lb-ft (4.4 Nm) (in accordance with ICEA S-87-640)", the change in attenuation shall not exceed 0.15 dB at 1550 nm for single-mode fiber.

g. When tested in accordance with FOTP-33, "Fiber Optic Cable Tensile Loading and Bending Test," using a maximum mandrel and sheave diameter of 22 inches (560 mm), the cable shall withstand a rated tensile load of 601 lbf (2670N) and residual load of 30% of the rated installation load. The axial fiber strain shall be ≤ 60% of the fiber proof level after completion of 60 minute conditioning and while the cable is under the rated installation load. The axial fiber strain shall be ≤ 20% of the fiber proof level after completion of 10 minute conditioning and while the cable is under the residual load. The change in attenuation at residual load and after load removal shall not exceed 0.15 dB at 1550 nm for single mode fiber and 0.30 dB at 1300 nm for multimode fiber.

h. When tested in accordance with FOTP-85, "Fiber Optic Cable Twist Test," a length of cable no greater than 6 feet (2 meters) shall withstand 10 cycles of mechanical twisting. The change in attenuation shall not exceed 0.1 dB at 1550 nm for single mode fiber

i. When tested in accordance with FOTP-181, "Lightning Damage Susceptibility Test for Optic Cables with Metallic Components," the cable shall withstand a simulated lightning strike with a peak value of the current pulse equal to 80 kA without loss of fiber continuity. A damped oscillatory test current shall be used with a maximum time-to-peak value of 15 μs (which corresponds to a minimum frequency of 16.7 kHz) and a maximum frequency of 30 kHz. The time to half-value of the waveform envelope shall be from 40 - 70 μs.

j. When tested in accordance with FOTP-37, "Low or High Temperature Bend Test for Fiber Optic Cable," the cable shall withstand four full turns around a mandrel of ≤ 20 times the cable diameter after conditioning for four hours at test temperatures of -22 ºF and 140 ºF (-30°C and +60°C). Neither the inner or outer surfaces of the jacket shall exhibit visible cracks, splits, tears, or other openings. The change in attenuation shall not exceed 0.30 dB at 1550 nm for single mode fiber and 0.50 dB at 1300 nm for multimode fiber.

4. All optical fibers, coatings, tubes, metals and jackets shall be free of roughness, porosity, blisters, splits and voids in accordance with good manufacturing practice.

5. The color coding and position of fibers / buffer tubes within the cable shall be in accordance with TIA/EIA–598-A "Optical Fiber Cable Color Coding". Fibers shall be colored with ultraviolet

curable ink. In buffer tubes containing multiple fibers, the colors shall be stable across the specified storage and operating temperature range and not subject to fading or smearing onto adjacent fibers or into the gel filing material. Color materials shall not cause fibers to stick together.

6. The buffer tubes shall be resistant to external forces and shall meet the buffer tube cold bend and shrinkback requirements of 7 CFR 1755.900.

7. The cable shall be suitable for operation over a temperature range of -40 ºF to 158 ºF (-40^{o}C to +70^{o}C) and shall be suitable for installation in outdoor ducts or installed aerial between wood poles.

8. The cable shall provide mechanical support and protection for the specified number of fibers.

9. The central anti-buckling member shall consist of a dielectric, glass reinforced plastic (GRP) rod. The GRP rod shall be coated with a black colored thermoplastic when required to achieve dimensional sizing to accommodate buffer tubes/fillers.

10. Each buffer tube shall contain a water-swellable yarn for water-blocking protection. The water-swellable yarn shall be non-nutritive to fungus, electrically non-conductive, and homogeneous. It shall also be free from dirt or foreign matter. This yarn will preclude the need for other water-blocking material; the buffer-tube shall be gel-free.

11. Buffer tubes shall be stranded around the dielectric central member using the reverse oscillation, or "S-Z", stranding process. Water blocking yarn(s) shall be applied longitudinally along the central member during stranding.

12. A water blocking tape shall be applied longitudinally around the outside of the stranded tubes/fillers. The tape shall be held in place by a single polyester binder yarn. The water blocking tape shall be non-nutritive to fungus and electrically non-conductive.

13. The cable shall be able to withstand a maximum pulling tension of 600 lb (2700 N) during installation without any resulting damage. Tensile strength shall be provided by dielectric yarns. The high tensile strength dielectric yarns shall be helically stranded evenly around the cable core.

14. Non-armored cables shall be sheathed with medium density polyethylene (MDPE). The minimum nominal jacket thickness shall be 0.055 inches (1.4 mm). Jacketing material shall be applied directly over the tensile strength members (as required) and water swellable tape. The polyethylene shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus. The MDPE jacket material shall be as defined by ASTM D1248, Type II, Class C, Category 4 and Grades J4, E7 and E8.

15. The cable shall contain at least one ripcord under the sheath (outer cable jacket) for easy sheath removal of all-dielectric cable.

16. Cable jackets shall be marked with the manufacturer's name, month and year of manufacture, sequential foot (meter) markings, a telecommunication handset symbol as required by Section 350G of the National Electrical Safety Code® (NESC®), fiber count, and fiber type. The actual length of the cable shall be within -0/+1% of the length markings. The print color shall be white, with the exception that cable jackets containing

one or more coextruded white stripes, which shall be printed in light blue. The height of the marking shall be approximately 0.098 inches (2.5 mm).

17. Materials used in the cable shall not produce hydrogen in a concentration large enough to cause any degradation in the transmission performance of the optical fibers.

18. Materials used in the cable shall not support galvanic action.

D. Fiber Optic Trunk Cable:

1. This item consists of furnishing and installing optical fiber cables and connectors of the size and type specified at the locations shown on the Drawings or as indicated by the Engineer, in accordance with these Specifications.

2. Fiber Optic cable shall be installed in conduit or inner-duct as shown on the Drawings by the Methods defined in this Specification. Fiber Optic cable shall be installed in the lowest available innerduct in the conduit, as specified below.

3. The Contractor shall provide multiple fiber, stranded, loose tube cable with single mode fiber that shall be suitable for placement in an underground environment as shown in the Drawings.

4. The Contractor shall provide a manufacturer's certification that the offered cable complies with all optical and mechanical requirements set forth in this Specification. Any deviation of the offered cable from the specifications set forth herein shall be clearly noted in the Contractor's proposal.

E. Fiber Optic Drop Cables:

1. Drop cables are used for connecting Camera Hub cabinets to the fiber optic trunk cable and for connecting Variable Message Sign controllers to the Camera Hub cabinet.

2. The Drop Cable shall consist of single mode fibers housed in a protective jacket. One end of the fiber shall be connectorized for termination within the Camera Hub, the other end shall be spliced into a fiber optic trunk cable at an underground Splice Closure within an adjacent pullbox or above ground Splice Case attached to the nearest utility pole or wood pole. Drop Cables used for interconnection of the Variable Message Sign Controller cabinets with the Camera Hub equipment shall be field connectorized at both ends of the cable for termination within the Camera Hub cabinet and Variable Message Sign Controller cabinet.

3. The drop cables shall be suitable for operation over the temperature range of -40 ºF to 158 ºF (-40^{o} C to +70^{o} C).

4. Drop Cables shall be of length suitably long to be connected to the rack mounted fiber optic transmission equipment within the Camera Hub and the fiber optic cable splice case or splice enclosure in the adjacent pullbox. Sufficient slack shall be left at each end to allow removal of the Splice enclosure and trays.

5. The attenuation of Drop Cable after installation, not including the connector loss, shall not exceed 0.15 dB measured at 1310 nm and 1550 nm.

6. All optical fiber cable used for a drop cable shall comply with all other aspects of these Specifications for optical fiber cable as set forth. The drop cable shall be spliced and connected as shown in the Drawings and within these Specifications.

F. Single Mode Optical Fibers:

1. The Single Mode fiber shall consist of a doped silica core surrounded by a concentric silica cladding. The fiber shall be matched clad design.

2. The dispersion un-shifted or dispersion flattened single mode fiber shall conform to the following specifications:

   a. The Single Mode fiber core shall have a diameter of between 8.2 to 9 μm inclusive with a tolerance of ± 1.3 μm.

   b. The Single Mode fiber cladding shall have an outer diameter of 125 μm with a tolerance of ±0.7 μm.

   c. The core-to-cladding offset shall not be greater than 0.5 μm.

   d. The cladding Non-Circularity shall not be greater than 0.7% defined as:
   Minimum Cladding Diameter/Maximum Cladding Diameter) x 100

   e. The Single Mode fiber shall be coated with a protective polymer to preserve the strength of the fiber. The coating shall be removable by mechanical or chemical means. The coating shall retain its color when subject to the manufacturer's recommended fiber cleaning and splicing preparation methods.

   f. The SM fiber shall have attenuation and bandwidth specified at two wavelength windows.

      i. The first wavelength window shall be at and around 1310 nm.
      ii. The second wavelength window shall be at and around 1550 nm.

3. The maximum optical attenuation at 1310 nm shall not be greater than 0.64 dB/mile (0.4 dB/km).

4. The maximum optical attenuation at 1550 nm shall not be greater than 0.48 dB/mile (0.3 dB/km).

5. The fiber attenuation shall not vary more than 0.32 dB/mile (0.2 dB/km) over the specified cable operational temperature range.

6.

7. The zero dispersion wavelength shall be at a wavelength of 1310 ± 10 nm.

8. The maximum dispersion at 1550 nm shall not exceed 18 ps / (nm-km).

9. The maximum dispersion in the wavelength range of 1285 to 1330 nm shall not exceed 3.2 ps / (nm-km).

G. Fiber Optic Connectors:

1. The connector shall have a ceramic ferrule with a nickel-plated nut and body.

2. The connector shall be of the ST-type and fully compatible with the fiber optic cable utilized and the mating jacks to which they will be attached.

3. The connector shall be compatible with a physical contact (PC) finish. All connectors shall be polished to a PC finish such that the return loss per mated pair of connectors is at least 25 dB. The return loss when the connector is mated with previously installed connectors shall be at least 18 dB.

4. The connector mean loss shall not be greater than 0.2 dB with a standard deviation of not greater than 0.1 dB.

5. Index matching fluids or gels shall not be used.

6. The connector loss shall not vary more than 0.2 dB after 500 repeated matings.

7. The connector shall withstand an axial load of 11.2 lb (50 N) at 0˚ pull out angle with strength members and 0.5 lb (2.2 N) at 0˚pull out angle without strength members.

8. The connectors shall be attached in accordance with the manufacturer's recommended materials, equipment and practices.

9. The connector shall be suitable for the intended environment and shall meet the following environmental conditions.

a. Operating Temperature: -4 ºF to 122 ºF (-20 to +50^{o} C)

b. Storage Temperature: -22 ºF to 140 ºF (-30 to +60^{o} C)

c. The connector loss shall not vary more than 0.2 dB over the operating temperature range.

d. Connectors shall be protected by a suitably installed waterproof protection cap.

H. Fiber Optic Cable Fabrication:

1. Packing and Shipment

a. The cable shall be supplied on reels. Top and bottom end of the cable shall be available for testing. Both ends of the cable shall be sealed to prevent ingress of moisture.

b. The optical cable shall be in one continuous length per reel with no factory splices in the fiber. Each reel shall be marked to indicate the direction the reel should be rolled to prevent loosening of the cable. Installation procedures and technical support shall be furnished upon request.

c. Each reel shall have the following information clearly labeled on it:
   i. Customer
   ii. Customer order number
   iii. Reel number
   iv. Destination
   v. Ship date
   vi. Manufactured date
   vii. Manufacturer's name
   viii. Cable code
   ix. Length of cable

I. Warranty:

1. All equipment supplied for this shall be warranted for parts and labor by the vendor against defects and failures, which may occur through normal use for a period of one (1) year from the date of installation. A copy of the warranty must be presented to the Engineer before installation of the equipment.

J. Quality Assurance:

1. The Contractor shall have a Quality Assurance Program in place.

2. A minimum of ten (10) year's experience in the design, manufacture, and testing of Fiber Optic Cable and Connectors is required. The cable and connectors shall be designed and manufactured according to world class quality standards. The manufacturer shall be ISO 9001 certified.

Construction Methods:

A. Submittals:

1. Submit:

   a. Functional block diagrams, cabling diagrams, and point to point cabling details, including locations of all trunk cable splice points (both drop cable splices and reel-end splices.)

   b. As built drawings including a cable route diagram indicating the actual cable route and "foot (meter) marks" for all interchanges, intersections, directional change points in the cable routing,

and all termination points. The Contractor shall record these points during cable installation. Cable system "as-built" drawings showing the exact cable route shall be provided by the Contractor to ConnDOT. Information such as the location of slack cable and its quantity shall also be recorded in the cable route diagram.

c. Product data, manufacturer's test certifications, installation manuals, materials, system configuration options and features, and accessories.

d. Shop Drawings shall be completely dimensioned and shall indicate the intended installation method and details.

e. Specifications of cable, connectors, and fiber splice kits.

f. Operating and maintenance manuals for all equipment.

g. Vendor Optical Time Domain Reflectometer (OTDR) certification for each reel of fiber optic cable listing each specification compliant fiber by fiber color code and group color code.

B. Delivery, Storage, and Handling:

1. The Contractor shall deliver, store, handle and install all materials and equipment in such a manner as not to degrade quality, serviceability or appearance.

2. The Contractor shall be responsible for storage of the materials and equipment prior to installation in a clean, dry location free from construction dust, precipitation and excess moisture.

3. Contractor shall be required to replace any damaged materials and equipment, as determined by the Engineer, at no additional cost to the owner.

4. Cable shall be transported to site using cable reel trailers.

5. Care shall be taken at all times to avoid scraping, denting, or otherwise damaging the cable before, during or after installation. Damaged cable shall be replaced by the Contractor without additional compensation.

6. Sufficient slack shall be pulled to allow cable cutting and connection to communications equipment.

C. Installation in Ducts:

1. The Contractor shall contact Mr. James Gannon of ConnDOT Highway Operations (203-673-7373) at least fourteen (14) days prior to fiber optic cable installation in the duct system. Mr. Gannon will identify the specific fiber optic conduit innerducts that shall be used for cable installation.

2. Cable shall be installed in innerduct, duct or conduit in the field in accordance with the Contract Drawings.

3. The Contractor shall install cables in innerducts consistently throughout the project; crossover of a cable from one innerduct to another is not allowed.

4. Duct ends shall have all rough ends smoothed to prevent scraping the cable.

5. Where cable will be installed directly in conduit with no innerduct, a stiff bristle brush shall be pulled through each section of duct before pulling cable.

6. The Contractor shall not exceed the manufacturer's recommended safe pulling tension and minimum bending radius during delivery and installation.

7. A manufacturer's recommended lubricant shall be applied to the cable to reduce friction between the cable and the duct.

8. A cable grip shall be attached to the cables so that no direct force is applied to the optical fiber. The cable grip shall have a ball bearing swivel to prevent the cable from twisting during pulling.

9. Cable rollers and feeders and winch cable blocks shall be used to guide the cable freely into the duct and at maintenance hole locations.

10. Mechanical aids and pulling cable or ropes shall be used as required.

11. The Contractor shall employ personnel at as many pull points as need be to achieve the longest continuous cable segment as possible to reduce the need for excessive main-line splices.

12. Personnel equipped with two-way radios shall be stationed at each maintenance hole, cabinet and communications vault at which the cable is to be pulled to observe and lubricate the cable.

13. Where mechanical pulling is required (i.e. all runs greater than 164 feet (50 m)), a dynamometer shall be used to record installation tension and a tension limiting device shall be used to prevent exceeding the maximum pulling tension as defined by the cable manufacturer. The maximum pulling tension shall be recorded for each run of cable. The cable shall be taken up at intermediate pulling points with an intermediate cable take-up device as approved by the Engineer to prevent over tension on the cable. Cable pulls shall be continuous and steady between pull points and shall not be interrupted until the entire run of cable has been pulled.

14. Trunk fiber cable segment lengths shall be the maximum tolerable length within the maximum pulling tension defined by the manufacturer. The number of trunk cable reel-end splices shall be minimized. The Contractor shall provide a plan to the Engineer showing the reel-end splice point locations following a field investigation of the conduit and shall not install cable until receiving the Engineer's approval of the reel-end splice location plan. The Contractor shall obtain the Engineer's approval for all required changes to the reel-end splice point location plans. Cable segments installed with reel-end splices not approved by the Engineer will be replaced by the Contractor at no additional cost to the Department.

15. The Contractor shall be responsible for ensuring the cable length is sufficient to allow for connection between the communication equipment and the splice enclosures including provision for slack, vertical runs, cable necessary for splicing, wastage and cable to allow for the removal of the splice enclosure for future splicing.

16. Drop Cable fibers in the Camera Hub Cabinets shall be connectorized and the Active Fiber connected directly to the Optical Video/Data Transceiver. The Spare Fiber with Connector shall be safely and securely attached to the interior of the equipment rack with plastic ties. The cable shall not be stressed beyond the minimum bending radius at any time.

17. All cable ends, connectors, and fiber optic jacks shall be protected from moisture ingress by using properly sealed caps.

18. Following installation of the cable in the ducts, all duct entrances at pedestals and cabinets shall be sealed with duct sealing compound to prevent the ingress of moisture, foreign materials, and rodents.

19. 20 feet (6 m) of cable going to and coming from each Splice Closure shall be coiled in the first maintenance hole on each side of each closure. In addition, 50 feet (15 m) of cable shall be left coiled in the first maintenance hole on each side of all surface mounted conduit systems.

20. Where trunk cable terminations are left "dead ended", 100 feet (25 m) of cable shall be left coiled.

21. All coiled cables shall be securely fastened in place with a minimum of four galvanized steel conduit straps.

22. At intermediate pulling points, to prevent over tension on the cable, the cable shall be either taken up with an intermediate cable take up device as approved by the Engineer, or all excess cable shall be laid out on the ground in a figure eight configuration before subsequent installation.

23. Following installation in duct, a label shall be affixed to each cable end in a pull box or cable vault and the label shall contain the following information:

    - Customer order number
    - Reel number
    - Ship date
    - Manufactured date
    - Manufacturer's name
    - Cable designation as shown on the Drawings
    - Length of cable to next reel-end splice point
    - Location of other end of cable (reel-end splice point)
    - Cable test data

D. Aerial Installation:

1. The Contractor shall provide the proper clearance between the aerial cable and the adjacent electric or telephone service cable. This is to assure the proper gain is attained between cables. The Contractor shall verify the proper clearance with the appropriate utility company.

2. Cables shall be double lashed to messenger supports.

3. Cables shall be attached to existing wood poles with 3-bolt suspension clamp with J-hooks. Cable lashings shall be provided on either side of the wood pole.

4. Cable guards shall be provided at bends to ensure proper termination of lashing wire and insertion of spacers at each pole location as shown on the plans.

E. Splicing:

1. The Contractor shall contact Mr. James Gannon of ConnDOT Highway Operations (203-676-7373) at least fourteen (14) days prior to fiber optic cable splicing. Mr. Gannon will provide direction on splicing the drop cable to the existing fiber cable network, and identify the specific fibers that will be utilized for the camera locations shown on the plans.

2. Splicing of the cable shall only be permitted at splice enclosure, splice case or field fiber optic interconnect panel locations as indicated in the Drawings, unless authorized by the Engineer.

3. The Contractor shall prepare for splicing the designated fibers of the cable to the Drop Cables connecting the communications equipment located in the Camera cabinets. Sufficient cable shall be coiled in the pullbox/cabinet to allow for consumption during the splicing and to permit the splice closure to be removed from the pullbox/cabinet for future splicing.

4. At least 3 ft. (1.0m) of each fiber shall be stored in the splice trays. The Contractor shall further splice all additional fibers provided in order to meet the fiber requirements specified in the Contract and including any fibers provided which are additional to the Contract requirements.

5. For aerial installations, the Contractor shall install splice cases constructed with a watertight cover assembly to prevent ingress of moisture. Splice cases shall be provided with clamp assemblies and end caps to securely fasten the splice trays.

6. Aerial splices shall only be done at existing wood poles. Splice cases shall be installed to one side of the wood pole to allow for the free movement of optical fiber cable from the splice case to the duct entrance of an adjacent conduit riser or to accommodate the direction change of a 2-Fiber drop cable.

F. Testing:

1. Test Documentation:

a. The Contractor shall be responsible for all testing and documentation required to establish approval and acceptance of this Item.

b. The Contractor shall submit test procedures and documented test results to the Engineer. The test procedures shall document the nature of test activities to be performed.

c. The test procedures shall be submitted to the Engineer prior to initiation of the testing. The procedures will be returned to the Contractor within two weeks indicating either "accepted" or "make corrections noted". If corrections are required, the Contractor shall submit revisions within 1 week.

d. Four copies of the final test procedures shall be submitted to the Engineer prior to commencement of testing.

2. Pre-Installation Testing:

   a. Reels of cable shall be tested for attenuation prior to installation in ducts. The Contractor shall measure and record the attenuation of 100% of the total single mode fibers on each reel. Attenuation shall meet or exceed the specified performance requirements in accordance with the Contract.

   b. The Contractor shall ensure that specifications for the fiber optic cable are met prior to installation.

3. Proof of Performance Testing:

a. The Contractor shall measure the attenuation per mile (kilometer) of fiber in each length of cable after installation.

b. The Contractor shall measure the attenuation of a randomly selected minimum of 10% of the total single mode fibers, which will be connected to equipment.

c. All (100%) of optical fibers assigned to be spare or reserved shall be individually tested for optical attenuation.

d. The Contractor shall sequence the fibers which are to be measured after each pull, such that the same fibers are not measured on consecutive lengths.

e. The Contractor shall record the reel number from which the cable came, the identification of the fibers measured and the attenuation in dB/mile (dB/km) of the fibers measured.

f. The Contractor shall measure and record the splice quality of each fusion splice performed. The Engineer shall be provided with access to interim results.

4. Optical Time Domain Reflectometer (OTDR) Testing:

a. The Contractor shall perform Single Mode Fiber OTDR testing after each cable has been installed.

b. The Contractor shall provide the Engineer with information regarding OTDR test equipment make and model with the equipment calibration procedures and certification dates prior to conducting the test routine.

c. An OTDR shall be used for backscattered light measurements. The OTDR shall operate at a nominal wavelength of 1310 nm and 1550 nm and shall include all necessary hardware required to couple it with single mode fiber.

d. The backscatter light measurement of each single mode fiber and each single mode optical link shall be measured in both directions and at both 1310 nm and 1550 nm wavelengths. Each single mode optical link shall be defined as being the total length of interconnected single mode fibers and the splices which form a continuous end-to-end optical link.

e. The Contractor shall maintain a test result record of each single mode optical link and each single mode fiber by means of printer copy of the OTDR measured cable attenuation profile. Single mode optical links shall be identified in the test results by identifying the fiber under test and by identifying the cabinet site at which the OTDR was connected.

f. The test results shall include the following measurements:

    i. Total length of the single mode link
    ii. Total attenuation of the single mode link
    iii. Attenuation of each splice in the link under test
    iv. Attenuation per mile (kilometer) of each interconnected fiber in the link under test

g. Attenuation shall be measured in decibels referencing optical power.

h. Each single mode fiber and splice tested shall be tested to meet the performance requirements in accordance with the Contract. Fiber strands failing this test shall be re-terminated and re-tested.

Method of Measurement:

Work under this item shall be measured for payment by the number of linear foot (meter) of "Optical Fiber Cable – Single Mode Loose Buffer Tube Cable" of the type indicated, furnished and installed, as specified and shown on the Drawings.

Basis of Payment:

The work to be done under this item shall be paid at the Contract unit price for each foot (meter) of the Optical Fiber Cable – Single Mode Loose Buffer Tube Cable " of the type indicated, furnished and installed as described in this Specification. This work shall include all cable, connectors, equipment, materials and incidental items required to satisfy these Specifications.

Pay Item	Pay Unit
Optical Fiber Cable – Single Mode Loose Buffer Tube Cable, 6 Fiber	LF
Optical Fiber Cable - Single Mode Loose Buffer Tube Cable, 72 Fiber	LF

ITEM #1113906A –CAT 6 CABLE

Description: The work under this item shall consist of furnishing and installing a CAT 6 Cable as shown on the plans or as directed and in accordance with these specifications:

Required Submittals:

Shop Drawings:
Submit 3 copies of shop drawings for the CAT 6 in accordance with these specifications and the contract general requirements.

Materials:

CAT 6 Cable: This cable shall be outdoor rated CAT 6 cable and shall be as manufactured by Belden or Comscope or equal.

Construction Methods: The CAT 6 cable shall be installed between the camera dome and the video or controller cabinet in new and existing conduit, handholes, or supported on a messenger cable or signal span as shown on the plans. All cables shall be handled with care to avoid damage to the conductors or the jacket. When pulling in conduit, the contractor shall use an approved lubricant, as required. Cable shall be looped in and out of cabinets and handholes to provide adequate slack and the least amount of stress on conductors and connectors. When installed overhead, drip loops of a minimum one foot diameter shall be provided. Camera cable shall run without splices between the camera and the cabinet. The contractor shall furnish and install all necessary end connectors as required.

Method of Measurement: The quantity to be paid under the item "CAT 6 Cable" shall be the actual number of linear feet of the size specified, measured along the center of the cable, installed, tested, operational and accepted in place

Basis of Payment: This work shall be paid for at the contract unit price per linear foot for "CAT 6 Cable", which price shall include furnishing and installing cable; connectors; all labor, tools, materials, equipment, storage, transportation and other incidentals necessary to complete the work.

Pay Item	Pay Unit
CAT 6 Cable	LF

ITEM 1116100A INTERNALLY ILLUMINATED SIGN (LED)

Description: This item shall consist of furnishing and installing An Internally Illuminated Sign (LED) at the location and to the dimensions and details shown on the plans, or as ordered by the Engineer and in conformity with these specifications.

Required submittals

Shop Drawings:
Submit 4 copies of shop drawings for hand holes and covers in accordance with the contract general requirements.

Materials: These signs shall be as manufactured by Engineered Castings. The materials for this work shall conform to the following specifications.

The sign shall incorporate Edge Lit with 12VDC LED modules with transparent reflective sheeting. The frame shall be made of extruded aluminum with no welds or sheet metal fabrication.

Photocell: One photocell shall be provided to turn ON/OFF the illuminated sign power panel. This photocell shall be installed on a nearest pole at 15 feet from the base.

Mounting Brackets: Mounting brackets shall be as specified in the contract documents or as to allow the sign to be mounted to the face of the mast arm, or free swinging, or hung from the span wire, or mounted on a pole.

Construction Methods: The sign shall be installed with rust proof hardware. The two sided signs shall be installed with connectors to align the sign vertically and horizontally. The wiring shall be installed in neat manner with UV rated sleeve and grommets.

Method of Measurement: This work will be measured for payment by the number of signs specified, completed and accepted in-place.

Basis of Payment: This work will be paid for at the contract price each for "INTERNALLY ILLUMINATED SIGN (LED)" of the type called for, complete in-place, which price shall include all connectors, wiring, photocell, brackets, signs and work incidental thereto.

Pay Item	Pay Unit
INTERNALLY ILLUMINATED SIGN (LED)	EA.

ITEM 1118051A – TEMPORARY SIGNALIZATION (SITE NO. 1)

Description:
Provide Temporary Signalization (TS) at the intersections shown on the plans or as directed by the Engineer.

Existing Signalized Intersection: Keep each traffic signal completely operational at all times during construction through the use of existing signal equipment, temporary signal equipment, new signal equipment, or any combination thereof once TS has started as noted in the section labeled Duration.

Site Numbers:

This Special Provision refers to specific intersections and construction stages by Site Numbers. The following is a listing of the sites numbers and their corresponding location and stage in the contract drawings.

SITE NUMBER	INTERSECTION	STAGE
1	South State Street at Atlantic Street	2

Materials:
Pertinent articles of the Standard Specifications
Supplemental Specifications and Special Provisions contained in this contract

Construction Methods:
Preliminary Inspection
In the presence of the Engineer and a representative from the DOT Electrical Maintenance Office (Town representative for a Town owned signal), inspect and document the existing traffic signal's physical and operational condition prior to Temporary Signalization. Include but do not limit the inspection to the following:
Controller Assembly (CA)
Controller Unit (CU)
Detection Equipment
Pre-emption Equipment
Coordination Equipment
Vehicle and Pedestrian Signals
Vehicle and Pedestrian Detectors
Emergency Vehicle Pre-emption System (EVPS) *
Interconnect Cable and Splice Enclosures
Support Structures
Handholes, Conduit and Cable
It may be necessary to repair or replace equipment that is missing, damaged, or malfunctioning. Develop a checklist of items for replacement or repair after the inspection. If authorized by the Engineer, this work will be considered "Extra Work" under Article 1.09.04.
* At a State owned signal the EVPS equipment is usually owned by the municipality. It is recommended to apprise the municipality of the inspection schedule and results.

TS Plan

At least 30 days prior to implementation of each stage, submit a 1:40 scale TS plan for each location to the Engineer for review and comment. Include but do not limit the plan to the following:

Survey Ties
Dimensions of Lanes, Shoulders, and Islands
Slope Limits
Clearing and Grubbing Limits
Signal Phasing and Timing
Location of Signal Appurtenances such as Supports, Signal Heads, Pedestrian Push buttons, Pedestrian Signals
Location of Signing and Pavement Markings (stop bars, lane lines, etc.)
Location, method, and mode of Temporary Detection

Review of the TS plan does not relieve the Contractor of ensuring the TS meets the requirements of the MUTCD. A copy of the existing traffic signal plan for State-owned traffic signals is available from the Division of Traffic Engineering upon request. Request existing traffic signal plans for Town-owned traffic signals from the Town. Do not implement the TS plan until all review comments have been addressed.

Earthwork

Perform the necessary clearing and grubbing and the grading of slopes required for the installation, maintenance, and removal of the TS equipment. After TS terminates restore the affected area to the prior condition and to the satisfaction of the Engineer.

Maintenance and Protection of Traffic

Furnish, install, maintain, relocate, and remove signal-related signing (lane-use, signal ahead, NTOR, etc.) and pavement markings as needed. Install, relocate, and/or remove equipment in a manner to cause no hazard to pedestrians, traffic or property. Maintain traffic as specified in the Special Provisions "Prosecution and Progress" and "Maintenance and Protection of Traffic."

Electrical Service and Telephone Service at Existing Signalized Intersections

If the electrical service or the telephone service source must be changed or relocated make all arrangements with the utility company and assume all charges. The party previously responsible for the monthly payment of service shall continue to be responsible during TS.

Temporary Signalization

Furnish, install, maintain, relocate, and remove existing, temporary, and proposed traffic signal equipment and all necessary hardware; modify or furnish a new CA; reprogram the CU phasing and timing; as many times as necessary for each stage/phase of construction to maintain and protect traffic and pedestrian movements as shown on the plans or as directed by the Engineer. Equipment installed as part of the staged operations that shall remain in the permanent configuration shall not be included in the Temporary Signalization, but shall be paid for under the appropriate items. Equipment installed under Temporary Signalization shall be removed as part of this item.

Inspection

When requested by the Engineer, the TS will be subject to a field review by a representative of the Division of Traffic Engineering and/or the Town, which may generate additional comments requiring revisions to the temporary signal.

Detection

Provide vehicle detection on the existing, temporary, and/or new roadway alignment for all intersection approaches that have existing detection, that have detection in the final condition as shown on the signal plan, or as directed by the Engineer. Keep existing pedestrian pushbuttons accessible and operational at all times during TS. Temporary Detection is described and is paid for under Item # 11112XXA - Temporary Detection (Site No. X)

Emergency Vehicle Pre-emption System (EVPS)

Furnish, install, maintain, relocate, and remove the equipment necessary to keep the existing EVPS operational as shown on the plan. Do not disconnect or alter the EVPS without the knowledge and concurrence of the Engineer and the EVPS owner. Schedule all EVPS relocations so that the system is out of service only when the Contractor is actively working. Ensure EVPS is returned to service and is completely operational at the end of the work day. Keep the EVPS owner apprised of all changes to the EVPS.

Coordination

Furnish, install, maintain, relocate, and remove the equipment necessary to keep the intersection coordinated to adjacent signals as shown on the plan. Do not disconnect the interconnect without the approval of the Engineer.

Closed Loop System: If it is necessary to disconnect the communication cable, notify the Engineer and the Bridgeport Operation Center (BOC) or the Newington Operation Center (NOC) prior to disconnect and also after it is reconnected.

Time Base System: Program and synchronize all Time Clock/Time Base Coordination (TC/TBC) units as necessary.

Maintenance

Once TS is in effect, assume maintenance responsibilities of the entire installation in accordance with Section 1.07.12 of the Standard Specifications. Notify the Engineer for the project records the date that Temporary Signalization begins. Notify the following parties that maintenance responsibility has been transferred to the Contractor:

Signal Owner

CT DOT Electrical Maintenance Office or
Town Representative
Local Police Department

Provide the Engineer a list of telephone numbers of personnel who will be on-call during TS. Respond to traffic signal malfunctions by having a representative at the site within three hours from the initial contact. Within twenty-four (24) hours have the traffic signal operating according to plan.

If the Engineer determines that the nature of a malfunction requires immediate attention and/or the Contractor does not respond within three (3) hours, then an alternate maintenance service will be called to repair the signal. Expenses incurred by the alternate maintenance service for each call will be deducted from monies due to the Contractor with a minimum deduction of $1,000. The alternate maintenance service may be the owner of the signal or another qualified electrical contractor.

Duration

Temporary Signalization shall commence when any existing signal equipment is disturbed, relocated, or altered based on the inspection checklist in any way for the TS.
For intersections with a State furnished controller, TS terminates when the inspection of the permanent signal is complete and operational and is accepted by the Engineer. For intersections with a Contractor furnished controller, Temporary Signalization terminates at the beginning of the 30 day test period for the permanent signal.
Ownership
Existing equipment, designated as salvage, remains the property of the owner. Salvable equipment will be removed and delivered to the owner upon completion of use. Temporary equipment supplied by the Contractor remains the Contractor's property unless noted otherwise.

Method of Measurement:
Temporary Signalization shall be paid only once per site on a percentage of the contract Lump Sum price. Fifty percent (50%) shall be paid when TS is operational as shown on the plan or to the satisfaction of the Engineer. Fifty percent (50%) shall be paid when TS terminates.

Basis of Payment:
This work shall be paid at the contract Lump Sum price for "Temporary Signalization (Site No.)" for each site. This price includes the preliminary inspection, TS plan for each stage/phase, furnishing, installing, maintaining, relocating and revising traffic signal equipment, controller assembly modifications, controller unit program changes such as phasing and timing, removing existing, temporary, and proposed traffic signal equipment, arrangements with utility companies, towns or cities including the fees necessary for electric and telephone service, clearing and grubbing, grading, area restoration and all necessary hardware, materials, labor, and work incidental thereto.

All material and work for signing and pavement markings is paid for under the appropriate Contract items.

All material and work necessary for vehicle and pedestrian detection for TS is paid for under item 11112XXA - Temporary Detection (Site No. X).

All Contractor supplied items that will remain the Contractor's property shall be included in the contract Lump Sum price for "Temporary Signalization."

Any items installed as part of the permanent installation are not paid for under this item but are paid for under the bid item for that work.

Pay Item	Pay Unit
Temporary Signalization (Site No.1)	L.S.

ITEM #1131002A - REMOTE CONTROL CHANGEABLE MESSAGE SIGN

Description: Work under this item shall include furnishing and maintaining a trailer-mounted, "Changeable Message Sign", "Remote Controlled Changeable Message Sign", "Changeable Message Sign with Radar", or "Remote Controlled Changeable Message Sign with Radar" whichever is applicable, at the locations indicated on the plans or as directed by the Engineer.

Materials: The full matrix, internally illuminated variable message sign shall consist of a LED, fiber optic, lamp matrix, or hybrid magnetically operated matrix – LED message board; and a computer operated interface, all mounted on a towable, heavy duty trailer.

The sign shall have a minimum horizontal dimension of 115 inches and rotate a complete 360 degrees atop the lift mechanism.

In the raised position, the bottom of the sign shall be at least 7 feet above the roadway. The messages displayed shall be visible from a distance of 1/2 mile and be clearly legible from a distance of 900 feet during both the day and night.

The lighting system shall be controlled both manually and by a photocell for automatic sign dimming during nighttime use.

The sign shall be capable of storing a minimum of 100 preprogrammed messages and be able to display any one of those messages upon call from the trailer mounted terminal and/or through the cellular telephone hookup for the remote controlled sign.

The sign shall be a full matrix sign that is able to display messages composed of any combination of alphanumeric text, punctuation symbols, and graphic images (notwithstanding NTCIP limitations). The display shall be capable of producing arrow functions. Full- matrix displays shall allow the use of graphics, traffic safety symbols and various character heights.

Standard messages shall be displayed in a three-line message format with 8 characters per line. The letter height shall not be less than 18 inches.

The sign shall utilize yellow green for the display with a black background. Each matrix shall have a minimum size of 6 x 9 pixels. Each pixel shall utilize a minimum of four high output yellow green LEDs or equivalent light source. The LEDs or light source shall have a minimum 1.4 candela luminance intensity, 22 degrees viewing angle, and wavelength of 590 (+/- 3) nanometers.

For hybrid magnetically operated matrix – LED matrix, each pixel shall have one single shutter faced with yellow green retro-reflective sheeting with a minimum of four high output yellow green LEDs or equivalent light source. The hybrid magnetically operated matrix – LED matrix sign shall be capable of operating in three display modes; shutter only, LED only, and both LED and shutter. These modes shall be automatically controlled by a photocell for day and night conditions and also capable of being manually controlled through the software.

The sign shall be controlled by an on-board computer. The sign shall automatically change to a preselected default message upon failure. That default message shall remain on display until the problem is corrected.

The sign shall include all necessary controls, including, but not limited to, personal computer, keyboard or alphanumeric hand-held keyboard, and software. The sign shall interface with PCs, cellular phones, and radar speed detection devices as required.

Controls shall be furnished for raising and lowering the message board, aligning the message board and, for solar powered units, a read-out of the battery bank charge.

Power shall be provided by a self-contained solar maintained power source or a diesel engine driven generator. Hardware for connection to a 110-volt power source shall also be provided.

Solar powered signs shall display programmed messages with the solar panel disconnected, in full night conditions, for a minimum of 30 consecutive days.

Remote Controlled Changeable Message Signs shall include one (1) industrial-grade cellular telephone and be equipped with a modem to control the sign and a security system to prevent unauthorized access. The security system shall allow access only through use of a code or password unique to that sign. If the proper code or password is not entered within 60 seconds of initial telephone contact, the call will be terminated. Remote control for the Remote Controlled Changeable Message Sign shall be by cellular telephone and touch tone modem decoder.

The radar equipped signs shall include a high-speed electronic control module (ECM-X), Radar SI transceiver, signal processing board and radar logging software.

The radar software will operate the sign in four modes:
1) The sign will display words “YOUR SPEED” followed by the speed (2 digits). The display will repeat the message as long as vehicles are detected. The sign will blank when no vehicles are present.
2) The sign will display a series of up to six messages (programmed by the user) when a preset speed (programmed by the user) is exceeded. The sign will blank when no vehicles are present.
3) Will perform like mode #2 with the addition of displaying the actual speed with it.
4) The sign will work as a standard Changeable Message Sign or Remote Controlled Changeable Message Sign with no radar.

Construction Methods: The Contractor shall furnish, place, operate, maintain and relocate the sign as required. When the sign is no longer required, it shall be removed and become the property of the Contractor. The cellular telephone required for the Remote Controlled Changeable Message Sign shall be provided to the Engineer for his use, and subsequently returned to the Contractor.

When the sign is not in use, it shall either be turned off with a blank display or turned from view.

Any signs that are missing, damaged, defaced or improperly functioning so that they are not effective, 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.

Method of Measurement: This work will be measured for payment for each "Changeable Message Sign", "Remote Controlled Changeable Message Sign", "Changeable Message Sign with Radar", or "Remote Controlled Changeable Message Sign with Radar", whichever applies, furnished and installed, for the number of calendar days that the sign is in place and in operation, measured to the nearest day. When a sign is in operation for less than a day, such a period of time shall be considered to be a full day regardless of actual time in operation.

Basis of Payment: This work will be paid for at the Contract unit price per day for each "Changeable Message Sign", "Remote Controlled Changeable Message Sign", "Changeable Message Sign with Radar", or "Remote Controlled Changeable Message Sign with Radar" which price shall include placing, maintaining, relocating and removing the sign and its appurtenances and all material, labor, tools and equipment incidental thereto. Additionally, for the "Remote Controlled Changeable Message Sign", or "Remote Controlled Changeable Message Sign with Radar", the cellular telephone service and telephone charges shall be included.

Pay Item	Pay Unit
Remote Control Changeable Message Sign	Day

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:
Prior to the work the Contractor shall schedule a field review with Project Staff for an inspection and inventory of all existing signing scheduled to be relocated.

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.

The Contractor shall submit a schedule of values for payment to the Department for review and comment prior to payment.

Pay Item	Pay Unit
Removal and Relocation of Existing Signs	L.S.

ITEM #1208928A - SIGN FACE-SHEET ALUMINUM (TYPE III REFLECTIVE SHEETING)

This work shall conform to Article 12.08 supplemented as follows:

Description: Add the following:
Work under this item consists of the fabrication and installation of signs designated Type A and B on all new railroad structures, including catenary structure trusses as shown on the plans or as directed by the Engineer. Work also includes the fabrication and installation of signs on all existing trusses and where missing or to be replaced as shown on the plans or as directed by the Engineer. Work also includes the fabrication and installation of phase break signs and of car marker signs at each end of the passenger platforms as applicable.

Materials: Add the following:
Type A and B signs (Sign Face - Sheet Aluminum) shall have yellow high visibility background as specified in Form 816, Section M.18.09, Type III, and black letters.

The Contractor shall submit shop drawings and samples of the signs prior to fabrication.

Construction Methods: Add the following:
Railroad structure mounted signs shall be permanently secured using fasteners suitable for the installation of aluminum plate including Ramset fasteners subject to the Engineers approval.

Signs shall bear the number of the structure as shown on the plans.

Car Marker signs shall be permanently secured to metal sign post, which shall be installed to a minimum depth of two feet into the ground.

Pay Item	Pay Unit
SIGN FACE – SHEET ALUMINUM (TYPE III REFLECTIVE SHEETING)	SF

ITEM 1210101A – 4" WHITE EPOXY RESIN PAVEMENT MARKINGS
ITEM 1210102A – 4" YELLOW EPOXY RESIN PAVEMENT MARKINGS
ITEM 1210104A – 8" WHITE EPOXY RESIN PAVEMENT MARKINGS
ITEM 1210105A – EPOXY RESIN PAVEMENT MARKINGS, SYMBOLS AND LEGENDS

SECTION 12.10 – EPOXY RESIN PAVEMENT MARKINGS, SYMBOLS AND LEGENDS is amended as follows:

*Delete "**SYMBOLS AND LEGENDS**" from the title of the section.*

SECTION 12.10.03 – Construction Methods is amended as follows:

*Delete the entire sections titled "**3. Performance and Warranty:**" and "**WARRANTY:**" and replace them with the following:*

3. Initial Performance: The retroreflectivity of the markings applied must be measured by the Contractor three (3) to fourteen (14) days after installation. A Certified Test Report (CTR), in accordance with Section 1.06.07, must be submitted to the Engineer no later than ten (10) days after the measurements are taken using the procedures and equipment detailed below:

Test Lots - The following test lots shall be randomly selected by the Engineer to represent the line markings applied:

Table 3.1: Line Test Lots

Length of line	Number of Lots	Length of Test Lot
< 1.0 mi. (1.5 km)	1	1000 ft. (300 m)
≥1.0 mi. (1.5 km)	1 per 1.0 mi. (1.5 km)	1000 ft. (300 m)

Measurement Equipment and Procedure

Portable Retroreflectometer
1. Skip line measurements shall be obtained for every other stripe, taking no more than two readings per stripe with readings no closer than 20 in. (0.5 m) from either end of the marking.
2. Solid line test lots shall be divided into ten sub-lots of 100 ft. (30 m) length and measurements obtained at one randomly select location within each sublot.
3. For symbols and legends, 10 percent of each type shall be measured by obtaining five (5) measurements at random locations on the symbol or legend.
4. The Apparatus and Measurements shall be made in accordance with ASTM E1710 (Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer) and evaluated in accordance with ASTM D7585/D7585M (Standard Practice for Evaluating Retroreflective Pavement Markings Using Portable Hand-Operated Instruments).

Mobile Retroreflectometer

1. Calibration of the instruments shall be in accordance with the manufacturer's instructions.
2. Retroreflectivity shall be measured in a manner proposed by the Contractor and approved by the Engineer. The basis of approval of the test method will be conformance to a recognized standard test method or provisional standard test method.

The measurements shall be obtained when the pavement surface is clean and dry and shall be reported in millicandellas per square foot per foot candle - mcd/ft^2/fc (millicandelas per square meter per lux (mcd/m^2/lux)). Measurements shall be obtained sequentially in the direction of traffic flow.

Item	Pay Unit
4" White Epoxy Resin Pavement Markings	LF
4" Yellow Epoxy Resin Pavement Markings	LF
8" White Epoxy Resin Pavement Markings	LF
Epoxy Resin Pavement Markings, Symbols and Legends	SF

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

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 #1301860A- INSTALLATION OF WATER MAIN AND APPURTENANCES

DESCRIPTION:

Work under this section shall consist of the installation of water main and appurtenances as shown on the plans and shall include the following items and quantities.

ITEM	PAY UNIT	APPROXIMATE QUANTITY FOR LUMP SUM PRICE
ADDITIONAL BACKFILL MATERIAL (WATER MAIN)	C Y	x x
HYDROSTATIC PRESSURE TEST	E A C H	x x
INSTALL 12" DUCTILE IRON WATER MAIN	L F	x x
INSTALL 24" DUCTILE IRON WATER MAIN	L F	x x
12" CONNECTION TO WATER MAIN	E A C H	x x
PERMANENT PAVEMENT REPLACEMENT (WATER MAIN)	S Y	x x
TEMPORARY PAVEMENT REPAIRS (WATER MAIN)	S Y	x x
EXCAVATION AND DISPOSAL OF UNSUITABLE MATERIAL (WATER MAIN)	C Y	x x

All work shall be in accordance with these specifications and requirements of Aquarion Water. The above quantities are for information only and not to be considered as the actual for development of the cost. All materials to include pipes, fittings, valves and other pipe appurtenances will be supplied by Aquarion Water Company. The work shall include only the Phase 1 work (Project 135-326) as shown on the plans. Items of work to be provided shall comply with the following.

ITEM – ADDITIONAL BACKFILL MATERIAL (WATER MAIN)

Description:
Work under this section shall consist of clean backfill material required to replace material determined to be unsuitable for replacement in the utility trench. This work is more fully detailed under Item 4 of the Aquarion Technical Specifications included herein as part of this specification.

Materials:

Material shall be of a quality satisfactory to the Engineer which is free from large or frozen lumps, wood and other extraneous material. It shall be free from stones larger than 4 inches.

Construction Methods:

Refer to Item 4 of the Aquarion Technical Specifications included herein as part of this specification.

ITEM – HYDROSTATIC PRESSURE TEST

Description:
This item shall consist of the Contractor furnishing all materials, tools and equipment necessary for performing hydrostatic and leakage testing as described in Item 7 of the Aquarion Technical Specifications. The Contractor shall be responsible to ensure the new main, or segment thereof, passes the hydrostatic and leakage testing.

Materials:
The materials required to accomplish this testing in conformance with AWWA C600 latest revision will be supplied by the Contractor.

Construction Methods:
The procedures for completing this item of work shall conform to Item 7 of the Aquarion Technical Specifications.

ITEM - INSTALL 12" DUCTILE IRON WATER MAIN
ITEM - INSTALL 16" DUCTILE IRON WATER MAIN

Description:
This item of work shall include the installation of ductile iron pipe, bends, valves, tees and other fittings selected by the Aquarion Water Company and furnished to the Contractor for installation on the project. The Contractor shall provide all labor, tools, materials and equipment necessary to the installation of the ductile iron water main in conformance with Item 1 of the Aquarion Technical Specifications included as part of this specification.

Materials:
The materials to be provided by Aquarion to the Contractor for installation on this project will be new and unused. A list of Aquarion approved materials and suppliers will be provided at the

Contractor's request.

Construction Methods:
The procedures for completing this item of work shall conform to Item 1 of the Aquarion Technical Specifications.

ITEM – 12" CONNECTION TO WATER MAIN

Description:

Work under this section shall consist of connecting the new water main to the existing water main using a ductile iron solid sleeve furnished by Aquarion. This work is more fully described under Item 1 of the Aquarion Technical Specifications included herein as part of this specification.

Materials:
Aquarion will provide a ductile iron solid sleeve of this purpose to the Contractor for installation. The Contractor shall be responsible to excavate and expose the existing water main at the point of connection and to verify to Aquarion the correct size solid sleeve required.

Construction Methods:
Construction methods shall conform to the appropriate section(s) of the Aquarion Technical Specifications included herein as part of this specification. The New water main shall be connected to the existing water main using approved and appropriate gaskets, materials and fittings.

The interior of all water main pipe and fittings not receiving 24 hour chlorine disinfection contact time must be spray or swab disinfected with a 1 to 5 percent solution of chlorine no more than 30 minutes prior to installation. The interior and exterior of cut ends of existing pipe shall also be cleaned and disinfected.

All fittings shall be solidly braced against the trench wall to prevent any deflection due to thrust pressure. Bracing shall be accomplished by the use of cast-in-place concrete thrust blocks and restrained joints as shown in the Aquarion Relocation Plans and Details.

All water pipe joints shall be made watertight. Prior to backfilling, the water main shall be filled with potable water and installation tested for leaks under line pressure in the presence of the Project Representative.

ITEM – PERMANENT PAVEMENT REPLACEMENT (WATER MAIN)
ITEM – TEMPORARY PAVEMENT REPAIRS (WATER MAIN)

Description:
Work under this section shall consist of permanent pavement repairs to roadway areas disturbed by the Contractor's operations during the installation of water mains and appurtenances. This work is more fully detailed under Item 10 of the Aquarion Technical Specifications included

herein as part of this specification. The work shall conform to the details on the plans for Temporary and Permanent Patch.

Materials:
Material to be utilized for this shall work conform to the requirements of Item 10 of the Aquarion Technical Specifications, except in the case of State Highway Projects where the Marshall mixes specified in Item 10 shall be replaced by Hot Mix Asphalt (HMA) mixes when such mixes are specified elsewhere in the contract documents for use by the Contractor. The depth of permanent pavement required shall be consistent with those specified by the State documents. Substitutions of materials and required pavement thickness shall be made as directed by the Aquarion representative.

Construction Methods:
Construction methods shall conform to Item 10 of the Aquarion Technical Specifications included herein as part of this specification. The work shall conform to the details on the plans for Temporary and Permanent Patch.

ITEM - EXCAVATION AND DISPOSAL OF UNSUITABLE MATERIAL - WATER MAIN

Description:
Work under this section shall consist of the transport and disposal of unsuitable material in accordance with the Aquarion Technical Specifications and in conformance with the environmental requirements established for State Project No. 135-326 and located elsewhere in these Project Special Provisions. Materials removed from an AOEC area and not reused shall be transported to the WSA site for classification and disposal.

Material removed from an area not an AOEC designated area and deemed unsuitable for trench refill shall be removed and disposed of off site by the Contractor. Materials so disposed of shall be replaced with clean backfill as provided by Item 1304115A Granular Fill Water Main.

The Contractor shall coordinate all water work with the Aquarion Water Company (Mr. Carlos Vizcarrando at 203-337-5950) or the Aquarion Resident Project Representative.

Construction Methods:
Construction methods shall conform to the requirements of the Aquarion Technical Specifications included elsewhere in this specification.

Method of Measurement:
The Item "Installation of Water Main and Appurtenances" will not be measured.

Basis of Payment:

The Item Installation of Water Main and Appurtenances will be paid for at the contract lump sum price for "Installation of Water Main and Appurtenances" which price will include the following

items:

Excavation and Disposal of Unsuitable Material (water main)
Hydrostatic Pressure Test
install 12" Ductile Iron Water Main
Install 24" Ductile Iron Water Main
12" Connection to Water Main
Permanent Pavement Replacement (water main)
Temporary Pavement Repairs (water main)

which lump sum price shall include all materials not supplied by Aquarion Water Company, labor, equipment, tools and other items incidental thereto to the approval and acceptance of the Engineer and Aquarion Water Company.

Pay Item	**Pay Unit**
Installation of Water Main and Appurtenances	Lump Sum

The following Arquarion Water Company General Specifications and Technical Specification are made part of the specifications:

Attachment G
Aquarion Water Company of Connecticut

General Specifications

G.01 Scope of Work

The Contractor shall provide all the labor, superintendence, miscellaneous materials, plant, tools, and equipment necessary for properly constructing, within the time stipulated, the Water Main Installation and all other work necessary for the proper completion of the project as specified herein.

G.02 Standards

Wherever reference is made in this Contract to the standard of any technical society or other recognized organization, these shall be construed to mean the latest standard adopted and published at the date of advertisement for bids.

Abbreviations are defined as follows:

AWWA - American Water Works Association
ASTM - American Society for Testing and Materials
ANSI - American National Standards Institute
ASA - American Standards Association
ACI - American Concrete Institute
AASHTO - American Association of State Highway and Transportation Officials
ACPA - American Concrete Pipe Association
ASME - American Society of Mechanical Engineers
CIPRA - Cast Iron Pipe Research Association
CISPI - Cast Iron Soil Pipe Institute
DIPRA – Ductile Iron Pipe Research Association
IEEE - Institute of Electrical and Electronics Engineers
NCPI - National Clay Pipe Institute
FMHA - Farmers Home Administration
DOT - Connecticut Department of Transportation
C.I. - Cast Iron
D.I. - Ductile Iron
V.T. - Vitrified Tile
H.D.P.E - High Density Polyethylene
R.C.P. - Reinforced Concrete Pipe

G.03 Standard Details and Working Drawings

The Company's water main installation requirements are generally shown on the Standard Detail Sheets accompanying the Contract Documents. The location of water mains for specific water main extensions will be provided on working drawings by the Engineer or his authorized agent. The Engineer or his authorized agent will have the final decision as to location changes in

the field.

G.04 Lines and Grades

Aquarion will establish the location of the centerline of the pipeline. The Engineer will also establish Bench Marks as required. The Contractor shall establish offsets, as necessary, a suitable distance from the work to be done so that proper lines and grades for the work may be maintained. The Contractor shall protect all survey points from damage insofar as possible.

The Contractor shall be responsible for placing the pipe accurately to the established lines and grades as shown on the plans or as directed.

G.05 Alterations

Aquarion may make alterations in the line, grade, plan, form, dimensions, or materials of the work, or any part thereof either before or after the commencement of the work. If such alterations increase the quantity or work, such increase will be paid for according to the quantity of such extra work actually done and at the prices stipulated for such work under unit price items of the Contract. In case no unit price is applicable, the alterations will be paid for as extra work defined in Section F.29 of the General Conditions.

G.06 Planimeter

The use of the planimeter shall be considered satisfactory for estimating quantities where geometric and analytic methods would be comparatively laborious.

G.07 Estimated Quantities

To aid Aquarion in determining quantities to be paid for, the Contractor shall, whenever requested, give the Engineer access to the proper invoice, bills of lading, or other pertinent documents and shall provide methods and assistance necessary for weighing or measuring materials.

G.08 Explosives and Blasting

Explosives for blasting shall be stored, handled and used in accordance with the laws, ordinances and regulations of the State of Connecticut, all local regulations, and with such additional regulations as the Engineer may require. Blasting shall be conducted so as not to endanger persons or property; and unless otherwise permitted, shall be covered or otherwise satisfactorily confined. The Contractor shall be responsible for and shall make good any damage of

whatever nature caused by blasting or accidental explosions.

G.09 Storage of Materials

Materials shall be stored so as to insure the preservation of their quality and fitness for the work. When considered necessary, they shall be placed on wooden platforms and covered or stored in a suitable building, as directed by the Engineer. Stored materials shall be located so as to facilitate prompt inspection.

G.10 Removal of Condemned Materials

The Contractor shall remove from the site of the work, without delay, all rejected and condemned materials of any kind brought to or incorporated in the work. No such rejected or condemned materials shall again be offered for use by the Contractor.

G.11 Working Conditions

In prosecuting the work of this Contract, the Contractor shall provide working conditions on each operation that shall be as safe and healthful as the nature of the operation permits. He shall comply with all safety and sanitary rules, laws and regulations.

G.12 Deleted

G.13 Work in Inclement Weather

During freezing, stormy and inclement weather, no work shall be performed except such as can be done satisfactorily and in such manner as to secure first-class construction throughout.

G.14 Working Hours and Overtime Work

Working Hours: The Contractor's working schedule shall be confined to a five (5) day week, Monday through Friday, and an 8-hour working day confined between the hours of 8:00 a.m. and 4:30 p.m. current local time for all territories except, Greenwich. Greenwich normal working hours are from 7:00 a.m. to 3:30 p.m. Monday through Friday.

Unless otherwise especially permitted, no work shall be done between the hours of 4:30 p.m. and 8:00 a.m. except as necessary for the proper care and protection of the work already performed. If it shall become absolutely necessary to perform work at night, the Engineer shall be

informed a reasonable time in advance of the beginning of the performance of such work. Only such work shall be done at night as can be done satisfactorily and in a first-class manner. Good lighting and all other necessary facilities for carrying out and inspecting the work shall be provided and maintained at all points where such work is being done.

G.15 Water Supply, Electrical Energy, and Trailer

The Contractor shall make his own arrangements for providing a project trailer (if needed) and obtaining the electrical energy and water supply necessary for construction purposes. The cost of these items shall be included in the unit price bids.

G.16 Competent Person

The Contractor shall assign or designate a competent representative with authority to promote and enforce safety provisions and safe practices on or related to the project for the duration of the construction.

G.17 Safety Codes

The safety provisions of applicable laws building and construction codes and the latest edition of the code of Federal Regulations shall be observed. A copy of the latest edition and all supplements of the code of Federal Regulations pertaining to occupational Safety and Health (OSHA) for construction shall be available for reference at all times with the Contractor's competent representative on the job. Contractor's safety plan will be available so that it may be submitted to the Engineer on request.

G.18 Contract Limits

The Contractor shall confine his activities to within street lines, easements and rights-of-way.

The Contractor shall take particular care to protect trees and shrubs. He shall make good any damage to the satisfaction of Aquarion.

The Contractor shall not enter upon or make use of any private property along the line of work, outside the limits of the rights-of-way, except when written permission is secured from the owner of said property and a copy delivered to Aquarion. The Contractor will be held responsible for all damage or injury done by himself or those in his employ to any private or public property of any character during the prosecution of the work. The Contractor shall restore or repair at his own expense, in a manner satisfactory to Aquarion, such property as may be damaged by his operations during the prosecution of the work.

In case of failure on the part of the Contractor to restore or repair such property in a manner satisfactory to the Company, the Company may, upon 48 hours notice to the Contractor, proceed with such restoration or repair. The expense of such restoration or repair shall be deducted from any moneys which are due or may become due the Contractor under this Contract.

G.19 Work in Easements

(Deleted)

G.20 Soil and Groundwater Conditions

Soil borings have not been made for the work of this Contract.

In bidding on this Contract, each Bidder acknowledges that boring logs are not available and be aware of the general subsurface conditions of these areas.

G.21 Existing Structures

The Contractor shall abide by all updated State of Connecticut "Call Before You Dig" regulations. The Contractor shall call 48 hours in advance of commencement of construction and all excavations in existing streets shall be premarked showing the proposed trench widths for the entire water main extension.

If AQUARION WATER COMPANY provides drawings for a project and if these drawings show existing utilities, said utilities are shown for the convenience of the Contractor in accordance with the best information available, but are not guaranteed to be correct or complete. The Contractor shall explore the route ahead of trenching and shall uncover all known obstructing pipes sufficiently to determine their location. Necessary changes in location may be made by the Engineer to avoid unanticipated obstructions.

Wherever water or gas mains, electric or telephone ducts, electric, telephone or telegraph poles are encountered and may be in any way interfered with, the Contractor shall keep the utility company involved fully informed in advance. The Contractor shall cooperate with the utility company in the protection, removal, relocation and replacement of such structures.

The Contractor shall, at his own expense, sustain in their places and protect from direct or indirect injury all utilities, pipes, poles, conduits, walls, buildings and other structures, and property in the vicinity of his work. Such sustaining and supporting shall be done carefully by the Contractor and as required by the party owning or controlling the structure. Before proceeding with the work of sustaining and supporting the structure, the Contractor shall satisfy the Company that the methods and procedures to be used have been approved by the party owning said structure. The Contractor shall take all risks attending the presence or proximity of pipes, poles, conduits, walls, buildings, wires or other structures, utilities and property in the vicinity of his work, and he shall be responsible for all damage and assume all expense for direct or indirect injury, caused by his work, to any of the structures, or to any person or property – even if the Contractor believes that

damage or injury created by the Contractor is the result of a mis-marked utility.

Guard rails, posts, guard cables, signs, poles, markers, etc., which are temporarily removed to facilitate installation of the piping shall be replaced and restored in their original condition to the satisfaction of the Company. If such items are removed because AQUARION WATER COMPANY has requested placement of the pipeline in close proximity to the item, AQUARION WATER COMPANY will pay the cost to restore the item.

The Contractor shall, at his own expense, retain the services of a licensed surveyor to replace property markers on or adjacent to privately owned property which have been disturbed during the course of construction. If a property marker is removed because AQUARION WATER COMPANY has requested placement of the pipeline in close proximity to the marker, AQUARION WATER COMPANY will pay the cost to replace the marker.

G.22 Accommodation of Traffic

During the progress of the work, all roads shall be kept open for the passage of traffic and pedestrians and shall not be unnecessarily obstructed unless authorized by the authority having jurisdiction over same. Driveways, sidewalks and crossings shall be closed as short a time as possible while pipe is being placed, and passage shall be restored as soon as possible thereafter by properly placed backfill or approved bridging. The Contractor shall take such measures at his own expense as may be necessary to keep the roads open for traffic, and shall give advance notice to the Department of Transportation (D.O.T.), town public works department, local police and state police as required.

Warning signs shall be provided along all roads where work is in progress. The Contractor shall notify and make all arrangements with the D.O.T., town public works department, local police and state police for direction of traffic past the equipment, machinery, or construction operations. Barricades and lights shall be provided to protect traffic. Where trenches have been cut in road shoulders on which traffic may pass at times, warning signs shall be placed at frequent intervals and maintained until the shoulder is safe for travel. All such work and operations shall be in accordance with the requirements of the D.O.T., public works department, local police and state police.

Should the Contractor or his employees neglect to set out and maintain barricades or lights, as required in these Specifications, Aquarion may immediately and without notice, arrange for furnishing, installing and maintaining barricades or lights, and any other precaution deemed necessary. The cost thereof shall be borne by the Contractor and may be deducted from any amount due or to become due to the Contractor under this Contract.

The Contractor shall be held responsible for any damages that may have to be paid as a consequence of the Contractor's failure to protect the public.

G.23 Hauling Materials

Before starting any work, the Contractor shall arrange with the municipal or State officials having jurisdiction for the use of routes of travel for hauling materials, including surplus earth and rock, that will result in minimum inconvenience to the traveling public. Routes of travel so scheduled shall be adhered to throughout the course of the work, unless otherwise approved.

G.24 Emergency Work

The Contractor shall file with the first selectman, the director of public works, and police departments of the town involved, the name and telephone number of a person authorized by him who may be contacted regarding emergency work at the job site that may be required during non-working hours for reasons of public safety.

This person shall be readily available and have full authority to deal with any emergency that may occur.

G.25 Dust Control

The Contractor shall take all necessary precautions to prevent and abate nuisance caused by dust arising from his operations. Approved methods applicable to various parts of the work such as application of water spray or calcium chloride shall be employed. This also applies to maintaining temporary paving nuisance free until permanent paving is placed.

G.26 Cleaning Up Site

During progress of the work, the Contractor shall keep the construction areas in a neat condition, free from accumulations of waste material and rubbish.

On or before completion of the work and before acceptance and final payment shall be made, the Contractor shall clean and remove from the site and adjacent property, all surplus and discarded materials, rubbish and temporary structures, restore in an acceptable manner all property and leave the whole in a neat and presentable condition.

G.27 Sedimentation Control

All watercourses and wetlands shall be protected from sedimentation, both during and after construction. This provision applies particularly to dewatering activities, storage of excavated or stockpiled material, and trench or ditch excavation. The following best management practices for protecting the environment should be employed:

1. Where dewatering is necessary, the pump shall not discharge directly into the stream or river. Methods and devices such as pumping the water into a temporary sedimentation pool, providing surge protection at the inlet and outlet of pumps, or floating the intake of the pump, shall be used to minimize and retain the suspended solids. The pump may discharge into an area of the stream contained by curb or silt fence, if approved by Aquarion as the only feasible means of dewatering. Regardless of the method used, all affected areas shall be restored to their original condition.

2. Cofferdams, and other measures such as bank stabilization, shall be of minimal size necessary to carry out the project. In all cases, such installations shall not impede the normal flow of water or cause flooding.

3. No construction shall proceed until the erosion and sedimentation control plans, prepared by the contractor, have been approved by the Engineer.

4. All off-site locations for stockpiled material used or excavated during the progress of the project shall be indicated on a map. This map shall also show the location for final disposal of surplus excavated material.

5. All temporary fill, such as that used for access roads and/or cofferdams, shall be properly stabilized during use to prevent erosion, and must be disposed of at an upland site, and suitably contained to prevent runoff from reentering a waterway or wetland. All areas affected by temporary fills must be restored to their original contours and revegetated with suitable hydrophilic vegetation. The area extent of temporary fill or excavation shall be minimized to that area determined by the Engineer as absolutely necessary to perform the required work.

6. Excavated material from non-wetland areas associated with the activities in progress shall not be deposited in the surrounding wetlands or streams.

7. During temporary diversion of a waterway, water shall be kept deep enough in the channel to allow for the passage of fish wherever necessary.

8. Every precaution shall be used while working in the vicinity of a waterway to prevent and minimize degradation of the existing water quality. All activities shall conform and be at all times consistent with applicable water quality standards, and management practices of the CT Guidelines for Soil Erosion and Sediment Control, Federal Water Pollution Control Act (1988) and other applicable state laws, and as defined in the Form 814, Section 1.07.16, entitled "Pollution Control". Additionally, appropriate measures as detailed in Section 2.10 of the Form 814 shall be used, as approved by the Engineer.

9. Fording of streams with equipment shall be avoided. Where necessary, such equipment travel shall be kept to a minimum. Where frequent equipment travel on stream banks and beds is necessary, washed stone or rip rap shall be placed to

minimize erosion, scour, and turbidity. When appropriate, the Engineer may specify that such material may remain after completion of construction, provided no significant grade change or impact will result.

10. All stumps, tree roots, matted roots, debris, and all other objectionable materials resulting from clearing the specified areas, shall be removed and disposed of outside of designated wetland areas.

11. A method approved by Aquarion shall be used to prevent construction debris, paint or other materials from entering the waterway.

12. The Contractor, when grit abrasive blast cleaning structures directly over water, shall prevent all spent blast materials, dust and removed material from entering the water.

13. No equipment or machinery shall be stored, cleaned, or repaired within twenty-five (25) feet of a wetland or watercourse.

14. The dumping of oil or other deleterious materials on the ground is expressly forbidden. The Contractor shall provide a means of catching and retaining drained oil, removed oil filters, or other deleterious material, and of properly disposing of same, subject to the approval of the Engineer.

15. Work within and adjacent to watercourses shall be conducted during periods of low stream flow, whenever possible. The Engineer shall monitor stream flow conditions during the conduct of such work, and shall cause such activity to cease should stream flow conditions threaten to cause excessive erosion, siltation or turbidity. During storms, every effort shall be taken to secure the work site.

G.28 Work Within Areas Designated as Inland Wetlands

The Contractor shall adhere to all wetland permit requirements and wetland regulations of the town involved. See section G.27.

G.29 Work in Waterbodies

The Contractor's attention is directed to those portions of the work of this Contract which are in a brook or river bed. The Contractor shall operate all equipment and perform all construction operations so as to minimize pollution.

Care shall be taken to prevent or reduce to a minimum any damage to any waterbody from pollution by debris, sedimentation, or other material, or from the manipulation of equipment and/or materials in or near such waterbodies and on abutting property.

In all cases involving work in a waterbody, every effort should be made to return the waterbody to the highest possible standard for aesthetic value, water quality and fish habitat.

Sufficient flow of water shall be maintained at all times to sustain aquatic life downstream. Refer to section G.27 for best management practices.

G.30 Operation of Valves

Unless otherwise permitted, existing valves shall not be operated by the Contractor.

Whenever the operation of a valve is necessary the Contractor shall make arrangements, a reasonable time in advance of the need, to have Aquarion Water Company forces perform the required operations.

G.31 Payment for Miscellaneous Work

No direct payment will be made to the Contractor for furnishing and providing miscellaneous temporary works, project signs, plant and services, permits, insurances, watchmen, cleanup, and the like, unless payment therefore has been definitely provided. Compensation for the same is understood to be included in the scheduled prices herein before given for the various kinds of work contemplated.

G.32 Guarantee

The Contractor hereby guarantees all the work and equipment furnished under this contract against any defects in workmanship or material for a period of **two (2) years** following the date of final acceptance of work by the Company. Under this guarantee, the Contractor agrees to make good, without delay, at its own expense, any failure of such parts due to faulty construction or installation or to the failure of any such equipment to successfully perform all the work put upon it within the limits of the specifications and further shall make good any damage to any part of the work caused by such failure.

In addition, if any settlement of the trench is observed within a period **two (2) years** from the date of final acceptance of the work, the necessary repairs, as determined by the Engineer, shall be made by the Company or by the Contractor at the discretion of the Engineer and the cost therefore shall be borne by the Contractor. Such repairs shall include, but not be limited to, the necessary replacement of any pavement that may have been placed over the trench, which replacement is required as a result of such settlement. Contractor shall be responsible for maintenance of temporary pavement for up to **one (1) calendar year**.

ATTACHMENT T

INDEX TO TECHNICAL SPECIFICATIONS

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ITEM 3 ROCK EXCAVATION
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Aquarion Water Company of Connecticut
Service Agreement Between
Owner and Contractor

Attachment T
Technical Specifications

INSTALL WATER MAIN AND APPURTENANCES

Item 1

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1.21 Cleanup
1.22 Approved List of Manufacturers

1.1 Work Included

Under this item, the Contractor shall do all necessary work to install ductile iron pipe or HDPE in those projects as selected by AQUARION WATER COMPANY. AQUARION WATER COMPANY will normally provide and deliver all fittings, appurtenances, and other pipe materials to each project.

This item includes all labor, tools, materials, and equipment necessary for clearing and grubbing; excavation and backfill; furnishing and installing pipe, fittings, meter vaults, and valves; making connections to existing pipelines; pavement removal **(including necessary saw cutting)**; walls, fences, signs and any other structures which must be removed to carry out the work; removing topsoil and sod; care and protection of existing pipes, utilities, and other structures; dust control; piling and storing of unexcavated materials; disposing of

excess materials; sheeting and shoring; dewatering; stream crossings; furnishing and placing gravel or screened granular bedding; and all other work shown or specified for furnishing and installing the water main, except that which is specifically included for payment under other items of the Contract.

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1.2 Ductile Iron Pipe

1.2.1 Pipe, Fittings, and Specials

Pipe shall be of domestic ductile iron. Pipe joints may be either mechanical joint or push-on joint. Fittings shall be ductile iron with mechanical or restrained joints to match the pipe.

Ductile iron pipe shall conform in all respects, except for ends, to ANSI A21.51 (AWWA C151), latest editions. Ductile iron pipe shall be class 52, double tar coated and double cement lined. Ductile iron pipe is to carry a 10 year manufacturer's warranty from date of installation.

Pipe ends shall conform to ANSI A21.11 (AWWA C111), latest editions.

Fittings shall conform to ANSI A21.10 (AWWA C110) and ANSI A21.11 (AWWA C111), latest edition.

The manufacturer's certifications specified in Sections 51.4, 51.7, 51.9, and 51.14 of Specification ANSI A21.51 (AWWA C151) shall be furnished for ductile iron pipe. A statement shall also be furnished stating that the coating and lining have been installed in accordance with ANSI A21.4 (AWWA C104).

All pipe and fittings shall be furnished with a bituminous seal coat, standard thickness, cement mortar lining in accordance with ANSI A21.4 (AWWA C104), latest revision, and an exterior bituminous coating. Coating that is damaged during shipment or placement shall be touched up in the field with two (2) coats of an asphaltic coating fully resistant to water and chemicals. Materials used for interior surfaces shall be acceptable for use in a potable drinking water supply and shall not impact any odors to the pipe and water.

All bolts, nuts, glands, gaskets, and other jointing materials are included under this Item.

Before any pipe is shipped to the job site, the manufacturer shall furnish the Engineer with details of his proposed joint, giving manufacturer's tolerances. Each shipment of pipe shall be accompanied by a certification from the manufacturer that the pipe and the joints meet the Specifications and, in particular, the joint tolerances. Each piece of pipe and each fitting shall be plainly marked at the foundry with class number and weight.

At all reducers and changes in direction, an approved restrained joint will be required utilizing the following chart for determining the number of joints to be restrained:

NUMBER OF RESTRAINED JOINTS AND LENGTHS (D.I.P. OR P.V.C.)

(100 psi, Cohesive Granular Soils, 18-foot lengths)

Pipe Size	90º Bend	45º Bend	22 1/12º Bend	11 1/4º Bend	Dead End
6"	F(11)	F(5)	F(2)	F(1)	F+1(32)
8"	F(14)	F(6)	F(3)	F(1)	F+2(42)
10"	F+1(17)	F(7)	F(3)	F(2)	F+3(50)
12"	F+1(21)	F(9)	F(4)	F(2)	F+3(60)
16"	F+1(27)	F(11)	F(5)	F(3)	F+4(78)
24"	F+2(38)	F+1(16)	F(8)	F(4)	F+6(112)

Notes:

1. F+1 - Means fitting plus 1 joint either side of fitting.

2. (11) - Means 11 feet either side of fitting must be restrained, i.e. no short pieces.

3. For pressure greater than 100 psi., Aquarion will determine the number of restrained joints.

1.2.2 Laying Ductile Iron Pipeline

All pipe installation shall conform to AWWA Standard C600, latest revision, unless otherwise modified by these Specifications.

Ductile iron pipe shall be laid to a minimum depth between 4’-0” to 5'-0" to the top of pipe unless otherwise directed. Where the pipeline crosses existing utilities, a vertical clearance of twelve inches (12") minimum shall be maintained, except for sanitary sewers where if the water main is within ten (10) horizontal feet of the sewer, the water main must be at least eighteen inches (l8") above the sewer. The pipe between bell holes shall bear continuously on clean fill. If the Contractor excavates below the required limit, the trench bottom shall be brought to the required grade with an approved backfill of gravel, sand or crushed stone at the Contractor's expense. In laying pipe, the deflections given in AWWA Standard C600 latest revision shall not be exceeded.

All pipe fittings and valves shall be lowered carefully into the trench by means of mechanical equipment in such a manner as to prevent them from being damaged. The insides of all bells and outsides of spigots shall be wiped clean and dry and shall be free from oil or grease. During the laying of the pipe, extra care shall be taken to see that no dirt, debris, tools, clothing, or other illicit materials are allowed to be left in the pipeline.

After the pipe is laid in the trench, the spigot end shall be centered in the bell and forced home. Under no circumstances shall pipe be laid where there is water in the trench. The Contractor shall install and joint the pipe in accordance with the manufacturer's instructions. The joints shall be made continuous by the installation of metal wedges per the manufacturer's instructions.

When necessary to cut pipe in the field, the cutting shall be done such that neither the pipe nor the lining shall be damaged and such that a smooth, right angle to axis cut is made. A machine designed for this purpose shall be used for the cutting.

1.3 High Density Polyethylene (HDPE) Pressure Pipe

1.3.1 Pipe, Fittings, and Specials

Pipe shall be of HDPE DR-11. Pipe joints may be either mechanical joint or fusion joint as per AWWA Standards C906, or latest revision. Fittings shall be ductile iron with mechanical or restrained joints to match the pipe.

1.3.2 Laying High Density Polyethylene (HDPE) Pipeline

All pipe installation shall conform to AWWA Standards C906, or latest revision, unless otherwise modified by these Specifications.

HDPE pipe shall be laid to a minimum depth between 4'-0" to 5'-0" to the top of pipe unless otherwise directed. Where the pipeline crosses existing utilities, a vertical clearance of twelve inches (12") minimum shall be maintained, except for sanitary sewers where if the water main is within ten (10) horizontal feet of the sewer, the water main must be at least eighteen inches (l8") above the sewer. The pipe between bell holes shall bear continuously on clean fill. If the Contractor excavates below the required limit, the trench bottom shall be brought to the required grade with an approved backfill of gravel, sand or crushed stone at the Contractor's expense.

All pipe fittings and valves shall be lowered carefully into the trench by means of mechanical equipment in such a manner as to prevent them from being damaged. The insides of all bells and outsides of spigots shall be wiped clean and dry and shall be free from oil or grease. During the laying of the pipe, extra care shall be taken to see that no dirt, debris, tools, clothing, or other illicit materials are allowed to be left in the pipeline.

After the pipe is laid in the trench, the spigot end shall be centered in the bell and forced home. Under no circumstances shall pipe be laid where there is water in the trench. The Contractor shall install and joint the pipe in accordance with the manufacturer's instructions. The joints shall be made continuous by the installation of metal wedges per

the manufacturer's instructions.

When necessary to cut pipe in the field, the cutting shall be done such that neither the pipe nor the lining shall be damaged and such that a smooth, right angle to axis cut is made. A machine designed for this purpose shall be used for the cutting.

1.4 Line Valves

1.4.1 Work Included

The Contractor shall install all line valves as shown.

1.4.2 Butterfly Valves – 12-inch and Larger

Butterfly valves shall be of the rubber seat, tight closing type. They shall meet or exceed all strength and performance requirements of AWWA Standard C504, latest revision, for Class 150B.

Butterfly valves shall be AWWA rubber seat butterfly valves with the seat mounted in the body of the valve.

Valves shall have mechanical joint ends.

Valve shafts shall be 316 stainless steel Type 507.

Exterior steel or cast iron surfaces of valves, except finished or bearing surfaces, shall be shop painted with two coats of asphalt varnish in accordance with AWWA Standard C504. Interior surfaces shall be painted with AWWA approved epoxy paint.

All valves shall be a product of a manufacturer having units of similar type, size, and service requirements successfully operating in municipal waterworks projects for a period of not less than five (5) years. The manufacturer, if requested by the Engineer, shall furnish torque design calculations.

The valve shaft shall be horizontal and the operator shall be on the side of the pipeline shown on the plans.

Valve seats for water service shall be natural rubber. Seats shall be replaceable. The mating material for the resilient seal shall be No. 18-8 stainless steel. The resilient seat shall be recess mounted, bonded and mechanically retained in the valve body and shall not be penetrated by the valve shaft in sizes 12-inch and larger and shall be completely adjustable around the full 360 circumference.

The method used for bonding the valve seat in place shall be approved by ASTM D429, Method A.

Valve shaft bearings shall be sleeve type, of self-lubricated, woven-oriented Teflon, non-cold-flowing, and shall be contained in reinforced phenolic cylinders through 2-3/4 inch diameter shafts and bronze cylinders on 2-7/8-inch and larger diameter shafts.

The valve operator shall be the traveling-nut type, sealed, gasketed, and lubricated for underground service. It shall be capable of withstanding an overload input torque of 450 foot/lbs. at full-open or closed position without damage to the valve or valve operator. It shall be designed to resist submergence in water to 25 feet of head pressure. Operator nut (crosshead) shall be made of high-strength manganese bronze.

Valve shall be easily operable by one man using standard valve key, even under emergency line-break conditions as severe as those causing a valve torque requirement of as much as two times AWWA Class 150B. Operator shall produce full class 150B output torque requirement throughout entire travel with an input torque no greater than 100 foot-pounds.

All valves shall open to the direction shown on the table *Gate & Hydrants by Town* at the end of this section and be equipped with a 2-inch AWWA operating nut.

All valves shall be tested bubble-tight air-under-water by the manufacturer as follows: 4-inch through 12-inch at 175 psi and 14-inch and up at 150 psi.

In addition, a 300 psi hydrostatic test shall be given to the assembled valve. The 300 psi pressure shall also be applied against the fully closed valve to prove structural soundness and assure compatibility with field-line test procedures.

1.4.3 4", 6", and 8" Gate Valves

The gate valves shall be Resilient - Seated Gate Valves (RSV) AWWA Standard C515, non-rising stem, zinc coated bolts and nuts, mechanical joint ends, "O" ring stem seal, iron full body valves. The valves will be installed vertically in horizontal pipelines and shall open to the direction shown on the table *Gate & Hydrants by Town* at the end of this section and shall be furnished with 2-inch operating unit.

Exterior ductile iron surfaces of valves shall be shop painted with two coats of asphalt varnish in accordance with AWWA Standard C515. Interior surfaces shall be painted with AWWA approved epoxy paint.

All valves shall be a product of a manufacturer having units of similar type, size, and service requirements successfully operating in municipal waterworks projects for a period of not less than five (5) years.

1.4.4 Valve Boxes

Valve boxes shall be cast iron or ductile iron, 48 inches long, 5-1/4-inches diameter shaft with sliding type adjustable top.

Covers shall be cast iron and shall have "WATER" cast on them. Valve boxes shall be set

carefully, truly vertical, and accurately centered over the operating nut with the top set at roadway or existing ground surface grade.

If valve boxes are not centered over the valve the Contractor will be responsible to re-excavate and repair at their own expense.

1.4.5 Insertion Valves

Insertion valves shall be Team Insert Valve RW-Gate as manufactured by Team Industrial Services, Alvin, TX. No acceptable equivalent. Valve must be installed by the Jack Farrelly Co. (800) 423-0012.

1.5 Connection to Existing Water Mains

The Contractor will be required to connect to the existing mains as directed by the Engineer. The following connections may be requested and are included as pay item in the special provisions

.

Tapping Sleeves and Valves

Tapping sleeve and valve units (furnished by the Company) shall be installed when directed by Aquarion and will be Stainless Steel tapping sleeve with MJ outlet.

Cutting and Installation of Branch and Connection to Existing Water Main

When ordered by Aquarion, connection to an existing main shall be made by cutting such main in the manner herein before specified and installing a branch or cross as directed together with a nipple piece and sleeve to complete the closure. The use of cold chisel and striking hammer shall not be permitted. Payment for installation of branch laterals shall be per the Contractor's unit price bid... However, if the Contractor cannot install the lateral or make the connection at the time that he installs the Tee for the lateral and thus must return at a later date to install the lateral or make the connection, payment for installation of the lateral shall be per the unit price in Section A. The branch installation or connection to the existing water main shall be made by cutting such main in the manner herein before specified and installing fittings on the branch and existing water main, along with a nipple piece and sleeve to complete the closure. This unit price bid shall cover the following work related to installation of a branch lateral or connection to existing water main and: removal of pavement, disposal of pavement, excavation, installation of lateral, connection to existing water main and backfill, shall be paid under this item. Additional items required with a branch lateral installation or connection, including temporary paving, traffic control, and rock removal, shall be paid for using the Contractor's unit bid price for these items.

Pipe, and fittings required for making connection or branch installation to existing water main shall be furnished by Aquarion Water Company for installation by the Contractor.

The required shutdown shall be scheduled with Aquarion Water Company; so that affected

customers may be notified of the shutdown. The shutdown shall not be made until all materials for making the connection or branch installations have been secured and approved. As the connection or branch installation will not be disinfected with the new piping installed, the interior of all piping shall be swabbed or sprayed with a 1% hypochlorite solution in accordance with Section 10 AWWA C651 prior to installation. After the connection is made, the piping shall be thoroughly flushed and subjected to the normal working pressure with all joints being checked for leaks prior to backfilling.

Tapping Saddles and Valves

Tapping saddles, furnished by the Company will be with flanged outlet and shall be installed in accordance with the manufacturer's specifications. Payment will be made on hole size rather than on pipe size.

1.6 Hydrants

Installing hydrant assemblies is specified under Item 5.

1.7 Handling and Distribution of Pipe, Specials, and Valves

The pipe, specials, and valves shall be handled and protected during loading, transporting, and unloading operations in such manner as to avoid damage. Pipe, specials, and valves shall be unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall they be dropped nor shall they be permitted to roll against pipe already on the ground. Insofar as practicable, each piece of pipe shall be delivered and unloaded near the place where it is to be installed and where it will not interfere with excavation operations, traffic, or adjacent property owners and may be readily inspected by the Engineer. If this is not possible, the pipe, specials and valves shall be stored in a safe area as close to the job site as possible. The Contractor is responsible for identifying a location for storage of pipe, fittings, valves, excavated material, and borrow material. AQUARION WATER COMPANY is responsible for delivering "AQUARION WATER COMPANY-provided" materials to said location. The contractor is responsible for stringing pipe along the intended pipeline route. All damaged pipe, specials, and valves will be rejected and such rejected pipe, specials, and valves shall be removed from the site. In the event of slight damage to the coating or lining, Aquarion may permit the damage to be repaired at the site. Such repairs shall be made at the Contractor's expense.

1.8 Bedding

There shall be a minimum four inch (4") base of bank run gravel, dead sand, stone fill (as specified under Item 4), or clean backfill under the pipe when necessary. The material shall be spread in layers and shall be compacted in place at the proper grade to provide a solid uniform bed for the pipe or structure for the full width and length of the bottom of the excavation. The bedding shall extend four inches (4") up the pipe as shown on the plans or as directed by the Engineer. Bell holes shall be carefully dug at the ends of the pipe to provide ample room for properly making and checking of joints and providing

room for four inches (4") of compacted bedding material under the bell when necessary.

When the pipe has been bedded satisfactorily and the joint made, the recess under the bell shall be refilled and tamped on each side of the pipe to hold it securely in place, care being taken not to disturb the position of the pipe during the process, and in such a manner that the bearing is distributed evenly over the entire length of pipe.

Bank run gravel, dead sand or stone fill necessary for bedding is included with the various pipe installation items in Section A.

1.9 Cleaning and Inspection of Pipe, Specials, and Valves

The insides of the pipes, specials, and valves shall be thoroughly cleaned before laying and shall be kept clean until accepted in the completed work. Whenever the work is interrupted, all open ends of pipe shall be temporarily closed by watertight plugs. No trench water shall be permitted to enter the pipe. All pipe and special castings shall be carefully examined for defects and no pipe or special casting shall be laid which is known to be defective. If any such pipe or casting is discovered to be defective after placement, it shall be removed and replaced with a sound pipe or casting by the Contractor at his own expense.

1.10 Existing Utilities

The Contractor shall abide by current State of Connecticut "Call Before You Dig" regulations. The Contractor shall call 48 hours in advance of commencing any construction. All excavations in existing streets shall be pre-marked showing the proposed trench width for the entire water main extension.

1.11 Clearing and Grubbing

The Contractor shall remove all trees, brush, shrubs, and debris where encountered in the line of work only to the extent necessary for the prosecution of the work.

Unless otherwise specified, all brush and trees shall be cut within six inches (6") of the ground.

Cutting and removal of cleared materials shall be carried out in such manner as to avoid injury to other trees and structures.

Burning shall not be permitted on the site.

Trees, stumps, brush, and debris shall be disposed of away from the site by the Contractor at no additional cost to the Owner.

1.12 Excavation

The excavation defined herein shall be deemed earth excavation, which shall include the removal of all material other than rock. Rock excavation shall consist of solid ledge

rock or boulders, which require drilling and blasting for removal. Rock excavation is specified under Section T-3.

Excavation shall be made in such a manner and to such widths as will give ample room for properly installing and inspecting the pipe or structures that they are to contain and for such sheeting and bracing, pumping and draining as may be necessary. The Contractor shall not use excavating equipment that requires the trench to be excavated to an excessive width. The width of the trench for pipe shall be sufficient to allow thorough compacting of earth or granular refill adjacent to the bottom half of the pipe. Enlargements of the trench shall be made to give ample space for required operations at the pipe joints. The depth of trench in general shall be as described in Item 1.3.2, but if approved by the Engineer, the depth shall be increased or, decreased as required to avoid obstructions. Hand excavation shall be employed whenever, in the opinion of Aquarion, it is advisable to increase the depth more than twelve inches (l2") below the bottom of the pipe or structures, or below the limits on the Plans or laying schedule.

The Contractor's attention is directed to the fact that pipe must be bedded as described in Item 1.8 herein. Special care shall be taken to excavate accurately to grade. If the trench is over-excavated, it shall be brought to grade, at the Contractor's expense, by refilling with suitable material in compacted layers, each layer not to exceed six inches (6") in thickness.

Where the bottom of the trench at sub grade is found to be unstable or to contain material which, in the judgment of the Engineer, should be removed, the Contractor shall excavate and remove such material to the width and depth ordered. Before pipe is laid, the sub grade shall be made by refilling with bedding material conforming to Item 1.8, in compacted layers, each layer not to exceed six inches (6") in thickness. The layers shall be thoroughly compacted so as to provide a uniform and continuous bearing for the pipe. Extra excavation and backfill material ordered by the Engineer will be paid for under Section A.

1.13 Rock Excavation

Rock excavation and granular refill including bedding is specified under Section T-3.

1.14 Test Pits

Test pits are specified and paid for as described in the Special Provisions.

1.15 Unauthorized Excavation

All unauthorized excavations outside the lines and grades shown and specified shall be at the expense of the Contractor and he shall refill them with suitable material, in a manner as shown, specified, or approved at his own expense.

1.16 Sheeting and Bracing

Where necessary, the sides of the trenches and excavations shall be supported by adequate sheeting and bracing. The Contractor shall be held accountable and responsible for the sufficiency of all sheeting and bracing used and for all damages to persons or property resulting from the improper quality, strength, placing, maintaining, or removing of the same. When sheeting is removed, care shall be taken not to disturb the new work or existing utilities and structures.
No sheeting is to be left in place unless expressly permitted by the Engineer. Steel and wood sheeting is described in Item 14.

1.17 Dewatering

The Contractor shall provide all necessary pumps, drains, well point systems, and other means for removing water from the trenches and other parts of the work. Before pipes are laid or structures built, the trenches and excavations shall be free from water and, if necessary, suitable drainage facilities shall be provided and maintained. Any drainage system used by the Contractor shall be subject to the approval of the Engineer.

Subgrade damaged by failure to properly dewater will be repaired at the Contractor's expense.

Water from the trenches and excavations shall be disposed of in such a manner as will neither cause injury to public health nor to public or private property, nor to the work completed or in progress.

No direct payment will be made for removal of water, but compensation for such work and all expenses incidental thereto shall be considered as part of the price bid for this Item.

1.18 Erosion Control and Restoration of Grassed Areas

When the trenches cross or disturb grass plots along streets, in open areas, and on slopes or embankments, the disturbed areas shall be fertilized, seeded, mulched, watered, and maintained until a permanent stand of grass is developed. Areas to be seeded shall be raked and rolled to an even grade with all stones and debris removed. All areas disturbed by construction shall be similarly seeded.

Drainage swales or berms shall be constructed as necessary and maintained until such time as an adequate formation of sod is obtained.

1.19 Backfilling

Unless otherwise specified or directed, all trenches and excavations shall be backfilled immediately after installation and inspection of the pipe.

Selected material from excavation shall be used for backfilling trenches along and over the pipe to a level twelve inches (12") above the top of the pipe and shall be earth,

sand, or well-graded gravel with a maximum size of four inches (4"). The Contractor shall use suitable material from excess excavation from other portions of the work or from approved gravel pits. It shall be carefully deposited in uniform layers not exceeding twelve inches (12") in depth, and unless otherwise permitted, each layer shall be carefully and solidly tamped with appropriate tools in such a manner as to avoid disturbing the completed work.

Backfilling for the remainder of trenches and excavations shall be approved material free from organic matter. No large stones shall be used in the trench until there is at least two feet (2') of fill over the top of the pipe or around the structure and, in depositing stone, care must be taken not to injure the pipe or structure. Stones which are used in backfilling shall be so distributed through the mass that all interstices are filled with fine material. Backfill shall be deposited in layers and solidly compacted.

Rock and miscellaneous materials from trenches and excavations may be used in the fill, provided individual pieces are not larger than one-half cubic foot in volume and that they are placed so that voids are filled with sand, gravel, and earth.

Backfilling within two feet (2') of structures shall be uniformly deposited on all sides and, unless otherwise permitted, solidly compacted in such manner as to avoid injuring the structure or producing unequal pressures thereon.

When sheeting is drawn, all cavities remaining in or adjoining the trench shall be solidly filled. When sheeting is permitted left in place, all cavities behind such sheeting shall be solidly filled.

If the material from trench excavation is considered, in the opinion of the Engineer, to be unsuitable for use in backfill, the Engineer shall order the Contractor to furnish suitable and approved material for fill which will be paid for under Item No. 13000XXA – Additional Backfill Material (Water Main).

Additional backfill material to replace unsuitable material from rock excavation is included for payment under Item No. 13000XXA – Additional Backfill Material (Water Main).

1.20 Storage and Disposal of Excavated Materials

Materials removed from the trenches shall be stored in such a manner that they will not interfere unduly with pedestrian or vehicular traffic. Sufficient material suitable or backfill shall be stored and hauled as necessary to replace excavated material that is unsuitable for backfill. Materials unsuitable for replacement in the utility trench shall be removed to the City's on-site Waste Stockpile Area for City disposal. All other excess excavated material shall be removed and disposed of away from the site by the Contractor immediately after backfill has been placed.

1.21 Clean-Up

Periodically, as the work progresses and immediately after the work has been completed, the Contractor shall remove all excess materials from the area of the work. The area, in general, shall be kept clean and orderly and returned to a neat condition. The area of construction along roadways shall be broom swept each day after completion of the day's work.

Trees, stumps, brush, and debris shall be disposed of by the Contractor off the site. Burning shall not be permitted.

1.22 Approved List of Manufacturers

List will be provided by Aquarion at the Contractor’s request.

ADDITIONAL EARTH EXCAVATION

Item 2

2.1 (Deleted)

2.2 (Deleted)

2.3 (Deleted)

2.4 (Deleted)

2.5 (Deleted)

2.6 (Deleted)

ROCK EXCAVATION

Item 3

3.1 Scope of Work
3.2 Definition of Rock
3.3 Limits of Rock Excavation
3.4 Blasting
3.5 Backfill
3.6 Mechanical Removal of Rock
3.7 Measurement
3.8 Frost Excavation
3.9 Payment

3.1 Scope of Work

This work shall include removal and disposal by hand or mechanical means of all boulders, ledge formations, cement masonry or concrete structures to be removed from within the payment lines.

This work shall include removal, by hand labor, if required, of ledge rock, boulders, masonry or concrete structures in the vicinity of gas mains or other utilities.

3.2 Definition of Rock

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, Portland cement pavement or base, of ½ cubic yard or more in volume, removed as indicated or directed from within the payment lines for trench excavation.

3.3 Limits of Rock Excavation

Rock shall be excavated so that generally there will be clear space of at least twelve inches (12") from the outside of the structure or barrel of the pipe to the vertical side of the excavation. Isolated points of rock shall not come nearer than four inches (4") to the outside of the structure or pipes and at joints there shall be sufficient room for properly making the joint. At the bottom, no rock shall come nearer than four inches (4") to the outside barrel of the pipe. Rock in miscellaneous excavations shall be excavated in accordance with the directions and to the limits directed by the Engineer.

The surface of the rock shall be stripped in sections satisfactory to the Engineer before the rock is excavated so that the proper measurements may be made.

3.4 Blasting

Explosives for blasting shall be stored, handled, and used in accordance with the laws,

ordinances, and regulations of the State of Connecticut and all local regulations and with such additional regulations as the Engineer may require. Blasting shall be conducted so as not to endanger persons or property and, unless otherwise permitted, shall be covered or otherwise satisfactorily confined. The Contractor shall be responsible for and shall make good any damage of whatever nature caused by blasting or accidental explosions. If rock removal is required near existing utility pipes, cables, or structures, the Contractor may be required to remove such rock without blasting.

3.5 Backfilling

Where pipe is laid in rock excavation, clean backfill or bank run gravel refill as specified under Item 4, it shall be placed over the rock and tamped to sub grade. The minimum of six inches (6") of clean backfill or bank run gravel bedding is specified under Item 4 and paid for under Section C. Excess rock, which cannot be used with earth to provide satisfactory fill in the upper portions of the trench, shall be disposed of the same as excess earth excavation. No pieces of rock in excess of one-half cubic foot in volume shall be used in backfilling.

The Contractor shall place backfill material obtained from excess material from other portions of the work or from additional backfill material as specified under Item 4.

3.6 Mechanical Removal of Rock

Mechanical removal of rock shall include removal by hoe ram. AQUARION WATER COMPANY will pay the unit bid price for mechanical removal of rock when mechanical methods are used (1) due to the proximity of the pipeline route to existing structures or (2) due to restrictions against blasting set by federal, state, or local officials, or (3) at the request of AQUARION WATER COMPANY. If mechanical methods are used for any other reason, AQUARION WATER COMPANY will pay the unit bid price that applies to blasting.

3.7 Measurement

For excavation in rock for pipe trenches, the trench will be computed as having a width as shown in the table below, vertical sides, a flat bottom, and a depth from the surface of the rock to a plane six inches (6") below the invert of the pipe. For excavation in rock for structures, the pay line shall be computed as having a width of one-foot (1') outside the structure, vertical sides, a flat bottom, and a depth from the surface of the rock to a plane six inches (6") below the underside of the structure. Typical trench details and payment limits are shown in the Water Relocation Plans and Details. No payment will be made for additional width in pipe trenches at field joints or beyond the lines described above.

For boulders and all rock excavated for purposes other than above described, measurement for payment will be made of the amount of rock actually removed as ordered.

DIMENSION LINES FOR ROCK EXCAVATION IN TRENCHES

PIPE SIZE	TRENCH WIDTH (w/o Trench Box)	TRENCH WIDTH (w/ Trench Box)
6 Inch Pipe	3.00 Feet	6 Feet
8 Inch Pipe	3.00 Feet	6 Feet
10 Inch Pipe	3.00 Feet	6 Feet
12 Inch Pipe	3.00 Feet	6 Feet
16 Inch Pipe	3.33 Feet	6 Feet
20 Inch Pipe	3.67 Feet	6 Feet
24 Inch Pip	4.00 Feet	6 Feet
30 Inch Pipe	4.50 Feet	6 Feet
36 Inch Pipe	5.00 Feet	6 Feet

3.8 Frost Excavation

Frost excavation shall mean removal of frozen earth exceeding twelve (12) inches in depth which, in the opinion of Aquarion, requires for its removal, drilling and blasting or breaking with specialized power operated frost removal equipment. No frost exceeding the payment limits designated for rock excavation in Section 3.6 will be measured or allowed.

3.9 Payment

The unit price bid per cubic yard shall include payment for all labor, tools, materials, and equipment necessary to excavate and dispose of all rock necessary to complete the work as specified herein. The unit price bid for rock excavation shall include the cost of backfilling and the cost of any borrow material needed to replace the rock. AQUARION WATER COMPANY will not pay any cost beyond the unit price bid for rock excavation for laborers and equipment that are idle during periods of rock removal.

Clean backfill or bank run gravel bedding for refill required to bring the excavation to sub grade or for bedding is specified under Item 4. The unit price for mechanical rock removal (i.e., hoe ram) shall not include the cost of any borrow material needed to replace the rock.

ADDITIONAL BACKFILL MATERIAL

Item 4

4.1 Work Included
4.2 Bank run Gravel
4.3 Dead Sand Fill
4.4 Stone Fill
4.5 Clean Backfill
4.6 Placing
4.7 Measurement Payment

4.1 Work Included

This Item includes all bank run gravel, dead sand, or stone fill as ordered by Aquarion or others, which is not specifically included under other Items of this Contract. Materials ordered for refill of rock removal, frost removal, unsuitable material, bedding or pavement granular base are specified under this Item but paid for under those individual items.

4.2 Bank run Gravel

Bank run gravel, as defined herein, shall be gravel of such size that one hundred percent (100%) passes a sieve having two inch (2") square openings and shall be reasonably uniform, graded down to one-quarter inch (1/4") size. It shall not contain vegetation or masses of roots and shall be substantially free from loam and other organic matter, clay, and other fine or harmful substances.

4.3 Dead Sand Fill

All sand used for backfill shall be a natural bank sand, graded from fine to coarse, not lumpy or frozen and free from slag, cinders, ashes, rubbish, or other material which, in the opinion of Aquarion is objectionable or deleterious. It shall not contain a total of more than 10 per cent by weight of loam and clay and all material must be capable of being passed through a three-quarter inch sieve. Not more than 5 per cent shall remain on a No. 4 sieve.

4.4 Stone Fill

Stone fill shall consist of sound, tough, durable particles of crushed or uncrushed gravel free from soft, thin, elongated or laminated pieces and vegetable or other deleterious matter. It shall meet such graduation requirements as specified by the Engineer.

4.5 Clean Backfill

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. It shall be free from stones larger than 4 inches. All backfill shall be placed in a manner acceptable to the Engineer. Unless otherwise ordered by the Engineer, the backfill shall be brought to the surface of the

surrounding ground and neatly graded. Backfilling will only be done under the supervision of the Engineer of his representative.

4.6 Placing

Bank run gravel, dead sand, clean backfill, or stone fill shall be placed to the lines and grades ordered. Fill shall be placed in layers not exceeding twelve inches (12") in thickness and shall be well compacted in place by hand and/or by mechanical tamping devices.

4.7 Measurement and Payment

The quantity of bank run gravel, dead sand, or stone fill required under this Item will not be measured for separate payment.

Clean backfill required to replace material determined to be unsuitable for replacement in the utility trench will be measured for payment by the cubic yard compacted in place, which price shall be considered payment in full for all labor, materials and equipment necessary to complete the installation in accordance with these technical specifications.

The cost of bank run gravel, dead sand and stone fill will be included for payment as part of the cost bid for installing DIP pipes of various sizes and service installations/adjustments under Section A, which price shall include payment in full for all labor, materials, and equipment necessary to complete the installation as specified.

INSTALL HYDRANT ASSEMBLIES

Item 5

5.1 Work Included
5.2 Materials
5.3 Installation of Hydrant Assemblies
5.4 Measurement and Payment

5.1 Work Included

Under this Item the Contractor shall supply all labor, tools and equipment necessary for installing hydrant assemblies, complete as shown and specified. Material to be supplied by AQUARION WATER COMPANY unless otherwise specified.

5.2 Materials

Hydrant assembly shall include tee, elbow fitting, 6-inch gate valve, 6-inch ductile iron pipe, and a hydrant.

5.2.1 Tees

Tees shall have 6-inch outlet and shall be ductile iron with mechanical joint ends.

5.2.2 6-inch Gate Valves

Gate valves shall be as specified under Section 1.5.3 of Item 1.

5.2.3 6-inch Piping

The 6-inch piping shall be cement lined ductile iron pipe, Class 52, conforming to ANSI A21.51, latest revision.

5.2.4 Hydrants

See Aquarion hydrant detail in Attachment W.

Hydrants shall be with 5-1/4 inch valve opening, unless otherwise specified by the Town. Hydrants are to be factory painted “VALDURA YELLOW” WITH REFELCTIVE SILVER BONNETS.

Hydrants shall open to the direction shown on the table *Gate & Hydrants by Town* at the end of this section and shall have a pumper and double hose nozzles.

Threading of hose and pumper nozzles shall be "National Standard" or "Bridgeport Thread" as required by Aquarion.

Connection to main shall be 6-inch mechanical joint.

Hydrants shall be suitable for five-foot (5') burial.

5.2.5 Retainer Glands

Mechanical joint retainer glands shall be megalug design type. Set screw type retainer glands will not be accepted.

5.3 Installation of Hydrant Assemblies

Hydrant installations shall conform to the detail drawings (See Attachment W).

After excavation and grade is determined, the proper buried depth hydrant should be used if an offset is needed. This is the time to make the decision if an offset is needed. After 6-inch valve is installed using retaining glands (Mega Lugs), offset/lateral and valve should be blocked. Lateral is now connected to hydrant with retaining gland. After hydrant is plumb and level/blocked bottom, check the weep/drain holes on sides to make sure they are clean and clear of any obstructions. Next, dig back to good virgin material for blocking the bottom ball with solid cement blocks (as many as needed), oak blocks and wedges to get a tight fit. Back-fill the ball of the hydrant with 1 ¾-inch or 1 1/4 –inch trap stone 1-foot above the bottom flange. Place a layer of filter fabric on top of trap rock. With silt cloth on top of stone, vent fill and flush hydrant (**Make sure hydrant drains**). Back-fill with process tamp and lifts. Make sure operating nut for valve is in the center of the gate box and keep top section set to finished grade. Area must be restored to original condition.

5.4 Measurement and Payment

The unit price bid for this Item shall be full payment for all labor, tools, equipment, and materials necessary for each hydrant assembly installed, complete as shown and specified. The hydrant branch lateral (including all pavement removal, pavement disposal, excavation, lateral installation, and backfill) shall be paid for under this item.

In addition, **Hydrant Checklist (Attachment W) must be completed and signed by a Contractor's representative and attached to invoice. Hydrant related invoice will not be paid until all required paperwork is completed and properly submitted with the invoice.**

CLASS "B" CONCRETE

Item 6

6.1 Work Included
6.2 Concrete
6.3 Measurement and Payment

6.1 Work Included

Under this Item, the Contractor shall furnish and place all concrete ordered by the Engineer which is not included under other Items of this Contract. Concrete used for thrust blocks, concrete encasement, and fill concrete is included and will be paid for under this Item.

6.2 Concrete

Portland cement shall conform to ASTM C150, latest revision, for Type I cement. Aggregate for concrete shall conform to ASTM C33, latest revision. Coarse aggregate shall be size no. 67 per Conn DOT, Form 816, M.01.01.

Concrete shall contain at least 4.7 bags of cement per cubic yard. The amount of water used shall not be more than 7.0 gallons per bag of cement and less shall be used if required, depending upon the character of the aggregates, the proportion of coarse to fine materials in the aggregates, and the consistency desired for the moisture content in the aggregates. The exact proportions of water, cement, sand, and coarse aggregates shall be varied as ordered to give the best results for the aggregate used. The minimum 28-day compressive strength shall be 2,500 lbs. per square inch.

Concrete shall be mixed in an approved rotating type of mixer at least one and one-half (1-1/2) minutes after all ingredients are combined. It shall be deposited immediately after mixing in a manner to avoid separation and shall be compacted through spading and by use of approved mechanical vibration devices. No concrete shall be placed in freezing weather.

Transit mix concrete may be used providing it meets all of the requirements specified above and the transit mix company and its equipment are approved by the Engineer. Concrete shall be discharged from the mixer not more than sixty (60) minutes after cement is added to the other ingredients.

6.3 Measurement and Payment

The unit price bid for this Item shall be full payment for all labor, equipment, and materials required for each cubic yard of concrete measured in place to the size, which is ordered by the Engineer.

HYDROSTATIC AND LEAKAGE TESTING

ITEM 7

7.1 Work Included
7.2 Description of Work

7.1 Work Included

Under this Item the Contractor shall supply all labor, materials, tools, and equipment necessary for performing the Hydrostatic and Leakage Testing as specified in AWWA C600 latest revision. The Contractor will be responsible for making sure the new main passes the Hydrostatic and Leakage Testing.

7.2 Description of Work

After the completion of the water main installation and upon adequate notice to the AQUARION WATER COMPANY, the main will be Chlorinated by AQUARION WATER COMPANY and allowed to stand for forty-eight (48) hours. After flushing and a satisfactory test by AQUARION WATER COMPANY's Water Quality Department, the Contractor may be required to perform a hydrostatic and leakage test on the new main. AQUARION WATER COMPANY personnel must be on-site to witness the test. Pressure in the main will be brought to a point equal to 150 psi if the normal operating pressure is 100 psi or less and 200 psi if the operating pressure is over 100 psi. Allowable leakage in the new installation shall be determined by the following formula:

$$L = \frac{ND\sqrt{P}}{7400}$$

In which "L" is the allowable leakage in gallons per hour; "N" is the number of joints in the length of pipe tested; "D" is the nominal diameter of the pipe; and "P" is the average test pressure in pounds per square inch gauge.

For purposes of the hydrostatic and leakage test, test pressure in the main shall be maintained for a period of two (2) hours.

All visible leaks shall be made tight by the Contractor and, if the line does not meet the above leakage test, it shall be repaired by the Contractor and retested until the leakage requirement is met.

AIR VENT ASSEMBLY

Item 8

8.1 Work Included
8.2 Materials and Method of Construction
8.3 Measurement and Payment

8.1 Work Included

Under this Item the Contractor shall furnish all labor, tools, miscellaneous materials, and equipment necessary to furnish and install the air vent assembly, complete as shown and specified by the Engineer.

8.2 Materials and Method of Construction

The air vent assembly shall be installed where called for on the drawing or as directed by the Engineer. Air vent assembly installations shall conform to the detail drawings (See Aquarion Water Details). Materials to be supplied by the Company.

8.3 Measurement and Payment

The unit price for this item shall be full payment for the complete assembly, with tap, shut-off valve, blow-off, and piping with valve, fittings, and union all complete and ready for operation.

INSTALLATION OF POLYETHYLENE ENCASEMENT ON WATER MAINS AND APPURTENANCES

Item 9

9.1 Work Included
9.2 Description of Work

9.1 Work Included

Under this Item the Contractor shall supply all labor, materials, tools, and equipment necessary for installing the Polyethylene Encasement on the water main and appurtenances as specified in ANSI/AWWA C105/A215, latest edition and as ordered by the Engineer.

9.2 Description of Work

The installation of the encasement shall prevent contact between the pipe and the surrounding backfill and bedding material but is not intended to be a completely airtight and watertight enclosure. Overlaps shall be secured by the use of adhesive tape, plastic string or any other material capable of holding the polyethylene encasement in place until backfilling operations are completed. Any rips, punctures or damage during installation shall be repaired prior to backfilling.

Care shall be taken during backfilling to prevent damage to the polyethylene encasement. Backfill material shall be free of cinders, refuse, boulders, rocks, stones or other materials that could damage polyethylene.

The material to be used will be sheet type and supplied by AQUARION WATER COMPANY along with the necessary fastening materials.

PAVEMENT RESTORATION

Item 10

10.1 General
10.2 Work Included
10.3 Temporary / Permanent Pavement
10.4 Processed Aggregate – Rolled Granular Base
10.5 Permanent Pavement
10.6 Bituminous Concrete Resurfacing Course
10.7 Bituminous Concrete Sidewalks and Driveways
10.8 Bituminous Concrete Lip Curbing
10.9 Reinforced Concrete Base
10.10 Concrete Sidewalks and Driveways
10.11 Concrete Curbing
10.12 Asphalt Milling
10.13 Measurement
10.14 Payment

10.1 General

10.1.1 Limits of Responsibility

If AQUARION WATER COMPANY decides to have one contractor install pipeline and temporary paving and another contractor install permanent paving, the contractor who installed the pipeline will be responsible for any pavement failure that results from settling of the trench. This responsibility shall include replacement of the failed portion of pavement. In addition, the contractor who installed the pipeline and temporary paving will be responsible for maintaining the temporary paving for a period of four (4) months from the date of installation of the temporary paving.

10.1.2 Service Connection Contract – **N/A**

10.2 Work Included

Under Item 10.3-10.11, the Contractor shall furnish all labor, materials, tools, and equipment necessary for pavement, granular base and curbing restoration of Town and State roads disturbed by his operations. AQUARION WATER COMPANY will be responsible for all restoration within the limits specified below. The Contractor will be responsible for granular base and temporary /permanent pavement outside the specified limits. Add 2 feet to each width below if a trench box is used.

PAVEMENT AND GRANULAR BASE LIMITS

Pipe Size	Temporary Pavement Width Limit	Permanent Pavement Width Limit
6"	4.00 feet	6.00 feet
8"	4.00 feet	6.00 feet
10"	4.00 feet	6.00 feet
12"	4.00 feet	6.00 feet
16"	4.00 feet	6.00 feet
20"	5.00 feet	7.00 feet
24"	5.00 feet	7.50 feet
30"	6.00 feet	8.00 feet
36"	6.00 feet	8.50 feet

10.3 Temporary/Permanent Pavement

In pavement, the Contractor shall, immediately after back filling, place temporary or permanent trench pavement as directed by AQUARION WATER COMPANY. In town roads, the base thickness shall be ten inches (10"). The processed aggregate base shall meet the requirements of the State of Connecticut Department of Transportation Specifications, form 816, Section 3.04 and the requirements of Item 4 herein. In State Highways, the base thickness shall be ten inches (10"). The processed aggregate base and bituminous surfacing are included for payment under this Item. AQUARION WATER COMPANY will define at the commencement of the project whether the trench repair will be temporary or permanent.

Aquarion will determine the type of material to be used as temporary/permanent pavement. The temporary material will be either "cold patch" or "hot patch". Cold patch shall only be used under extreme cold weather conditions.

Hot patch shall be a Class 1 material as per the requirements of the Connecticut Department of Transportation Specification Form 816, Section 4.06, and Section M.04, Bituminous Concrete Mix. The permanent material under this item will be a Class 4 Binder as per the requirements of the Connecticut Department of Transportation Specification Form 816, Sections 4.04, 4.07, and Section M.04, Bituminous Concrete mix. During the progress of the work and until construction of the final surface, the Contractor shall maintain the surface of the streets in good and safe condition. He shall frequently inspect and promptly fill all depressions over and adjacent to trenches caused by settlements. The contractor is responsible for maintaining the trench for a period of one (1) year at their own cost, from the date of installation of the temporary or permanent hot patch. AQUARION WATER COMPANY will not pay for any leveling course.

Generally, in town roads, the pavement shall consist of a four (4) inch Class 4 base course and a two (2) inch surface course as directed by Aquarion. In state roads the pavement shall consist of a five inch (5") HMA S1 course and a four inch (4") HMA S0.5 course placed in two equal lifts. All stated pavement thickness are compacted and rolled into place.

The bituminous concrete shall meet the requirements of the State of Connecticut Department of Transportation Specification Form 816, Section 4.06, and Section M.04, Bituminous Concrete Mix.

Payment for permanent pavement shall not exceed the pay limits as in the table in Section 10.2.

Where existing pavement is disturbed at the intersection of driveways and street line, replacement of permanent pavement shall be "lipped".

Pavement in state highways shall meet the approval of the Connecticut Department of Transportation.

10.4 Processed Aggregate - Rolled Granular Base

Under this item, and after formation of sub grade under other items of these specifications has been substantially completed, the Contractor shall prepare the sub grade and construct a processed aggregate or rolled granular base course, as directed, in conformity with the line, grade, dimensions and compacted thickness shown on the drawings, or as directed.

Materials and construction methods shall conform to applicable provisions of CONN-DOT Specifications, form 816, Section 2.09 for Sub grade, Section 3.04, Processed Aggregate Base and Section 3.02 Rolled Granular Base.

10.5 Permanent Pavement

Contractor shall be responsible for coordinating with local and/or state authorities to define when permanent paving can be performed. Upon completion of main installation, the Contractor shall inform AQUARION WATER COMPANY in writing of the anticipated date of paving.

In preparation for the permanent pavement, the remaining edges of the existing pavement shall be cut back a minimum of twelve inches (12") from the edges of the trench. If required, the temporary pavement shall be removed and the sub grade formed to the required line, grade, and cross-section and properly compacted.

Throughout the work of this Section, the Contractor shall exercise care so as not to damage the cut edge of the existing pavement.

When the base is in proper condition, subject to the approval of Aquarion, a final two course bituminous concrete pavement shall be constructed. Immediately prior to laying the binder and wearing courses, the trimmed edges shall be stable and unyielding, free of loose or broken pieces and edges and shall be thoroughly broomed and coated with an approved tack coat. The binder course shall be tack coated prior to placing the wearing course.

10.6 Bituminous Concrete Resurfacing Course

Scope of Work

Under this Item, the Contractor shall construct bituminous concrete pavement of two inch (2") compacted thickness. This work shall be performed in conformity with the line, grade and dimensions shown on the plans or as directed.

Materials and Method of Construction

Materials and method of construction shall conform to applicable provisions of CONN-DOT Specifications, Form 816, Section 4.06, Bituminous Concrete, Class 2.

All edges of pavement along the existing roadway which shall be cut vertically straight and in a neat and workmanlike manner and shall receive a tack coat of bituminous material prior to constructing the new pavement.

Paving Equipment

Paving equipment shall be of the self-powered type with an adapter to provide guidance of the screeding action. The screed or strike-off member shall be adjustable to the shape of the cross-section of the finished pavement. Some method shall be provided for the tilting of the screed while in operation to secure the proper "drag" and to provide the compressive screeded surface required. The machine shall have a sufficient number of driving wheels so there will be no undue amount of slippage. Whenever the design of the equipment and plan of operation are such that the driving wheels travel on the finished surface of a completed pavement, said wheels shall be equipped with rubber tires or other means to protect the finished surface. Screeding members shall be preheated, and means shall be provided for heating the screeding members by some method that will prevent accumulation of bituminous material.

Automatic Grade and Slope Control

All paving equipment used on divided highways of four or more lanes in excess of one thousand feet long, shall be equipped with automatic grade and slope screed controls with sensors for either or both sides of the paver. These systems shall be capable of overriding the normal function of the self-leveling screed and maintain screed deviation relative to an external reference. This reference may be an existing grade, mat, slab, or curb.

The grade sensor shall react from a reference line or a floating beam or shoe (ski) traveling over the reference plans.

The transverse slope controller shall be capable of maintaining the screed at the desired slope within +/- 0.1 percent.

10.7 Bituminous Concrete Sidewalk and Driveway

This item shall consist of two-inch bituminous concrete surfaced sidewalk or driveway constructed on a five-inch granular base course in the locations shown on the plans or as ordered.

Materials for this work shall conform to CONN-DOT Specifications, Form 816, Section 9.22.02, and Article .02.01 for granular fill and Article M.04, Class 2 Bituminous Concrete Surface Course.
Construction methods shall conform to CONN-DOT Specifications Form 816, Article 9.22.03.

10.8 Bituminous Concrete Lip Curbing

Materials for this work shall conform to the requirements of Article M.04.01, Class 3, of the State of Connecticut Department of Transportation Form 816.

Prior to the arrival of the mixture on the work, the surface of the pavement where the curbing is to be constructed shall be cleaned of all loose and foreign material. The surface, which shall be perfectly dry and clean at the time the mix is placed, shall be coated with an RC-2 or other approved bitumen just prior to placing the mixture.

Bituminous concrete lip curbing shall be machine formed with an approved mechanical curbing machine.

The surface of the curbing shall be tested with a ten-foot (10') straightedge and any variation from a true line exceeding one-quarter of an inch (1/4") shall be satisfactorily corrected. The only compaction required shall be that obtained by the approved mechanical curbing machine.

Where machine work is impractical, the Engineer may permit hand laid curbing to be constructed.

After the completion of curbing, traffic shall be kept at a safe distance for a period of not less than twenty-four (24) hours and until the curbing has set sufficiently to prevent injury to the work.

10.9 Reinforced Concrete Base

The base shall consist of concrete composed of Portland cement and fine and coarse aggregates, mixed in the hereinafter specified proportions and constructed on the prepared sub base, to the form and dimensions shown on the plans, and in accordance with these specifications. The base shall be reinforced with 6 x 6 – W4.0 x W4.0 Welded Wire Fabric.

All material for this work shall conform to the requirements of Article M.03.01 for Concrete Pavement and Article M.06.01 for Reinforcing Steel, CONN-DOT specifications, Form 816.

The construction methods for the base shall conform to the applicable requirements given in Article 4.01.03 for Concrete Pavement. The operation of placing and spreading shall be continuous during any working period. At the end of any working period, a bulkhead of steel or 2 inch plank conforming to the cross-section of the base course shall be placed at right angles to the centerline and perpendicular to the surface, and the concrete shall be finished to it. When work is resumed, the bulkhead shall be removed and the surface roughened and wetted before concrete is placed against it. Cutback shall be a minimum of six inches (6") to eliminate irregular edges and shall be made at the time of repairing and not when trench is excavated.

10.10 Concrete Sidewalks and Driveways

This item shall consist of concrete sidewalks and driveways constructed on a granular base course in the locations and to the dimensions and details as directed by the Engineer.

Materials for this work shall conform to the requirements of Article M.03.01 State of Connecticut, Department of Transportation, Form 816 for Class "C" Concrete.

Excavation, including removal of any existing sidewalk, shall be made to the required depths below the finished grade. All soft and yielding material shall be removed and replaced with suitable material.

The granular base shall be placed in layers not over 6 inches 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.

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 of wood, they shall be of 2 inch surfaced plank except that at sharp curves thinner material may be used. If of metal, they shall be of approved section and shall have a flat surface on the top. 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 in thickness, of the full depth and width of the walk, shall be spaced at intervals of 12 feet, 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.

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 radius edging tool. Each slab shall be divided into two or more sections by forming dummy joints with a jointing tool as directed. The walks and ramps shall be mesh reinforced.

The sides of the sidewalk or driveway shall be backfilled with suitable material thoroughly compacted and finished flush with the top of the sidewalk or driveway. All surplus material shall be removed and the site left in a neat and presentable condition to the satisfaction of the Engineer.

10.11 Concrete Curbing

This item shall consist of concrete curbing constructed on the prepared sub-base in accordance with the dimensions and details as directed by the Engineer in conformity with these specifications.

The concrete for cast-in-place curbing shall be Class "C" Concrete conforming to the requirements of Article M.03.01 State of Connecticut, Department of Transportation, Form 816.

Construction method for concrete curbing shall conform to the requirements of Article 6.01.03 for concrete structures, as supplemented by the following requirements:

1. 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. Concrete shall be placed only on a moist base. Concrete shall not be placed on a soft, muddy or frozen base. The concrete curbing shall be constructed in sections having a uniform length of approximately 10 feet, 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 closure, but no sections less than 6 feet in length will be permitted. These sections shall be separated by an approved method at the time of placing of the concrete.

3. Forms shall be so constructed that the form for exposed faces may be removed before concrete has taken final set in order to permit correction of surface irregularities.

4. Concrete curbing shall be cured and protected in conformity with the requirements of Article 4.01.3 for concrete pavement.

5. After concrete has set sufficiently, the grading shall be completed, as directed by the Engineer, by refilling to the required elevation with approved material which shall be placed in layers of not over 6 inches in depth and compacted until firm and solid.

10.12 Asphalt Milling

1. When called for by the Contract or by the Engineer, the Contractor shall mill, profile, or remove existing asphalt as required in preparation of overlaying the roadway. The milling shall be performed by machinery specifically designed and constructed for this purpose and in good operating conditions. All milled areas shall be swept by the Contractor prior to commencement of overlay. All millings shall be removed and disposed of by the Contractor.

2. Keys shall be milled at all starting and ending points of the work. Further, keys shall be milled around all structures which are not to be raised to proposed road elevation such as catch basins, manholes, and other structures as necessary. All transition areas between new and existing asphalt shall be as smooth as possible. All keys shall be 1 1/2" deep and a maximum of 3' wide or as directed by the Engineer.

10.13 Measurement

The quantity paid for under Item 10.3 shall be measured in square yards as actually placed.

The quantity paid for under Item 10.4 shall be measured in cubic yards as actually placed.

The quantity paid for under Item 10.5 shall be measured in square yards placed.

The quantity paid for under Item 10.6 shall be measured in tons in place.

The quantity paid for under Item 10.7 shall be measured in square feet placed.

The quantity paid for under Item 10.8 shall be measured in linear feet.

The quantity paid for under Item 10.9 shall be measured in square yards placed.

The quantity paid for under Item 10.10 shall be measured in square feet placed.

The quantity paid for under Item 10.11 shall be measured in linear feet.

The quantity paid for under Item 10.12 shall be measured in square yards milled.

10.14 Payment

Under Item 10.3, the unit price bid per square yard shall be full payment for all labor, materials including tack coat cost, tools, and equipment necessary to place temporary/permanent pavement on town and state roads, complete as shown and specified. For work measuring less than 9 square yards, AQUARION WATER COMPANY will pay for 9 square yards of work.

This work will be measured for payment under Item 10.4, by the actual number of cubic yards of completed and accepted processed aggregate or rolled granular base and will be paid for at the contract unit price per cubic yard for "Processed Aggregate Base--Rolled Granular Base," which price shall include all work described above, and for all labor, materials, equipment, tools and incidentals necessary to complete this item.

Under Item 10.5, the unit price bid per square yard shall be full payment for all labor, materials including tack coat and joint seal costs, tools, and equipment necessary to place

permanent pavement on town and state roads, complete as shown and specified. For work measuring less than 9 square yards, AQUARION WATER COMPANY will pay for 9 square yards of work.

Under Item 10.6, the unit price bid per ton shall be full payment for all labor, materials including tack coat cost, tools, and equipment necessary to place permanent pavement on town and state roads, complete as shown and specified.

This work will be measured under Item 10.7, by the actual number of square feet of bituminous sidewalk and driveway completed and accepted and shall conform to CONN-DOT Specifications Form 816, Article 9.22.04. All excavation and granular base shall be included in the price bid for sidewalk and driveway.

The work will be paid for at the contract unit price per square foot for "Bituminous Concrete Sidewalk and Driveway" and shall include all excavation, backfill, disposal of surplus material granular base, and all equipment, tools, labor and materials incidental thereto.

Under Item 10.8 the unit price bid per linear foot shall be full payment for all labor, materials, tools and equipment necessary to install the bituminous concrete lip curbing on town and state roads, complete as shown and specified.

The method of measurement under Item 10.9, for the materials entering into the construction of the base shall be as described in Article 4.01.04 for Concrete Pavement. Payment for the concrete pavement will be paid for at the contract unit price per square yard, complete in place, which price shall include all materials, tools and equipment incidental thereto.

This work will be paid under Item 10.10, for at the contract unit price per square foot for "Concrete Sidewalk or Driveway, complete in place, which price shall include all excavation as specified above, backfill, disposal of surplus material, granular base, equipment, tools, materials and labor incidental thereto.

There will be no separate unit price submitted for per linear foot for "Concrete Curbing" of the type specified, complete in place, which price shall include all materials, equipment, tools and labor incidental thereto; also all excavation, backfilling, disposal of surplus material and drainage openings.

There will be no separate unit price submitted for per unit (that is, manhole or catch basin) to raise the unit to grade using adapters or bricks to excavate the manhole to grade. Cost includes labor, materials, asphalt or concrete repairs, traffic control, equipment, and adapters.

There will be no separate unit price submitted for Removal & Disposal of Asphalt Paving in excess of 4-inch thick and Removal & Disposal of Concrete Pavement.

There will be no separate unit price submitted for per gate box to raise the box to grade. For example, the bid unit price will apply to boxes that are buried 2 inches deep on an unpaved road and to boxes that are buried 4 feet deep under paved roads. The bid unit price shall include labor, materials, asphalt or concrete repairs, equipment, and adapters.

TOPSOIL AND SEED

Item 11

11.1 Scope of Work
11.2 Materials and Method of Construction
11.3 Measurement and Payment

11.1 Scope of Work

The work under this item shall consist of furnishing, placing and shaping topsoil in the areas shown on the drawings or where directed by the Engineer. The work shall also consist of furnishing and placing seed on all areas to be seeded.

11.2 Materials and Method of Construction

Topsoil shall be placed to a depth of two inches (2"). Topsoil shall conform to Connecticut Department of Transportation Specifications, Form 816, Article M.13.01.-1. Topsoil which has been stripped under other items of this contract and which meets the latter specifications may be used.

Construction methods shall conform to Connecticut Department of Transportation Specifications, Form 816, Section 9.44.03 and 9.45.03, where applicable.

The Contractor shall restore disturbed lawn areas with topsoil and seed as soon as practical after backfilling. Contractor shall be obligated to place topsoil and seed within 48 hours if requested by AQUARION WATER COMPANY.

11.3 Measurement and Payment

This work will be measured for payment by the number of square yards of surface area shown on the plan, or directed to be covered and actually covered with two inches (2") of topsoil and seeded, as specified and shall be paid for at the contract unit price per square yard for "Topsoil and Seed". For work that measures less than 9 square yards, AQUARION WATER COMPANY will pay for 9 square yards of work.

SODDING

Item 12

12.1 Scope of Work
12.2 Materials and Methods of Construction

12.1 Scope of Work

Work under this item shall consist of furnishing and placing of live sod and also the furnishing and prepared a sodbed composed of four (4") inches, after tamping, of approved topsoil in the areas designated by the Engineer and in conformance with these specifications.

12.2 Materials and Methods of Construction

The materials for this work shall conform to the requirements of Article M.13.01 for Topsoil, Article M.13.02 for Agricultural Ground Dolomitic Limestone, Article M.13.08 for Sod. Stakes for pegging sod shall be of wood, approximately 1" x 2" and of sufficient length to penetrate the sod, the topsoil and to a minimum depth of two (2) inches of subsoil.

The method of construction consisting of season, procuring sod, ground preparation, planting sod, pegging, finishing, care during construction, shall conform to the requirements of Article 9.53.03 State of Connecticut, Department of Transportation, Form 816.

EQUIPMENT AND LABOR RATES FOR EXTRA WORK

Item 13

13.1 General
13.2 Downtime resulting from DOT or town time restrictions

13.1 General

For Section H, the Contractor will submit a list of his equipment available for rental. The list of equipment will consist of the size, type, and model of the equipment. The rental rate will include the cost of the operator, driver, taxes, benefits, overhead, and profit. The unit price will be separated by hour, day, week, and month. The labor rates will include taxes, benefits, overhead, and profit, the unit price per hour.

For Section H the Contractor will submit a list of rates for laborers, drivers, operators, foremen, and supervisors.

13.2 Downtime resulting from DOT or town time restrictions

Working Hours: The Contractor's working schedule shall be confined to a five (5) day week, Monday through Friday, and an 8-hour working day confined between the hours of 8:00 a.m. and 4:30 p.m. current local time for all territories except, Greenwich. Greenwich normal working hours are from 7:00 a.m. to 3:30 p.m. Monday through Friday.

Unless otherwise especially permitted, no work shall be done between the hours of 4:30 p.m. and 8:00 a.m. except as necessary for the proper care and protection of the work already performed. If it shall become absolutely necessary to perform work at night, the Engineer shall be informed a reasonable time in advance of the beginning of the performance of such work. Only such work shall be done at night as can be done satisfactorily and in a first-class manner. Good lighting and all other necessary facilities for carrying out and inspecting the work shall be provided and maintained at all points where such work is being done. If AQUARION WATER COMPANY, DOT, or town officials restrict work during these work hours, the Contractor will incur downtime (for example, if DOT indicates that the Contractor can only work on the roadway from 9 am to 4 PM, the Contractor will incur 1-1/2 hours of downtime). AQUARION WATER COMPANY will pay for that percentage of the Contractor's downtime period based on an equivalent percentage of the daily crew rate bid in Section A for the appropriate size. Only laborers and equipment that are idle during this time period will be included in the downtime charge. Only laborers and equipment that work on the roadway during a specific day will be included in that day's downtime charge. Downtime charges will only be applicable during pipeline installation and for paving jobs in excess of 100 square yards.

AQUARION WATER COMPANY periodically has the need for a construction crew for miscellaneous water work. The contractor shall include all tools and equipment necessary for installing pipe including: all hand tools, wrenches etc., pipe saws and blades, dewatering pumps, tapping machines 3/4" to 12"taps, generator, safety equipment shoring box, air compressor, compaction equipment, roller, state highway signs and cones. In Section C, the Contractor shall provide a daily rate that covers the cost for a crew of 3 workers along with a backhoe, dump truck, and crew truck with tools. In Section C, the Contractor shall provide a daily rate that covers the cost for a crew of 4 workers, including a foreman, operator(s), driver and laborer(s), along with a 3 cyd loader, 18 cyd dump truck, ¾ cyd excavator and utility truck with tools. In Section C, the Contractor shall provide a daily rate that covers the cost for a crew of 5 workers, including a foreman, operator(s), driver and laborer(s), along with a 3 cyd loader, 18 cyd dump truck, ¾ cyd excavator and utility truck with tools. The contractor shall provide all tools that would be needed for the work described in the bid documents; Aquarion will not pay any tool rental fees. Saw cutting shall be included in day rate.

TRENCH BRACING

Item 14

14.1 General
14.2 Trench Bracing
14.3 Continuous Sheet Piling

14.1 General

Where trench conditions are found to consist of material which is unstable to such a degree that it cannot be removed and replaced with an approved material without creating an occupational hazard, the Contractor shall utilize trench bracing, sheeting or trench braces to support the trench. The Contractor must conform to all applicable state and OSHA standards for trench conditions.

14.2 Trench Bracing

Trench bracing is defined as planks placed against opposite sides of the excavation and held in place by timber struts or some extendable brace.

14.3 Continuous Sheet Piling

Sheeting is defined as continuous sheet piling of either steel or wood with whalers or shoring.

TRAFFICMEN & FLAGMEN

Item 15

15.1 General
15.2 Work Included
15.3 Measurement and Payment

15.1 General

Traffic men shall mean uniformed policemen of the town or uniformed State Troopers.

Flagmen shall mean properly trained and protected employees of the Contractor utilized solely to direct traffic in areas where traffic men are not available or required.

The intent of this Item is to provide vehicular and pedestrian traffic direction and traffic men are not to serve as watchmen to protect the Contractor's equipment and materials.

Nothing contained herein shall be construed as relieving the Contractor of any of his responsibility for the safety and protection of persons and property under the terms of this Contract.

15.2 Work Included

The Contractor shall furnish traffic men and/or flagmen for each location of the work of this Contract where construction operations are underway in State highways and Town Street, and the Contractor shall notify and make all arrangements with, and in accordance with the requirements of the Chief of Police of the town or the Special Duty Coordinator of the State Police for uniformed policemen to direct vehicular and pedestrian traffic.

15.3. Measurement and Payment

Services of traffic men and/or flagmen will be measured for payment on the basis of 8-hour man-days; fractions of man-days and overtime will be converted to equivalent man-days. This shall include, however, only such traffic men as are employed in the work of this Contract or upon a detour ordered or approved by the chief of police of the town or the State Police. Traffic men, traffic directors and/or flagmen furnished by the Contractor for continued use of a detour or bypass beyond the period for which the Chief of police deems traffic men necessary will not be measured for payment.

The use of flagmen and/or traffic directors by the Contractor to control the movements of his own vehicles (owned, hired or contracted for, or those delivering materials and equipment), for the protection of said vehicles, workmen or other traffic, shall not be measured for payment and costs shall be included in the unit prices bid for the various Items of this Contract.

The percentage markup for "Traffic men" shall include a 5 percent markup of the billed rate provided by the municipality. The unit price bid for flagmen shall be the hourly rate for such employees.

SERVICE CONNECTION SWITCHOVERS

Item 16

16.1 General
16.2 Work Included
16.3 Materials
16.4 Payment

16.1 General

This item applies to service connection switchovers required as part of the water main replacement for this project. Routine service connection work such as new services associated with extensions, service connection replacements or discontinued service connections will be handled under a separate service connection contract.

16.2 Work Included

Contractor shall furnish all supervision, labor, tools, excavation, backfill and equipment as needed to install service line switchovers for all existing AQUARION WATER COMPANY customers along the route of the water main improvement. Temporary pavement replacement and traffic control associated with service line switchovers are included in other Items in the special provisions.

In instances where the existing service connection is copper and in good condition and the new main is in close proximity to the existing main, AQUARION WATER COMPANY may direct the contractor to tie the new service connection into the existing service connection leaving the existing curb box and valve in place. Should the Contractor encounter difficulty in making a temporary connection to the existing service through no fault of his own, he shall stop work after examining six feet (6') of the existing service line and seek direction from the Aquarion Representative as to how to proceed. In instances where the existing service connection is lead, iron, galvanized, or plastic, the contractor shall install new service connection consisting of a tap (water main sizes will be from 4" to 36"), corporation valve, service connection pipe (Type K copper tubing), curb box and curb valve. When it is required to replace the curb box and valve, connection of the customer's service line to the curb valve is included in this item. The method of service line switchover shall be open cut or pulled method as directed by the engineer. In all cases, the contractor shall excavate and close the corporation valve on the existing main. Shutdown of the service connection and service line shall be coordinated with AQUARION WATER COMPANY and the customer.

The contractor shall provide assistance to Aquarion's Project Representative, who will be responsible to provide a sketch on AQUARION WATER COMPANY tap card forms of the location of the tap showing dimensions and swing ties. In addition, the contractor shall provide a list of all materials installed. Standard detail drawings of service lines are shown in the Water Relocation Plans and Details.

16.3 Materials

All materials shall be AWWA and AQUARION WATER COMPANY approved. Corporation valves shall be brass with Mueller (CC) threads.

16.4 Payment

The unit price bid for this item shall include full payment for all supervision; labor, tools, excavation, backfill and equipment required to complete each service line switchover complete as specified. Payment for pavement and traffic control is included in other Items in the Special Provisions.

Each service line switchover will be paid for under Item #1303395A – Relocate Service Connection.

ABANDONMENT

Item 17

17.1 General
17.2 Work Included

17.1 General

This item applies to abandonment necessary as a result of a plant improvement, water main replacement or other special project.

Unless otherwise specified, "abandonment" implies abandoned-in-place and will generally involve cutting and plugging or capping an existing main.

17.2 Work Included

Contractor shall furnish all supervision, labor, tools, excavation, backfill and equipment as may be needed to cut and plug or cap an existing water main.

The contractor shall cut out a section of the existing main located as directed by AQUARION WATER COMPANY. The cut section shall be large enough to allow the contractor to install a restrained mechanical plug on the "live" end of the remaining pipe. Shutdown of the main shall be coordinated with AQUARION WATER COMPANY.

17.3 Payment

Payment for abandonment shall be made only under the specific bid item(s) involved, i.e. “Cut and Cap”.

REPAIR SEWER SERVICES

Item 18

18.1 General
18.2 Work Included
18.3 Payment

18.1 General

Under this Item the Contractor shall supply all labor, materials, tools, and equipment necessary for repairing unmarked existing sewer services that are damaged by the Contractor, the Contractor shall repair the existing sewer connection.

18.2 Payment

Repairing sewer service connection will not be measured for payment. All costs associated with sewer repair shall be borne by the Contractor.

CONTROL BACKFILL MATERIAL

Item 19

19.1 Work Included
19.2 Materials
19.3 Installation
19.4 Measurements

19.1 Work Included

Under this item the Contractor shall furnish control backfill material (K-Crete) as backfill material where ordered by the Engineer.

19.2 Material

Control Backfill Material shall be in accordance with NYSDOT Item 08502.95, Option B

The material supplied shall be a low-strength concrete slurry commonly known as K-Crete. In the State of New York, any material supplied under this item shall be acceptable to the New York State Department of Transportation for use within state highway rights-of-way. This material shall have a minimum compressive strength of 50 psi.

19.3 Installation

The material shall be deposited into the trench from transit mix trucks. Care shall be taken to assure that the material fills in all the voids.

19.4 Measurements

Measurements shall be by the cubic yard of material placed within the following pay limits upon the specific order of the Engineer. No deduction will be made for the volume of the pipe.

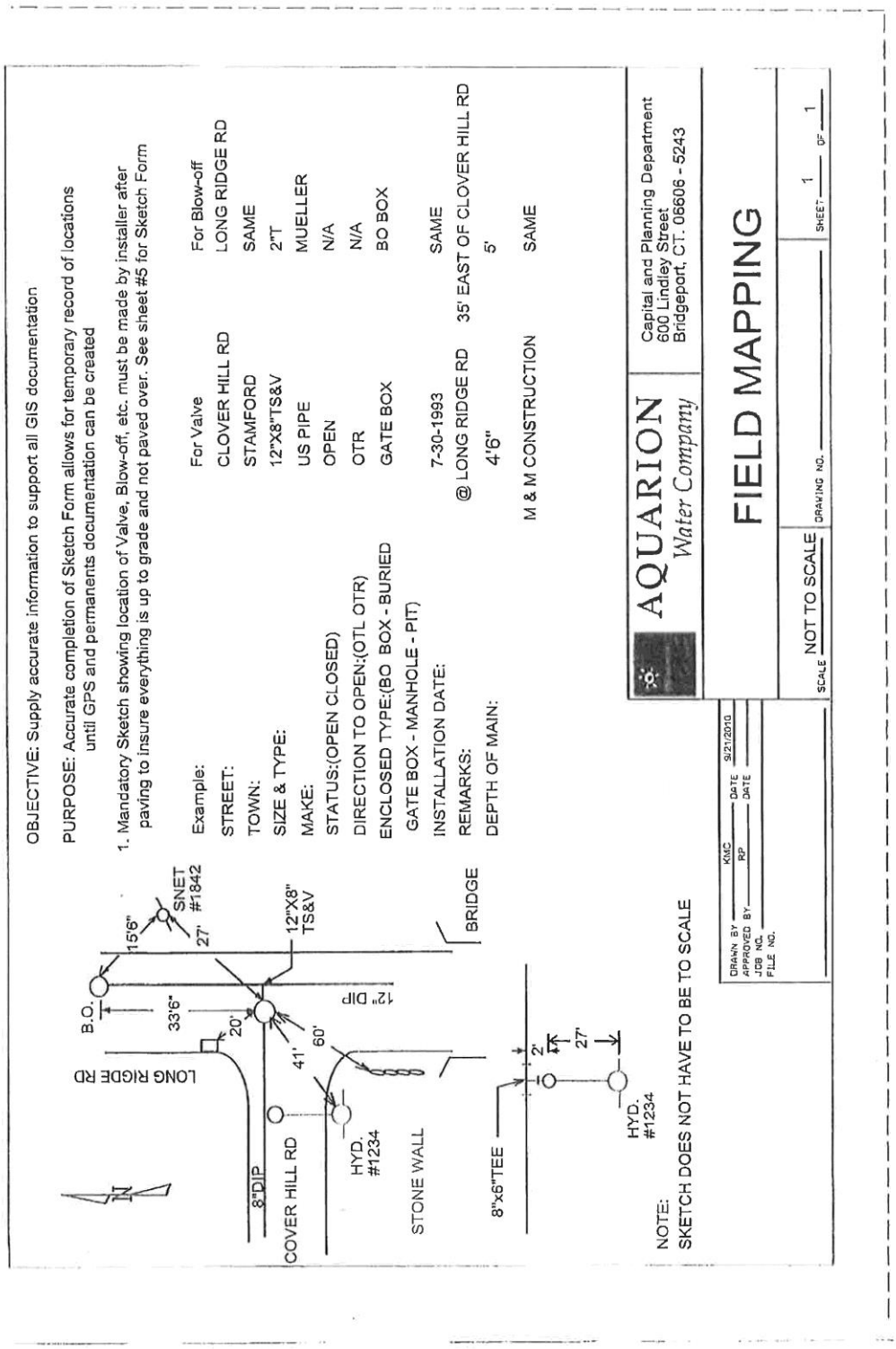
1. Length – The length measurement shall be the actual length of trench ordered to be filled by the Engineer.
2. Width – The width measurement shall be one foot on each side, outside the pipe or structure being installed irrespective of actual width of trench excavated.
3. Depth – The depth measurement for material placed shall be the depth of the excavation to the invert of the pipe or bottom of a structure as ordered by the Engineer. In no case shall payment be made to depths excavated below those ordered by the Engineer. No payment shall be made for using Control Backfill Material to fill undercuts below the required grade when not ordered by the Engineer

Gate & Hydrants by Town
Aquarion Water Company of CT

Town	Gate Valve Direction	Hydrant Spec
Beacon Falls	OTL	NST Spec 2
Bridgeport	OTL	Provided by Fire Department
Canaan	OTL	NST Spec 2
Cornwall	OTL	NST Spec 2
Darien	OTL	NST Spec 2
East Granby	OTL	NST Spec 2
East Hampton	OTL	NST Spec 2
Easton	OTR	NST Spec 2
Fairfield	OTR	NST Spec 2
Georgetown	OTR	NST Spec 2
Goshen	OTL	NST Spec 2
Granby	OTL	NST Spec 2
Greenwich	OTR	NST Spec 2
Groton	OTL	NST Spec 2
Kent	OTL	NST Spec 2
Lebanon	OTL	NST Spec 2
Litchfield	OTL	NST Spec 2
Monroe	OTR	NST Spec 2
New Canaan	OTR	NST Spec 2
New Fairfield	OTR	NST Spec 2
Newtown	OTR	NST Spec 2
Norfolk	OTL	NST Spec 2
North Canaan	OTL	NST Spec 2
Norwalk	OTR	NST Spec 2
Oxford	OTL	NST Spec 2
Ridgefield	OTR	NST Spec 2
Salisbury	OTL	NST Spec 2
Seymour	OTL	NST Spec 2
Shelton	OTR	NST Spec 2
Sherman	OTL	NST Spec 2
Simsbury	OTL	NST Spec 2
Southbury	OTR	NST Spec 2
Stamford	OTR	Provided by Fire Department
Stonington	OTL	NST Spec 2
Stratford	OTR	Bpt Thread Spec 1
Torrington	OTL	NST Spec 2
Trumbull	OTR	Bpt Thread Spec 1
Weston	OTR	NST Spec 2
Westport	OTR	NST Spec 2
Wilton	OTR	NST Spec 2

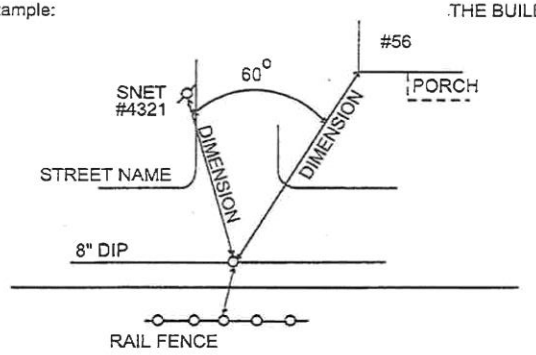
ATTACHMENT W – ATTACHMENTS TO CONTRACT DOCUMENTS

W-1 MAPPING REQUIREMENTS
W-2 ILLEGAL USE OF FIRE HYDRANTS NOTICE
W-3 HYDRANT INATALLATION CHECKLIST


OBJECTIVE: Supply accurate information to support all GIS documentation
PURPOSE: Accurate completion of Sketch Form allows for temporary record of locations until GPS and permanents documentation can be created
1. Mandatory Sketch showing location of Valve, Blow-off, etc. must be made by installer after paving to insure everything is up to grade and not paved over. See sheet #5 for Sketch Form
Example: For Valve For Blow-off
STREET: CLOVER HILL RD LONG RIDGE RD
TOWN: STAMFORD SAME
SIZE & TYPE: 12"X8"TS&V 2"T
MAKE: US PIPE MUELLER
STATUS:(OPEN CLOSED) OPEN N/A
DIRECTION TO OPEN:(OTL OTR) OTR N/A
ENCLOSED TYPE:(BO BOX - BURIED GATE BOX - MANHOLE - PIT) GATE BOX BO BOX
INSTALLATION DATE: 7-30-1993 SAME
REMARKS: @ LONG RIDGE RD 35' EAST OF CLOVER HILL RD
DEPTH OF MAIN: 4'6" 5'
M & M CONSTRUCTION SAME
B.O.
15'6"
SNET #1842
27'
12"X8" TS&V
BRIDGE
33'6"
20'
12" DIP
41'
60'
LONG RIGDE RD
8"DIP
COVER HILL RD
HYD. #1234
STONE WALL
8"x6"TEE
2'
27'
HYD. #1234
NOTE:
SKETCH DOES NOT HAVE TO BE TO SCALE
AQUARION Water Company
Capital and Planning Department
600 Lindley Street
Bridgeport, CT. 06606 - 5243
FIELD MAPPING
DRAWN BY KMC DATE 9/21/2010
APPROVED BY RP DATE
JOB NO.
FILE NO.
SCALE NOT TO SCALE
DRAWING NO. 1
SHEET 1 OF 1

2. When possible, a minimun of three locating dimensions approx. 60 degrees apart, must be taken.

Example:



NOTE: WHEN USING BUILDINGS FOR DIMENSIONS.
THE BUILDING NUMBER MUST BE SHOWN

3.Locating dimensions should be taken from any fixed objects except trees.

Example:

Poles	Telephone - Street Light - Traffic Light etc
Man Hole	Sewer - Telephone etc.
Catch Basin Corner	
Building	Indicate street Number or Lot Number
Hydrant	Indicate Hydrant Number along with dimensions Hyd. to Gate, - Gate to main
Wall	Indicate Stone - Brick - Block etc.
Fence	Indicate Wood - Chain Link etc.
Valves	Indicate Water - Gas - Curb Box
Bridge	

NOTE: when possible use fixed objects visible in snow.

4. Dimensions must be converted to nearest foot or foot and a half

Example: Actual Dimension	Converted Dimension
39' 0"	39'
39' 1"	39'
39' 2"	39'
39' 3"	39'
39' 4"	39' 6"
39' 5"	39' 6"
39' 6"	39' 6"
39' 7"	39' 6"
39' 8"	39' 6"
39' 9"	40'
39' 10"	40'
39' 11"	40'

DRAWN BY KMc DATE 9-30-2010
APPROVED BY RP DATE
JOB NO.
FILE NO.

AQUARION Water Company

Capital and Planning Department
600 Lindley Street
Bridgeport, CT. 06610-5243

FIELD MAPPING

SCALE NOT TO SCALE | DRAWING NO. | SHEET 1 OF 1

5. North must be indicated as shown. (North at top of Sketch)

Example:

6. When Bends, Reducers etc. are used, a sketch showing their location must be made
Dimensions should be left as taken and not convereted. See sheet #5 for sketch form.

Example:

STREET:

TOWN:

NOTE: ONLY FILL IN STREET - TOWN - INSTALLATION DATE

SIZE & TYPE:

MAIN DEPTH

MAKE:

STATUS: (OPEN CLOSED)

DIRECTION TO OPEN: (OTL OTR)

ENCLOSURE TYPE: (BO BOX - BURIED

GATE BOX - MANHOLE - PIT)

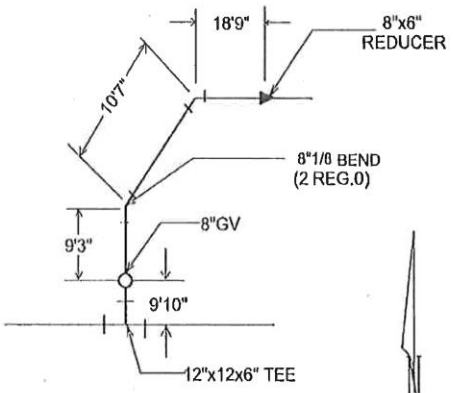
INSTALLATION DATE:

REMARKS:

DEPTH OF MAIN:

BY:

SKETCH



NOTE: SKETCH DOES NOT HAVE TO BE SCALE

AQUARION
Water Company

Capital and Planning Department
600 Lindley Street
Bridgeport CT 06606-5243

FIELD MAPPING

DRAWN BY KMC. DATE 9/21/2010
APPROVED BY RP DATE
JOB NO.
FILE NO.

SCALE NOT TO SCALE | DRAWING NO. | SHEET 1 OF 1

7. Symbols

GATE VALVE — 8"GV

BUTTERFLY VALVE — 16" BV

AIR VENT — 2" AV

CHECK VALVE — 24" CV

TAPPING SLEEVE & VALVE — 12"X8" TS&V

BLOW OFF — 2" BO

BEND — 6"X22½ BEND

REDUCER — 12"X12"X6" REDUCER, 12", 8"

TEE — 12" x 12" 12"X12"X6" TEE

SOLID SLEEVE / COUPLING — 8" DRESSER COUPLING, 8"CI, 8" DI

HYDRANT (INCLUDE DIMENSIONS HYD TO GATE - GATE TO MAIN) — HYD. #334

FENCE — CHAIN LINK

WALL — STONE WALL

BRIDGE — BRIDGE

CATCH BASIN

MAN HOLE — MH

POLE — SNET #5678; STREET LIGHT; TRAFFIC LIGHT

AQUARION *Water Company*

Capital and Planning Department
600 Lindley Street
Bridgeport, CT 06606-5243

STANDARD SYMBOLS

DRAWN BY KMC DATE 10/7/2010
APPROVED BY DATE
JOB NO.
FILE NO.

SCALE

DRAWING NO.

SHEET OF

STREET:

TOWN:

SIZE & TYPE

MAKE:

STATUS: (OPEN CLOSED)

ENCLOSURE TYPE: (BO BOX - BURIED

DIRECTION TO OPEN: (OTL OTR)

GATE BOX - MANHOLE - PIT)

INSTALLATION DATE:

REMARKS:

DEPTH OF MAIN:

BY:

SKETCH

AQUARION
Water Company

Captial and Planning Department
600 Lindley Street
Bridgeport ,CT 06606 - 5243

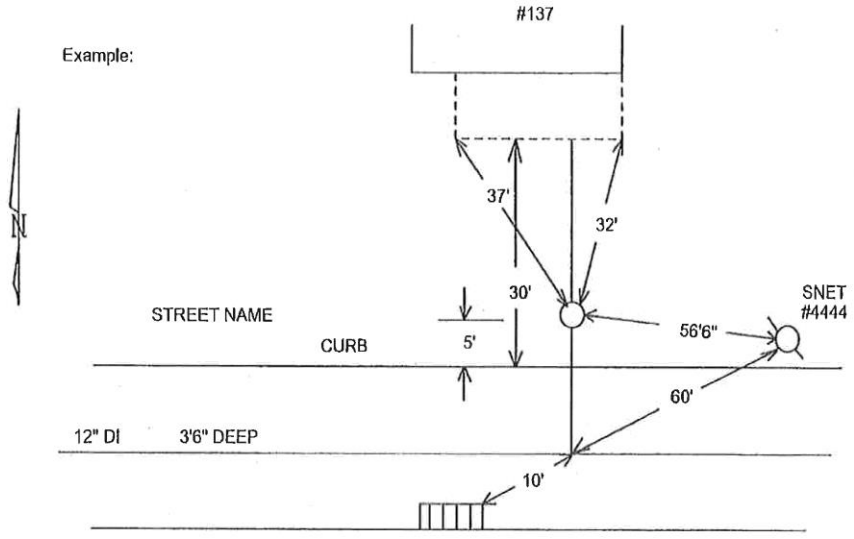
DRAWN BY KMC DATE 9/21/2010
APPROVED BY RP DATE
JOB NO.
FILE NO.

FIELD MAPPING

SCALE NOT TO SCALE | DRAWING NO. | SHEET 1 OF 1

8. Service Sketch drawn on Tap Card

Example:



INFORMATION REQUIRED

DATE OF TAP

OWNER

ADDRESS

TAPPED BY

KIND AND SIZE OF SERVICE

DEPTH

AQUARION Water Company

Capital and Planning Department
600 Lindley Street
Bridgeport, CT. 06610-5243

FIELD MAPPING

DRAWN BY KMC DATE 10/14/2010
APPROVED BY BP DATE
JOB NO.
FILE NO.

SCALE NOT TO SCALE | DRAWING NO. | SHEET 1 OF 1

NOTICE

ILLEGAL USE OF FIRE HYDRANTS

Please be advised that it is illegal and potentially dangerous for any person to use a fire hydrant owned or operated by Aquarion Water Company (Aquarion) for any purpose other than firefighting without first obtaining a permit. Connections to hydrants must be carefully controlled by Aquarion due to water quality, pressure and flow considerations. The unauthorized use of a fire hydrant is an extremely serious offense!

1. The use of water without permission is theft of service that Aquarion water customers must ultimately pay for through higher rates.

2. Connecting to a hydrant without an approved backflow prevention device is an illegal cross connection that may allow contaminated water to flow into the distribution system where it is a threat to drinking water quality and public health.

3. Tampering with a fire hydrant may be considered by law enforcement agencies as a threat to critical infrastructure and an act of terrorism.

Aquarion will aggressively pursue any person who illegally uses a fire hydrant and will prosecute them to the fullest extent of the law. Aquarion Water Company Police Officers have full arrest powers within the State of Connecticut and are working in cooperation with both state and local law enforcement to eliminate the illegal use of fire hydrants. Violators will, at a minimum, be subject to criminal charges for trespassing, larceny and criminal mischief. More serious criminal and civil penalties may be pursued depending on the severity of the violation.

If you intend to use an Aquarion Water Company hydrant, it is your responsibility to obtain a permit and a backflow prevention device (hydrant rig) from Aquarion. To do so, please contact one of the following:

Al Hildred by email at ahildred@aquarionwater.com or by phone at (203) 337-5932

Sincerely,

Howard J. Dunn, P.E.
Vice President, Operations & Technology

Ralph Fensore
Chief, Aquarion Police

AQUARION

Hydrant Installation Checklist (One per hydrant)

Contractor _____

Job Site & Town _____

Hydrant Location _____

Hydrant Number, if existing _____

(Initial Each Box)

☐ Received Aquarion Water Company Installation Instructions and Sketch.

☐ Hydrant drains properly installed before backfilling hole.

☐ Dry Well – Place 1 ¼ " – 1 ¾ " trap rock filling hole to at least 1' above lower hydrant flange. Filter fabric covering trap rock, per Aquarion specs.

☐ Hole was backfilled in 12"-18" lifts.

☐ Hydrant flange is 4"(±2") Above final grade.

Foreman Name _____
(Please print)

Signature _____ Date _____

Please contact Aquarion with questions regarding hydrant installation procedures.

ITEM #1303202A – INSTALL FIRE HYDRANT

Description:

Work under this section shall consist of the installation of hydrant assemblies where shown on the in conformance with Item 5 of the Aquarion Technical Specifications included in the Item 1301860A – Installation of Water Main and Appurtenances.

Materials:

Aquarion shall provide the 6 inch tee, 6 inch gate valve and the intervening 6 inch ductile iron pipe. The Contractor shall provide the hydrant, elbow and the 6 inch restrained mechanical joint pipe to the Aquarion gate valve.

Construction Methods:

Construction methods shall conform to Item 5 of the Aquarion Technical Specifications included in the Item 1301860A – Installation of Water Main and Appurtenances.

Method of Measurement:

This work shall be measured for payment by the unit each for "Install Fire Hydrant", complete in place and ready for operation from the Aquarion gate valve. Measurement for payment shall be for each fire hydrant assembly installed and accepted including all materials for a complete unit.

Basis of Payment:

Payment for "Install Fire Hydrant" shall be by the contract unit price each, complete in place, which price shall include all materials, equipment, tools and labor incidental thereto.

Pay Item	Pay Unit
INSTALL FIRE HYDRANT	EA.

ITEM NO. 1403501A – RESET MANHOLE (SANITARY SEWER)

This item shall comply with Section 5.07 supplemented as follows:.

Description: Add the following:

There will be no multiple measurement or payment for resetting the structure to accommodate the incremental lowering of Atlantic Street, South State and Manhattan Street for the roadway construction. Reset Manhole (Sanitary Sewer) shall be measured one time. Incremental lowering to accommodate traffic and roadway grades shall be considered incidental to the work.

Pay Item	Pay Unit
Reset Manhole (Sanitary Sewer)	Ea

ITEM 1507000A – PROTECTION AND SUPPORT OF EXISTING UTILITIES

Description:
Work under this item shall consist of designing, furnishing, placing and subsequently removing temporary supports and protection shields which will be necessary to protect and / or stabilize the existing utilities during the construction of the drainage, structures, roadway, traffic signal foundations and other work as shown on the plans. The affected utilities, as shown on the plans include, but are not limited to: SNET, dba Frontier Communications of Connecticut; Aquarian Water Company of Connecticut; Yankee Gas Services Company; Cablevision of Connecticut, LP; Northeast Utilities; Traffic Control lines owned by Connecticut DOT or City of Stamford; IMS lines owned by Connecticut DOT or City of Stamford; Sanitary Sewers owned by City of Stamford Water Pollution Control Authority, duct banks and fiber optics owned by Level 3 and drainage culverts owned by Connecticut DOT or the City of Stamford. The work shall be performed in accordance with these specifications.

The work pertaining to the temporary support of the drainage system, gas main, electrical lines and duct banks, communication lines and duct banks, water mains and sewer lines primarily involves the support and prevention of damages which are possible during the excavation and construction of the proposed work. The work shall also include the protection and support of overhead facilities and utility poles.

This work includes, but is not limited to the support and protection of the following:
-Utility facilities adjacent to and crossing the drainage work at South State Street and Canal Street, South State Street, Manhattan Street, Atlantic Street and Jefferson Street.

The Contractor shall support vertical trenches to avoid undermining or loss of lateral support for all utilities adjacent to parallel installations, crossings of utilities and utilities adjacent to the traffic signal mast arm foundations.

The Contractor is herein made aware that construction of the proposed work will require the installation of shoring or other lateral support work and will require pipe installation beneath or adjacent to active electrical conduit and duct banks, water main, gas mains, sanitary sewer and storm drains. The Contractor shall protect and provide for all utilities either buried or above ground to maintain service.

The Contractor is advised that no service interruption resulting from Contractor operations will be allowed, except as otherwise provided in the Special Provision “Prosecution and Progress.” Extreme caution shall be exercised during all stages of construction in order to preserve the existing utilities. A Department representative shall be present at the installation of the temporary supports. Further attention shall be paid to "Section 1.07 – Legal Relations and Responsibilities,” and the Notice to Contractor for “Protection of Existing Utilities".

The Contractor shall notify the Engineer prior to the start of his work and shall be responsible for all coordination with the Department and the utility companies. The Contractor shall allow the Engineer complete access to the work.

The Contractor is herein advised that it is his responsibility to verify locations, conditions and field dimensions of all existing features, as actual conditions may differ from information indicated on the plans or contained elsewhere in these specifications.

Materials:
The materials for this work shall be of satisfactory quality for the purpose intended and shall be submitted for review by the Engineer. The material shall be intended for use in structures and shall be sound and capable of safely carrying the specified loads.

Construction Methods:
The Contractor shall prepare working drawings and computations showing his proposed method of support and protection for each utility to be supported and protected. Preparation and submittal of working drawings and computations shall conform to the requirements of Article 1.05.02. The support shall safely carry all utility dead loads and any imposed loadings under all possible construction conditions. The utility protection shields shall safely carry any imposed loadings under all possible construction conditions. Said supports and protections shall be constructed in a manner that will not interfere with the proposed construction.

The Contractor shall use every effort to protect all utilities from damage of any nature which might result from carelessness or negligence in his operations. He shall be held solely and strictly responsible for any damage resulting from such carelessness and negligence.

A periodic inspection of the temporary utility support and protection shall be performed by the Contractor, as directed by the Engineer.

The Contractor shall and maintain the existing utilities until the proposed construction has been completed to a point where removal of the supports will not cause damage to the protected utility.

When the temporary support and protection systems are no longer required, they shall be removed from the site by the Contractor.

Method of Measurement
This work, being paid for on a lump sum basis, will not be measured for payment.

Basis for Payment:
The work will be paid for at the contract lump sum price for “Protection and Support of Existing Utilities" which price shall include designing and detailing all supports and protection shields, working drawing submittals, furnishing, installing, periodic · inspection, removing supports and protection shields, coordinating work with the utility companies, furnishing and installing vertical trench supports and shoring and all materials, equipment, tools and labor incidental thereto.

Pay Item	Pay Unit
Protection and Support of Existing Utilities	Lump Sum

ITEM 1803060A - TYPE B IMPACT ATTENUATION SYSTEM (NON-GATING)

Description: Work under this item shall consist of furnishing, delivering, and installing a Non-Gating impact attenuation system for the site shown or as directed by the Engineer including reflective sheeting for delineation.

Performance Criteria: This attenuation system shall be a crash tested device having approval in writing from FHWA conforming to the requirements in National Cooperative Highway Research Program (NCHRP) Report 350 or the AASHTO Manual for Assessing Safety Hardware (MASH).

Materials: The materials shall conform to the following requirements:

1. All materials for the impact attenuation system, including any transition sections and concrete backup walls, or pads, shall meet the Manufacturer's specification for the latest version of the attenuator chosen from the Department's Qualified Products List (Non-Gating) category and as depicted on the plans for a given length and width.
2. The Contractor shall submit a material certificate or certificate of compliance for each system supplied as defined in Article 1.06.07.
3. A Type III reflective sheeting shall be provided in conformance with Subarticle M18.09.01 and Connecticut Traffic Standard Sheet TR-1205_01, Sign #50-5032 or as provided by the Manufacturer.

Construction Methods: The impact attenuation system, transition and concrete pad, shall be installed in a neat and workman like manner at the location(s) shown on the plans and constructed in conformance with the Manufacturer's details. The reflective sheeting shall be installed on the nose of the impact attenuation system.

Failure to comply: In the event that, in the judgment of the Engineer, an impact attenuation system is not maintained adequately and/or safely on any part of the project, or the Contractor does not move or relocate traffic control devices to meet construction requirements for the safety of the traveling public when directed to do so by the Engineer, on any day, the sum of $1500.00 per day will be deducted from any money due the Contractor as a charge for failure to comply with this specification.

Method of Measurement: The impact attenuation system will be measured for payment by the number of each system installed at the location shown on the plans in conformance with the Manufacturer's details and specifications as accepted by the Engineer.

Basis of Payment: The impact attenuation systems will be paid for at the Contract unit price for each "Type B Impact Attenuation System (Non-Gating)" as specified on the plans. This price shall include all materials, excavation, concrete pad, backup system, transition section, reflective sheeting, site preparation, and transportation, removal of surplus material, equipment, tools and labor incidental to complete the installation.

Pay Item	Pay Unit
Type B Impact Attenuation System (Non-Gating)	Each

INDEX OF CSI FORMATTED SPECIFICATIONS

STAMFORD YARD CATENARY IMPROVEMENTS
AND TRACK 7 EXTENSION
STAMFORD, CONNECTICUT
STATE PROJECT NO. 0301-0163

NOTE: All the CSI-formatted Specifications listed below make up the Major Lump Sum Item (MLSI) and are included under the Form 816 ITEM #0063521A – RAIL FACILITY UPGRADE (SITE NO.1).

DIVISION 02

02 41 00 SELECTIVE BUILDING DEMOLITION

DIVISION 03 - CONCRETE

03 30 00 CAST-IN-PLACE CONCRETE
03 45 00 ARCHITECTURAL PRECAST CONCRETE

DIVISION 05 - METALS

05 10 00 STRUCTURAL METAL FRAMING
05 30 00 METAL DECKING
05 40 00 COLD-FORMED METAL FRAMING
05 50 00 METAL FABRICATION
05 52 00 METAL HANDRAIL AND GUARDRAIL SYSTEM
05 55 13 METAL STAIR TREADS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

07 14 16 COLD FLUID APPLIED WATERPROOFING
07 21 00 THERMAL INSULATION
07 22 00 ROOF AND DECK INSULATION
07 25 00 WEATHER BARRIER
07 50 00 SINGLE PLY MEMBRANE ROOFING
07 60 00 FLASHING AND SHEET METAL
07 71 23 ROOF SPECIALITIES
07 84 00 FIRESTOPPING

07 92 00 JOINT SEALANTS AND CAULKING

DIVISION 08 - OPENINGS

08 45 23 2¾" INSULATED TRANSLUCENT FIBERGLASS SANDWICH PANEL SKYLIGHT SYSTEM

DIVISION 09 - FINISHES

09 91 00 PAINTING

DIVISION 10 - SPECIALTIES

10 81 13 BIRD CONTROL DEVICES

DIVISION 16 - ELECTRICAL

16 44 00 PANEL BOARDS
16 46 10 DRY-TYPE DISTRIBUTION TRANSFORMERS

DIVISION 26 – ELECTRICAL

26 05 00 COMMON WORK RESULTS FOR ELECTRICAL
26 05 19 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
26 05 26 GROUNDING & BONDING
26 05 33 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS
26 05 53 IDENTIFICATION FOR ELECTRICAL SYSTEMS
26 27 26 WIRING DEVICES
26 28 16 ENCLOSED SWITCHES AND CIRCUIT BREAKES
26 51 00 INTERIOR LIGHTING

SECTION 02 41 00 - SELECTIVE BUILDING DEMOLITION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Description: Removal and demolition of selected items from selected areas of the station as indicated on the Drawings, and as required to complete the work and the project objectives.

B. Selective demolition/salvage:

1. Provide selective demolition and removals in accordance with the Contract Documents. The Work of this Section includes, but is not limited to, the following: guardrails, existing platform furnishings such as signage, and light poles as indicated on the drawings.

   a. Document existing conditions with drawings and photographs keyed to drawings and label elements.
   b. Provide temporary shoring as required to ensure stability of building elements and fabric to remain.
   c. Provide protection as required to protect both elements and materials to be removed and elements and materials to remain from damage or deterioration.
   d. Remove all items as indicated on drawings and in technical provisions.

2. Any & all materials that may be found during the current contracted work that is suspected to contain lead is to be brought to the attention of the CTDOT PM, to start the remediation process. A wipe test may be conducted to verify that any & all materials may contain lead. A licensed abatement contractor must perform any & all lead abatement work.

1.2 RESPONSIBILITY, PROTECTION, DAMAGES, RESTRICTIONS

A. Protections: Provide temporary barricades and other forms of protection required to protect railroad personnel and general public from injury due to selective removals and demolition work.

1. Provide protective measures as required to provide free and safe passage of personnel and customers.

2. Protect from damage existing finish work that is to remain in place and which becomes exposed during operations.

B. Damages

1. Promptly repair any and all damages to all property and finishes caused by the removals and demolition work, to the Engineer’s satisfaction.

1.3 SUBMITTALS

A. General: Submit the following:

1. Submit a schedule indicating proposed methods and sequence of operations for selective removal and demolition work prior to commencement of operations.

2. Include details for dust and noise control operation. Provide a detailed sequence of removal and demolition work.

B. Selective Demolition:

1. Qualification Data: Qualification data for firms and personnel specified in "Quality Assurance" Article that demonstrates that both firms and personnel have capabilities and experience complying with requirements specified for firm and foreman, provide a list of at least three completed projects within the Region similar in size and scope to the work required on this project. For each project list project name, address, architect, scope of contractor's work, and other relevant information. This information shall be submitted with the bid.

2. Selective Demolition and Removal Program: Detailed description of methods and procedures, equipment, tools, and materials proposed for use in removal operations including, but not limited to, the following:

   a. Documenting and identifying elements and materials to be removed.
   b. Procedures for controlling noise and dust.
   c. Releasing or freeing materials and elements from existing construction.
   d. Protection for elements to be removed and for elements to remain.
   e. Handling and transporting materials and elements removed.
   f. Packaging elements to be removed.
   g. Storage locations.
   h. Tools and methods of removing items as indicated.

3. Documentation Photographs: Submit photographs (minimum 5 in. x 7 in.) recording condition of elements to be removed (including overall views and close-up views of any cracks, damage, deterioration, or missing elements) before beginning selective demolition and removals. Record all as built conditions at all demolition locations after final commencement of work has been completed.

4. Shoring and Bracing: The Contractor shall retain the services of a Professional Engineer registered in the State of Connecticut to provide design of all temporary bracing, shoring, etc. that may be required as part of selective demolition and removals work.

   a. It shall be the responsibility of the Contractor's Controlled Inspecting Agent to prepare detail drawings and associated calculations representing all shoring, bracing, or other temporary construction that may be required to maintain the structural stability and integrity of the existing construction during the course of the Work represented in these documents.

   b. All drawings and calculations prepared by the Contractor's Controlled Inspecting Agent shall bear an original signature and seal indicating the inspector's Connecticut State Registration. Duplicate copies of all drawings and calculations shall be forwarded to the Engineer prior to commencing any of the temporary Work represented in those documents.

PART 2 - PRODUCTS

2.1 PEFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to commencement of the selective removals and demolition work, inspect the areas in which the work will be performed. Determine and list the existing conditions of rooms or area surfaces and equipment. After the Work in each respective area is completed, determine if adjacent surfaces or equipment have been damaged as a result of the Work; if so, the damage shall be corrected at the Contractor's expense.

3.2 PROTECTION

A. LAWS AND REGULATIONS: All work shall comply with all safety requirements of the State of Connecticut and City of Stamford; Standard No. 241 "Safeguarding Building Construction and Demolition Operations," latest edition, of the National Fire Protection Association; and OSHA regulations.

B. GENERAL:

1. Protect against damage by water and fire, and injury to the public, workers, occupants, and contents of existing building, damage to adjacent property, and portions of existing building not being selectively demolished. Contractor shall provide adequate protection to building, utilities, and equipment, including temporary supports, dust and other enclosures, barricades, etc., as required to protect elements from damage or deterioration caused by work of this Section.

2. Use every possible precaution to prevent damage to streets, sidewalks, curbs and paving on or adjacent to the site of the work. Repair or replace to Engineer's satisfaction and at no expense to CTDOT any such item destroyed or damaged.

3. Protect all persons from injury and all public and private property and building contents from damage due to the operations under this Section. Adequate protection of persons and property shall be provided at all times, including Saturdays, Sundays, and holidays, during time period in which work is being performed, and after working hours.

3.3 REMOVALS AND DEMOLITION WORK

A. Perform selective demolition work in a systematic manner and use such methods as required to complete the work indicated on the Drawings and as needed for completion of the work and the project objectives in accordance with the requirements of the Project Specification and governing City, State and Federal regulations.

1. Demolish and remove existing construction only to extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as specified herein.

2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

3. Remove all electrical wiring, to include, but not limited to, lighting and all related appurtenances, conduits, devices, fixtures, and other electrical items accessories occurring on or in the construction to be removed, disconnect power and remove wiring and conduit back to source. New electrical work shall be as indicated on Drawings and as needed for the completion of the work and the project objective as specified in the Electrical – Div. 16.

3.4 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove debris, rubbish and other materials resulting from the removals and demolitions from the building immediately; transport and legally dispose of materials off-site. Disposal method shall be in accordance with City, State, and Federal regulations.

B. Burning or burying of removed materials is not permitted on the job site.

C. No materials shall be dropped or thrown from any height. Remove debris from building using suitable containers or conveyances.

D. Keep premises clean by removing accumulation of waste materials, rubbish, and debris from site daily. Dispose of waste, rubbish, and debris in a proper manner in accordance with all federal, state and local laws and regulations, to the satisfaction of all authorities having jurisdiction, and to the satisfaction of the Engineer. Keep site and public rights of way clear. Take all precautions necessary to keep dust resulting from work of this Section at an absolute minimum.

E. Do not store or permit excess debris to accumulate on site. If contractor fails to remove excess debris promptly, Engineer reserves the right to cause same to be removed at Contractor's expense.

3.5 TEMPORARY SHORING

A. Provide temporary shoring as required to maintain existing construction safely in position during removal and salvage.

B. Perform shoring in such a manner as to prevent any settlement or vertical or horizontal deformation of the existing building elements to remain. Before commencing with the work, the Contractor shall thoroughly investigate the existing structure to verify its present condition.

C. Execute shoring in best, substantial, workmanlike manner to avoid danger to workman and public and damage to the building.

3.6 CLEAN-UP AND REPAIR

A. Upon completion of removals and demolition Work, remove tools, equipment and all remaining demolished materials from the site.

B. Repair all damaged areas caused by the removals and demolition Work. Repair adjacent construction or surfaces soiled or damaged by selective demolition work at contractor's expense to the Engineer's approval.

C. All areas in which Work was performed under this Section shall be left "Broom clean."

END OF SECTION 02 41 00

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Contractor shall coordinate work with that of other trades affecting or affected by the work included under this Section and shall cooperate with such trades, the Engineer, the Designer and the Department to assure the steady and timely progress of the work.

1.2 SUMMARY

A. Provide all materials and labor necessary to complete all concrete, plain and reinforced as indicated on the Plans or called out for in these specifications within the limits of "Rail Facility Upgrade (Site No. 1)" and "Rail Facility Upgrade (Site No.2)" and as required to complete the Project. Work includes, but is not limited to, the following:

1. The installation of cast-in-place concrete curb at the platform canopy extension and composite decks at the pedestrian overpass.

2. All forms, staging, bracing and other materials and equipment necessary and required to produce the concrete in place and for removal of same.

3. Installation of reinforcing steel, including accessories and supports.

4. Finishing of concrete as specified herein or as indicated on Plans.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Carefully examine all of the Contract Documents for requirements which affect the work of this section.

1. Carefully review all of the Contract Documents for anchor bolts, inserts, conduits, sleeves, anchors, and all other items which must be cast into concrete construction.

2. Items to be embedded in concrete work may or may not be described in detail and must be determined through careful coordination of all subcontractors and building trades.

B. Other specifications sections that directly relate to the work of this section include, but are not limited to, the following:

1. Section 05 30 00 – Metal Decking.
2. Section 05 50 00 – Metal Fabrications.
3. Section 07 92 00 – Joint Sealants.

1.4 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 shop drawings and schedules of all work under this Section for approval prior to fabrication of any material. Shop drawings shall include sufficient plans, sections and detail drawings to suitable scale to permit the erection of the reinforcing steel. Reinforcement: Submit shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures". Shop Drawings shall include but not be limited to the following:

1. Bar reinforcement shop drawings shall include setting plans, elevations, bending diagrams, cutting lists and other information so as to define and establish completely the location, spacing, size, length, bending, shape, splicing and keying at construction joints and all other pertinent information as required. Drawings shall show grades of reinforcing steel. Opposite hand reinforcing shall be detailed separately.

2. Type, size and location of all accessories required for proper assembling, placing and support of the reinforcement.

3. All openings, depressions, construction joints, control joints, trenches, sleeves, inserts, and all other project requirements affecting reinforcing details and placing.

4. Sizes, thickness of material, methods of assembly, anchorage, galvanizing, shop paint and all other information necessary.

C. Field and Laboratory Testing; Certified Test Reports: Field and laboratory testing shall be performed, and certified test reports provided, in accordance with the applicable requirements of “Section 6.01 Concrete for Structures” and “Section M.03 Portland Cement Concrete”.

D. Materials Certificates: Provide materials certificates in accordance with the applicable requirements of “Section M.03 Portland Cement Concrete”.

1.7 PRE-INSTALLATION MEETING

A. Conduct a Pre-Installation Meeting at the Project Site in compliance with the requirements of Form 816 Subarticle 1.20-1.05.24-2.

B. Prior to submittal of the specified concrete design mixes, the Contractor shall schedule a meeting to review procedures for producing proper concrete construction.

C. The Contractor shall require attendance by responsible representatives of every party who is involved with the concrete work including, but not limited to, the following:

1. Contractor's superintendent.

2. Testing Agency responsible for the concrete mix design.

3. Testing Agency responsible for field quality control.

4. Concrete Sub-contractor.

5. Ready-mix concrete producer(s).

6. Admixture manufacturer.

7. Concrete pumping Contractor.

8. Formwork Contractor.

9. Concrete Finisher.

D. The Designer will be present at the meeting and must be notified at least 10 days prior to the scheduled date of the meeting.

E. Minutes of the meeting shall be recorded, published and distributed by the Contractor to all parties concerned within 5 working days of the meeting.

PART 2 - PRODUCTS

2.1 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Epoxy-Coated Reinforcing Bars: ASTM A 615, grade 60 epoxy coated in accordance with ASTM D 3963.

C. Steel Wire: ASTM A 82, plain, cold-drawn steel.

D. Epoxy-Coated Wire and Welded Wire Fabric: ASTM A 884 with Fy = 70ksi.

E. Welded Plain and Deformed Steel Wire Fabric: ASTM A 1064 minimum 60ksi.

F. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI specifications. Wire for tying shall be 18 gauge black annealed wire conforming to ASTM A 82.

1. For structural slabs, use supports with sand plates or horizontal runners where base material will not support chair legs.

2. For concrete surfaces exposed to view, where legs of supports are in contact with forms, provide supports with legs that are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

G. Fabrication: Reinforcement shall be accurately formed to dimensions of the plans, details and schedules. Fabrication shall not commence until details and schedules have been approved by the Designer in writing.

1. Reinforcement shall be bent cold, around a pin with a free revolving collar having a diameter ratio to the diameter of the bar not less than:

- Two times for stirrups
- Six times for bars up to and including 1 inch

- Eight times for bars over 1 inch

2. Reinforcement shall not be straightened or re-bent in a manner that will injure the material. Bars with kinks or bends not shown on the plans will not be used.

2.2 CONCRETE AND RELATED MATERIALS

The materials for this work, including aggregates, cement, water, admixtures; mix design requirements; producer equipment and production requirements; curing materials; non shrink, non staining grout; chemical anchors; joint materials; protective compound/sealers; and formwork shall conform to the requirements of "Section M.03 Portland Cement Concrete". The grades of concrete shall be as shown on the contract plans.

PART 3 - EXECUTION

3.1 CONSTRUCTION METHODS:

A. The construction methods used for this work, including false work and forms; protection from environmental conditions; transportation and delivery of concrete; acceptance testing and test specimens; progression cylinders and compressive strength specimens; handling and placing concrete; bearing surfaces; curing concrete; finishing concrete surfaces; mortar, grout, epoxy and joint seal; application of loads; and dispute resolution shall conform to the applicable requirements of "Section 6.01 Concrete for Structures".

END OF SECTION 03 30 00

SECTION 03 45 00 - ARCHITECTURAL PRECAST CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies architectural precast concrete work, including the following:

1. Structural design, fabrication, and erection of architectural canopy column jackets.

2. Connections, including anchorage devices attached to structural framing.

1.2 RELATED WORK

A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that relate directly to work of this Section include, but are not limited to:

1. Section 05 10 00 - Structural Metal Framing.

2. Section 07 92 00 - Joint Sealants.

3. Section 09 96 23 – Graffiti-Resistant Coatings

1.3 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirement shall govern.

1. State of Connecticut Department of Transportation/ Standard specifications for roads, bridges and incidental construction - Form 816

2. Portland Cement Association (PCA):

Ref. 1 Forms for Architectural Concrete

3. Prestressed Concrete Institute (PCI):

MNL-117 Quality Control for Plants and Production of Architectural Precast Concrete Products

MNL-122 Architectural Precast Concrete

4. American Concrete institute (ACI)

1.4 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 large scale Shop Drawings for fabrication and erection of all parts of the work. Provide plans, elevations, and details of anchorages, connections, lifting devices, and accessory items. Provide installation templates for work installed by others. Provide information on erection sequence with plans coded to numbered precast units. Provide shop drawings stamped and sealed by a professional engineer registered in the State of Connecticut.

1. Erection Drawings: Provide detailed Drawings, properly checked and coordinated with existing conditions showing precast design including supports, anchors, connections and attachments. For items installed in work by others, include setting diagrams, templates, and instructions. Erection drawings may be incorporated into Shop Drawings.

2. Welding Diagrams: Provide floor-by-floor charts showing the location of each weld and schedule of welding work. Update charts regularly to indicate completed welds.

3. Certificate of Compliance: Provide notarized certificates indicating compliance with these Specifications.

C. Product Data: Submit manufacturer's product data, installation instructions, use limitations and recommendations for each material used.

1. Mix Design: Submit concrete mix design. Engage services of a concrete technician approved by Designer and having access to suitable laboratory facilities. Pre-caster may use his own laboratory facilities, if adequate, and the services of a technician regularly in his employ for such duties. Confirm mix designs by tests on trial mixes made with proposed materials. Provide mix design and trial mixes sufficiently in advance so that seven day compression test results will be available prior to first production of precast units.

D. Calculations: Provide professionally prepared calculations and certification of the performance of the work. Show how design load requirements and other performance criteria have been met. Provide calculations stamped and sealed by a professional engineer registered in the State of Connecticut.

E. Initial Selection Samples: Submit individual cube samples showing complete range of colors, textures, and finishes available for each precast color and texture required for the Project.

F. Verification Samples: After approval of cube samples, submit minimum 12 in. x 12 in. samples of each finish that is to be exposed in the finished work, showing full range of color and finish variations expected.

G. Test Reports: Submit certified reports for tests required.

H. Referenced Standards: Submit copies of referenced standards for permanent availability in Contractor's site office.

I. Prior to commencement of fabrication, submit fabrication schedule to Designer so that plant inspection plan can be prepared. Do not transport pre-cast concrete column jacket to site until they have been accepted by Designer's representative.

1.5 MOCK-UPS

A. Prior to commencing primary work of this Section, provide one full-size mock-up of pre-cast concrete jacket and steel column. Obtain Designer's acceptance of visual qualities. Protect and maintain approved mock-ups throughout the work of this Section.

B. Mock-up jacket: If mock-up is approved by the Designer, it shall remain on-site and be used as a standard of quality for all architectural precast concrete work. Fabrication of the precast work shall not commence until an on-site full-size pr-cast concrete column jacket has been approved by the Designer. Approved mock-ups may be incorporated into the finish work.

1.6 TESTING AND INSPECTION

A. Testing by Pre-caster: Supply and place concrete of specified strength and quality. Provide and pay for compression tests. Submit results of tests to Designer. Provide a minimum of one test for each day's pour, with each test consisting of four cylinders, one of which to be broken at 7-days, two at 28-days, and one at a time selected by Pre-caster. Sampling, molding, curing and testing of the cylinders shall conform with ASTM C 31 and C 39, under laboratory conditions.

B. The Designer retains the right to inspect placing of concrete; to make slump tests of concrete; and to test concrete cylinder samples for compressive strength. Designer will review materials proposed for use by Pre-caster, and may, to extent deemed advisable, inspect batching operations at plant from time to time.

1.7 QUALITY ASSURANCE

A. Provide precast concrete work conforming to ACI 318, Chapter 16, and PCI MNL- 122. Plant quality control program shall comply with PCI MNL-117.

B. Designer's Sample: Sample of the precast concrete are to be on file at the Designer's office showing aggregate sizes, gradation, color, and finishes expected in the completed work. Matching this sample with mock-ups, and sample submittals is required.

C. Welders: Employ only experienced welders qualified by tests listed in the AWS Code. Tests shall have been made using the same electrodes specified for use in this work.

D. Engineering and Design: Provide the services of a Professional Engineer, registered as a Structural Engineer in the State of Connecticut specified in this section. The engineer shall assume professional responsibility for precast and connection design and safety, including miscellaneous supporting steel framework. Design decisions and modifications that affect visual characteristics shall be subject to approval by Designer. Engineer shall coordinate work with building Structural Engineer to obtain restrictions on attachment locations and loadings.

E. Maintain profiles shown without increasing or decreasing sizes of members or altering alignment shown.

F. Final acceptance of each member will be subject to approval by the Designer as based upon full conformance with these Specifications. Members shall be made accessible and fully visible to the Designer for inspection at the plant prior to shipment and/or at the site after shipment. Rejected members shall be immediately removed from the site and plant storage areas.

1.8 PERFORMANCE REQUIREMENTS

A. Precast Concrete Compressive Strength: Minimum 5,000 psi at 28-days when tested in accordance with ASTM C 39.

B. Water Absorption by Weight of Concrete: 5% percent maximum for individual units and 4-1/2% maximum, as an average. Tests shall be made as determined by the Designer in accordance with ASTM C 97.

C. Tolerances: Architectural precast concrete units shall be true to dimension, not more than 1/16 in. in 10 feet out of plane, and completely without twists or bends. Arises shall be sharp, whole, and clearly defined. The facing shall be a minimum two inches and shall wrap around all sides for the column jacket. Dimensions shall be held within a tolerance of plus zero (0) and minus 1/8 in.

D. Design: Engineer and design architectural precast concrete units to withstand stresses induced by wind loads, live loads, dead loads, temperature, shrinkage, fabrication, handling and erection in accordance with applicable codes. Furnish engineer's certificate stating that precast design meets or exceeds requirements of Contract Documents.

1. Design Wind Load: Positive and negative pressure of 25 psf at typical areas; 35 psf at corner zones.

E. Sizes: When sizes of precast units are not indicated on Plans, determine convenient unit sizes subject to Designer's approval. In such cases, locate precast joints subject to Designer's approval.

1.9 HANDLING, TRANSPORTATION, AND STORAGE

A. Refer to Form 816 Article 1.06.03 and Form 816 Article 1.20-1.06.03 for additional information. B.

Deliver, store and handle precast in strict compliance with fabricator's instructions and recommendations and industry standards. Protect from all possible damage. Lift and support units only at designated lifting points as shown on approved shop drawings.

C. Sequence deliveries to avoid delays, but minimize on-site storage.

D. Assume full responsibility for any damage to precast units which occurs after erection. Such units shall be either repaired or replaced as determined by Designer. No repairs shall be made until the damaged unit has been examined by Designer and a proposed repair procedure has been submitted to and approved by Designer. Designer may insist that repairs be made by precast manufacturer.

E. Provide blocking, packing, and protective materials that will not cause damage, staining, or other disfigurement.

1.10 GUARANTEE

A. Provide manufacturer's standard written guarantee in Department's name for materials furnished under this Section where such guarantees are offered in the manufacturers published product data.

B. Guarantee in writing all materials and workmanship of architectural precast concrete work for a period of not less than five (5) years from date of the issuance of the Certificate of Compliance. Should defects develop within this time as a result of unit design, manufacturing, weathering, erection or attachment, make necessary repairs and replacements as determined by the Designer, at the Contractor's expense.

PART 2 - PRODUCTS

2.0 GENERAL

A. Provide a precast concrete column jacket.

B. Provide precast concrete from one of the following manufacturers or approved equal:

1. Rex Precast Systems, Cheshire, CT
2. Precast Specialties Corp., Abington, MA
3. StressCon, Morrisville, PA
4. High Concrete Group LLC, Denver, PA
5. Oldcastle Precast, Fairless Hills, PA.

2.1 FORMWORK

A. Comply with applicable requirements of ACI 347, and with PCA Ref. 1. Provide form facing materials of metal, plastic, wood, or other acceptable material that is non-reactive with concrete and will produce required finish surfaces.

B. Construct formwork accurately, mortar-tight, and of sufficient strength to withstand pressures due to concrete placement, and temperature changes.

C. Coating: Coat forms with approved non-staining form release agent that will not interfere with adhesion of sealants, glazing compound, insulation adhesives or applied finishes. Do not use castor oil or form release agents containing castor oil or retardants.

D. Formwork Joints: Seal joints in formwork with gaskets, silicone sealant, or other method approved by the Designer to provide acceptable finish.

E. Forms may be designed with a draft of 1/8 in. in 12 in., and all forms may have 1/8 in. radius corners to facilitate removal and reduce breakage.

F. Clean forms thoroughly after each use and prior to reuse. Check forms for tightness at each usage.

2.2 REINFORCEMENT

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Galvanized Reinforcing Bars: ASTM A767, Class II, hot-dip galvanized after fabrication and bending. Test galvanized reinforcing for uniformity of coating by a ten (10) cycle Preece test conforming to ASTM A239.

C. Steel Wire: ASTM A 82, plain, cold-drawn steel.

D. Welded Wire Fabric: ASTM A 185.

E. Reinforcing Supports: Provide reinforcing supports, including bolsters, chairs, spacers, and other devices for fastening, spacing, and supporting reinforcing.

F. Place reinforcement dowels securely and accurately as shown on the approved submittals. Attach connection hardware rigidly to forms.

G. Detail and fabricate reinforcement in conformance with ACI 315 and 315R.

H. Place reinforcement on accessory bolsters and chairs with plastic tips of color to match finished concrete. Accessories shall be galvanized and have plastic tips. Splicing of bars shall be as specified in ACI 318.

I. Provide minimum 1 in. coverage of reinforcing steel, including ties. Assembly and placing of reinforcing shall ensure minimum coverage being maintained during the placing, consolidating, and curing of concrete.

2.3 STEEL SUPPORTS, FASTENERS, AND EMBEDDED ITEMS

A. Steel Plates: Structural quality, hot-rolled carbon steel, ASTM A 283, grade C.

B. Steel Shapes: ASTM A 36.

C. Stainless Steel Shapes: AISI Type 302/304.

D. Miscellaneous Steel: Provide clip angles, ties, straps, studs, plates, channels, frames, shims, clips, bolts, nuts, and washers conforming to ASTM A 36 and hot-dipped galvanized in accordance with ASTM A 123 and A 153.

E. Bolts and Nuts: ASTM A 307, hexagon type, with washers as required, hot-dip galvanized in accordance with ASTM A 153. Overtap threads as required to ensure proper fit with galvanized inserts.

F. Finish: Hot-dip galvanize steel after fabrication in conformance with ASTM A 153.

G. Slotted Inserts: Heavy malleable iron inserts with a depth of not less than 2-1/2 in. and a length of 4-1/2 in., with 3/4 in. steel nuts, hot-dip galvanized in accordance with ASTM A123.

H. Threaded Inserts: Malleable iron, with 3/4 in. sound standard threaded steel bolts, unless otherwise shown on Plans, hot-dip galvanized in accordance with ASTM A123.

I. Lifting Devices: Design and place lifting devices so as not to weaken unit during manufacture and handling.

J. Anchors: Design and place anchors to permit proper installation without forcing. Do not induce or superimpose any undue loads or stresses onto other work. Design anchors to allow for leveling, plumbing and positioning of precast units to accepted tolerances in structural steel as defined by AISC Code.

K. Plastic Washers and Shims: Multipolymer plastic material with a minimum compressive strength of 8,000 psi.

L. Neoprene Bearing Pads: 70 durometer hardness.

2.4 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I or Type III. Use only one brand, type, color, and source of cement throughout the Project.

1. Cement Color: Provide white Portland cement for facing concrete mix if required to match Designer's sample.

B. Water: Clean, clear, potable and free from deleterious chemicals and substances.

C. Course Aggregate: ASTM C 33, specially selected for color, supplied from a single source for entire Project. Provide aggregate washed, clean, hard and durable, inert, material, free of staining or deleterious material.

1. Aggregate Gradation and Color: As required to match Designer's sample.

D. Fine Aggregate: ASTM C 33 manufactured sand of same material as course aggregate, unless approved otherwise by Designer.

1. Aggregate Gradation and Color: As required to match Designer's sample.

E. Air-Entraining Admixtures: ASTM C 260, manufacturer and product as Approved by Designer.

F. Water Reducing: ASTM C 494, Type A, manufacturer and product as Approved by Designer.

2.5 CONCRETE MIX

A. Submit proposed concrete mix proportions to Designer for approval prior to fabrication. Show batch weights, gradations, specific gravity, absorption of aggregates, slump, fresh unit weight and air content. Verify mix design and provide four compression tests, two at 7-days, and two at 28 days, on 6 inch diameter x 12 inch high cylinders filled with proposed mix materials in proposed proportions.

B. Proportion mixes by either laboratory trial batch or field experience methods, using materials to be employed on the project for each type of concrete required, complying with ACI 318.

C. Concrete Mix: Standard weight concrete consisting of specified portland cement, aggregates, admixtures, and water to produce the following properties:

1. Compressive Strength: 5,000 psi minimum at 28 days.

2. Total Air Content: not less than 4% or more than 6%.

3. Slump: 3 inch minimum, 5 inch maximum.

D. Submit written reports to Designer of proposed mix for each type of concrete at least 15 days prior to start of precast unit production. Do not begin concrete production until mixes and evaluations have been reviewed by Designer.

E. Adjustment to Concrete Mixes: Mix design adjustments may be requested when characteristics of materials, job conditions, weather, test result, or other circumstances warrant. Laboratory test data for revised mix designs and strength results must be submitted to and accepted by Designer before using in the work.

F. Admixtures: Use admixtures in strict compliance with manufacturer's instructions. Adjust admixture quantities as required to maintain quality control.

2.6 FABRICATION

A. General: Design and fabricate precast concrete units to comply with manufacturing and testing procedures, quality control recommendations, and dimensional tolerances of PCI MNL-117, unless otherwise indicated.

B Fabricate units straight, smooth, and true to size and shape, with exposed edges and corners precise and square unless otherwise indicated.

C. Provide prefabricated reinforcing cages. Hang reinforcement from rear, or use other Designer approved method, to prevent reinforcement supports from touching surfaces exposed to view and weather.

D. Built-In Items: Provide reglets, slots, holes, embeds, anchors, and other accessories in units to receive windows, cramps, dowels, reglets, waterstops, flashings, light fixtures and other similar work as indicated. Provide all necessary cast in embeds and anchors.

E. Anchorages: Provide loose steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other miscellaneous steel shapes not provided by other trades, necessary for securing precast units to supporting and adjacent members.

1. Design and provide items to be embedded in and attached to building structure for attachment and support of precast. Design and engineer support systems to support precast at every floor.

F. Concrete Mixing: Comply with requirements of PCI MNL 117.

1. Measure water used in mixing to an accuracy of 0.5% using a calibrated measuring device. Measure all cement and aggregate materials by weight to an accuracy of 1%.

2. Use admixtures in strict compliance with manufacturer's instructions and recommendations; use amounts accepted in approved mixed designs to obtain performance criteria indicated.

3. Mix concrete for at least 60 seconds in a mechanical mixer. Place concrete promptly after mixing; discard mixed concrete after 1 hour.

4. Handle and place concrete to avoid segregation, honeycombs, and migration of air. Vibrate or tamp concrete to consolidate, but not to move concrete within forms.

G. Curing: After removal from forms, cure precast jackets in strict compliance with PCI MNL-117. Do not permit curing units to become damaged by loss of moisture or staining and dripping. After precast units have cured enough to prevent uncontrolled erosion during finishing process, lightly sand blast all surfaces indicated to receive "smooth" finish. Do not over blast to such an extent that large aggregates become more exposed than in approved sample. Control blasting to prevent arises and reveals from losing sharpness and definition.

1. Size of finished units shall be accurate within tolerances prescribed in PCI MNL-117.

H. Repairs: Surface defects may be repaired when acceptable to the Designer and when indistinguishable in finish, color, texture and quality from acceptable unrepaired surfaces. Demonstrate repair techniques, including curing; obtain Designer's approval of repair results before continuing work. Replace units that cannot be repaired as specified.

1. It is intended that any required repairs be made in the fabrication plant prior to delivery of units to jobsite. Surface damage occurring after units have left the plant may be repaired in the field only with Designer's approval; units that the Designer deems irreparable in the field may be rejected.

2. Determine repair mix formulas by trial to obtain finish, color, and texture match when both repaired and acceptable unrepaired concrete are cured and dry.

3. Fill holes, if any, using the same source of cement, sand, and pigment used in the parent concrete.

4. Moist cure repaired units for 7 days. Keep units continually damp by covering with damp flannel and polyethylene. Do not wash out repair mortar.

5. Touch up textured surfaces as necessary.

I. Welding: Clean surfaces to be welded to remove all loose scale, slag, rust, paint, galvanizing, and other foreign materials. Surfaces shall be free of fins and tears. Bring parts to be welded as close together as possible; in no case shall parts be ore than 1/16 in. apart.

1. Shims may be used only when approved by Designer.

2. Tack weld nuts and washers to bolts after tightening.

3. Clean welds to remove flux, rust, slag, and other foreign materials. Coat welded and bare surfaces with galvanized repair paint.

J. Predelivery Cleaning: Clean objectionable stains or spots off units as directed by the Designer using brushes, soap and clean, running water before delivery to site. Acid cleaning is not acceptable unless approved by Designer.

K. Identification: Mark each unit on a surface concealed from view in final installation with a non-staining, non-migrating paint. Coordinate marking with approved erection drawings.

2.7 FINISH

A. Smooth Surface Texture: Provide smooth surface on both sides of jacket. Provide mechanical or chemical light etching to create a fine surface texture similar to existing column jacket finish. Obtain Designer's approval and match approved samples and mock-ups.

B. Install graffiti resistance coating to concrete surface per specification section 09 96 23.

PART 3 - EXECUTION

3.1 INSPECTION

A. The Installer/Erector shall examine substrates, supports, and conditions under which this work is to be performed and notify Contractor, in writing, of conditions detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning of installation means Installer accepts substrates and conditions.

3.2 INSTALLATION

A. General: Deliver anchorage items which are to be embedded in other construction before start of such work. Provide setting diagrams, templates, instructions and directions as required for installation.

B. Do not install precast units until concrete has attained its design compressive strength.

C. Install precast concrete members plumb, level, and in alignment within PCI MNL-117 specified limits of erection tolerances. Provide temporary supports and bracing as required to maintain position, stability and alignment as members are permanently connected.

1. Maintain horizontal and vertical reveal and joint alignment and uniform joint width as erection progresses.

D. Accessories: Install clips, hangers, and other accessories required for erection of precast units to supporting members and back-up materials.

E. Anchor units in final position by bolting, welding, grouting, or as otherwise designed. Remove temporary shims, wedges, and spacers as soon as possible after anchoring is completed.

1. At bolted connections use lock washers or other acceptable means to prevent loosening of nuts.

2. At welded connections apply rust inhibitive coating on damaged areas, same as shop applied material. Use galvanizing repair coating on galvanized surfaces.

3. All connections shall be concealed within building finishes.

F. Surfaces to be welded shall be free from loose scale, slag, rust, and other foreign material, and shall be free of fins and tears. Stud welding shall be done before concrete floor fill is poured. Thoroughly clean and wire-brush steel anchorage items between structural steel.

G. On completion of all welding, clean welds thoroughly of flux, rust, etc. Field touch prime all welds and abraded steel using zinc rich compound.

H. Notify Designer in sufficient time so that inspection of completed welding can be made by testing agency under the Designer's direction should he so require.

I. Cleaning: Clean exposed facings to remove dirt and stains which may be on units after erection and completion of joint treatments. Wash and rinse in accordance with precast manufacturer's recommendations. Protect other work from damage due to cleaning operations. Do not use cleaning materials or processes which could change the character of exposed concrete finishes.

3.3 PERFORMANCE REQUIREMENTS

A. Conduct inspections, perform testing, and make repairs or replace unsatisfactory precast units as required.

B. In addition to above, in-place precast units may be rejected for any one of the following reasons:

1. Exceeding the specified installation tolerances.

2. Irreparable damage during construction operations.

3. Exposed to view surfaces which develop surface finish deficiencies.

4. Non-compliance with acceptance criteria listed below.

3.4 GENERAL ACCEPTANCE CRITERIA

A. Units shall meet specifications. No structural deficiencies, cracks, loose inserts or anchors, exposed steel, steel with less than 1 in. minimum cover, or other defects shall be permitted.

B. Appearance Acceptance Criteria: When viewed at a distance of 10 ft. in natural daylight, exposed surfaces shall be uniform in color, texture, and finish shall be within the range of approved mock-up samples when compared side by side. Jacket edges and details of decoration shall be clear, well defined and true to line within specified alignment tolerances. Following is a list of finish defects which are unacceptable and cause for rejection of jackets:

1. Ragged or irregular edges.

2. Excessive air voids, commonly called bugholes, evident on exposed surface.

3. Adjacent flat, round and return surfaces with a greater difference in exposure than the approved samples.

4. Casting lines evident from different placements.

5. Visible form joints or irregular surfaces.

6. Rust stains on jacket surfaces.

7. Jackets not matching approved sample or non-uniformity of color within a jacket or in adjacent jackets due to areas of variable aggregate concentration and variations in depth of exposure.

8. Blocking stains or acid stains evident on jacket surface.

9. Non-uniformity of textures or color.

10. Areas of backup concrete bleeding through the facing concrete.

11. Foreign material embedded in the face.

12. Visible repairs.

13. Reinforcement shadow lines.

14. Visible cracks.

15. Telegraphing of form lines such as plywood grain.

16. Burns or other damage resulting from welding work.

C. Precast units shall be reviewed for compliance with specifications in three stages as follows:

1. Units will be inspected at fabrication plant.

2. Units will be inspected after delivery to site.

3. Units will be inspected after installation and final cleaning.

D. Repair or replace units as directed by the Designer.

END OF SECTION 03 45 00

SECTION 05 10 00 - STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and fabricate all items necessary to complete work indicated on the plans and as specified herein. Structural steel shall be as defined in the AISC Code of Standard Practice for Steel Building and Bridges. Work shall include, but not be limited to the following:

1. Structural beams and columns.
2. Structural built-up plate girders, bracing members, and connecting elements

B. Include anchor bolts for column bases, column setting, base and bearing plates, beams, columns, column and beam detail connections, angles, bolts, stiffeners, plates and electrodes (for welded work).

C. The following surfaces shall be milled:

1. Contact surfaces between column and base plates.
2. Abutting ends of columns at column connections.
3. Contact surfaces between beam seat and bearing plate.
4. Bearing stiffener

D. Include the Temporary Track Protective Shield for the pedestrian overpass construction (Rail Facility Upgrade (Site No. 1)).

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Carefully examine all of the Contract Documents for requirements which effect the work of this section.

B. Other specifications sections which directly relate to the work of this section include, but are not limited to the following:

1. Section 03 30 00 - Cast-in-place Concrete
2. Section 05 30 00 - Metal Decking
3. Section 05 50 00 - Metal Fabrications
4. Section 09 91 00 - Painting

1.3 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of following, except as otherwise indicated:

1. AISC 303 "Code of Standard Practice for Steel Buildings and Bridges".

a. Paragraph 4.2.1 of the above code is hereby modified by deletion of the following sentence: "This approval constitutes the Department's acceptance of all responsibility for the design adequacy of any connections designed by the fabricator as a part of his preparation of these shop drawings".

2. AISC 360 "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings", including "Commentary" and Supplements thereto as issued.
3. AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts" approved by the RCRBSJ “Research Council on Riveted and Bolted Structural Joints” of the Engineering Foundation.
4. ANSI/AWS D1.1 "Structural Welding Code".
5. ASTM A 6 "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use".
6. SSPC "Painting Manual Vol. 1, Good Painting Practice".
8. SSPC "Painting Manual Vol. 2, Systems and Specifications".

B. Qualifications for Welding Work: Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure".

1. Provide certification that welders to be employed in work meet the requirements of Article 6.03.03, section 6, subsection (a) of the Form 816.

2. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests within past 12 months.

3. If recertification of welders is required, retesting will be Contractor's responsibility.

C. Fabricators Qualifications: Engage a firm experienced in fabricating structural steel similar to that indicated for the project and with a record of successful in-service performance.

1. Fabricator must participate in the AISC quality certification program and be designated in AISC certified plant as follows:

a. Category STD, conventional steel structures.

b. Fabricator shall be registered with and approved by authorities having jurisdiction.

D. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

E. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1 or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

1.4 TESTS

A. Inspection and Testing: The Contractor shall employ and pay an independent testing agency to inspect and test steel during fabrication and erection. The Contractor shall cooperate and permit all requested inspection and testing. All reporting by the testing agency shall be provided concurrently to the Department and the Contractor during testing.

B. Field Welds: The Contractor shall employ and pay an independent testing agency to test all welds in strict compliance with AISC and Building Code Requirements.

1.5 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 producers or manufacturer's specifications and installation instructions for following products. Include laboratory test reports and other data to show compliance with specifications (including specified standards).

1. Structural steel (each type), including certified copies of mill reports covering chemical and physical properties.

2. High-strength bolts (each type), anchor bolts, including nuts and washers.

3. Structural steel primer paint and top coat paint.

4. Shrinkage-resistant grout.

5. Expansion Fastening systems

6. Adhesive Anchor Rod systems

C. Shop Drawings: Submit shop drawings, after field survey and adjustments are made, to the Designer for approval. Including complete details and schedules for fabrication and assembly of structural steel members, procedures and diagrams.

1. Include details of cuts, connections, camber, holes, and other pertinent data.
2. Include embedment drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
5. Identify members and connections of the seismic-load-resisting system.
6. Indicate locations and dimensions of protected zones.
7. Identify demand critical welds.
8. For structural-steel connections indicated to comply with design loads, include structural design data and calculations signed and sealed by the qualified professional engineer responsible for their preparation.
9. Submit job standards and typical connection details with calculations for the capacity of the connections for review prior to submittal of shop drawings.

D. Test Reports: Submit copies of reports of tests conducted on shop and field bolted and welded connections. Include data on type(s) of tests conducted and test results.

E. Welding Certificates: Provide welding certificates for welders who will be used for field welding.

F. Temporary Track Protective Shield: The Contractor shall submit to the Engineer for review and approval, all temporary track protective shield plans at least 30 days prior to undertaking any pedestrian overpass work. No pedestrian overpass work shall begin until such plans have been approved by the Engineer. These plans shall be in accordance with the contract plans, specifications and permits. These plans must include, but shall not be limited to working drawings showing the proposed shield installation and support structure, Netting Qualifications

Test per ANSI A10.11, Part 8.2 and vertical and horizontal clearances of the proposed shield over the railroad tracks.

1.6 DELIVERY, STORAGE AND HANDLING

A. Refer to Form 816 Article 1.06.03 and Form 816 Article 1.20-1.06.03 for additional information.

B. Deliver structural steel to project site at such intervals to insure uninterrupted progress of work.

C. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time so as not to delay affected work.

D. Store materials to permit easy access for inspection and identification. Keep steel members off ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.

E. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

F. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.7 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 MATERIALS

A. Metal Surfaces, General: For fabrication of work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness. Remove such blemishes by grinding, or by welding and grinding, prior to cleaning, treating and application of surface finishes.

B. Structural Steel Gusset plates: Carbon Steel ASTM A36, except where high-strength is noted, ASTM A 572, Grade50 ksi, and other types indicated on the drawings.
C. Rolled Shapes: ASTM A572 grade 50 ksi
D. All wide flange shapes: ASTM A992, grade 50 ksi
E. Structural Steel HSS Sections: ASTM A500, GR, B (Fy= 46ksi)
F. Structural Steel Pipes: ASTM A53 GR. B (Fy=35ksi)
G. Anchor Bolts: ASTM F1554, Grade 55 with Supplementary Requirement S4

H. Stainless Steel rods: ASTM A276, T304/304L, Non-polished finish, Tensile Strength = 85ksi

I. Unfinished Threaded Fasteners: ASTM A307, Grade A, regular low-carbon steel bolts and nuts

1. Provide hexagonal heads and nuts for all connections.

J. High-Strength Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers, as follows:

1. Quenched and tempered medium-carbon steel bolts, nuts and washers, complying with ASTM A 325.
2. Nuts shall comply with Heavy Hex Nuts ASTM A536A and Washers shall comply with A436.

K. Electrodes for Welding: Comply with AWS Codes as indicated on Plans. Filler metal for welding shall conform to the requirements of the AWS, E70XX classification.

L. Structural Steel Primer and Topcoat Paint: Primer paint for building steel members shall be aromatic zinc rich urethane primer applied at 2.5 to 3.5 mils DFT. Topcoat Paint shall be an epoxy mastic applied at 4.0 to 6.0 mils DFT. Provide one of the following products for each:

1. Primer
   a. Tnemec 394 - Omni-Thane zinc rich urethane primer
   b. E.I. du Pont Ganicin 2.8MCZ
   c. Hemple 1649 Hemple Zinc HS
   d. Or approved equal

1a. Primer required under beams and columns to receive intumescent fireproofing shall be Tnemec 27 WB Typoxy at 3 to 4 mils DFT. or approved equal.

2. Topcoat
   a. Tnemec 27 WB Typoxy
   b. E.I. du Pont Corlar 2.1-PR
   c. Hemple Hempadur 45880
   d. Or approved equal

M. Galvanizing shall be in accordance with ASTM A123. Touch-up for galvanized surfaces: Galvanizing paint repair shall be ZRC Cold Galvanizing Compound by ZRC World Wide, ZiRP by Duncan Galvanizing, Brite Zinc as manufactured by Brite Products or approved equal and shall conform with the requirements of ASTM A780, with 95 percent zinc by weight.

N. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean, uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

1. Non-Metallic Shrinkage-Resistant Grout: Pre-mixed, non-staining, non-corrosive, non-shrink, non-metallic cement based grout complying with ASTM C1107, "Grade C", *Standard Specification for Packaged Dry Hydraulic Grout - Non Shrink*.

   a. Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following or approved equal:

      1) Five Star Grout; Five Star Products Inc.

2) Crystex; L&M Construction Chemicals

3) Masterflow 555; Master Builders

O. Stainless Steel Threaded Rods shall meet the requirements of ASTM A193 B7 or AISI 316 for stainless steel rods.

P. Temporary Track Protective Shield: The protective shield shall be a combined personnel/debris net.

The materials and installation shall conform to CFR 1926.500 (OSHA Rules) and with ANSI A.10.11, "American National Standard for Construction and Demolition Operations – Personnel and Debris Nets". The combined nets (personnel barrier) must have a minimum working rating of not less than 10,000 ft. – lb.

The Contractor shall estimate the size, weight, and height-of-fall of anticipated objects. The netting shall have a mesh of the size and strength sufficient to contain the expected objects without penetration when properly supported by the personnel net. The net shall not compromise the design, construction, or performance of the personnel nets.

Barriers shall be capable of a minimum service life of two years under normal on-the-job exposure to weather, sunlight, and handling, excluding damage from misuse, mishandling, and exposure to chemicals and airborne contaminants.

2.2 FABRICATION

A. Shop Fabrication and Assembly: Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications for building steel, and as indicated on final shop drawings with the modifications and additional requirements specified in this Section.

1. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.

2. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects. Welds shall be finished flush and smooth.

B. Connections: Weld or bolt shop connections, as indicated.

1. Bolt field connections, except where welded connections or other connections are indicated.

a. Provide 7/8" diameter high-strength threaded fasteners for principal bolted connections, except where unfinished bolts are indicated.

b. Diameter of holes in bolted parts shall be 1/16" greater than the nominal diameter of the bolt. No unfinished holes will be accepted, and enlargement of holes shall not be accomplished by burning. Burrs resulting from drilling or punching shall be ground to the surface of the material. Shearing and punching shall be done cleanly so as not to deform or mar adjacent surfaces.

2. Eccentric connections shall be avoided if possible. Where necessary, care shall be taken that all shears, tensions and connections provided by eccentricities are amply provided for in connections and that harmful additional stress are not introduced into members.

C. High-Strength Bolted Construction: Install high-strength threaded fasteners in accordance with AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts" (RCRBSJ).

1. Bolts which have been completely tightened shall be marked with an identifying symbol.

2. The tightening of the bolts with other than calibrated wrenches will not be permitted. Contractor shall submit to Designer a certification that the calibrating device for setting the calibrated wrenches for high-strength bolts has been checked by the testing laboratory. If at any time during construction the Designer has reason to question the accuracy of the calibrating setting device, he may, at his option, require that the machine be sent back to the Contractor for certification of its accuracy by the testing laboratory. In any case, the calibrating setting device must be checked for accuracy after each six-month period of use on the project, and proof of certification must be submitted to the Designer.

3. In all cases on non-parallel abutment surfaces, the nut shall be torqued against a non-sloping surface.

4. High strength bolts shall have a hardened washer under the element (nut or thread) turned in tightening. Beveled washers shall be provided in all bolt connections to sloping flanges of American Standard beams and channels.

5. High strength bolts once tightened shall not be loosened and re-used.

D. Welded Construction: Comply with AWS Codes for procedures, appearance and quality of welds, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods which will produce true alignment of axes without warp.

E. Holes for Other Work: Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members, as shown on final shop drawings.

1. Provide threaded nuts welded to framing, and other specialty items as indicated to receive other work.

3. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.

2.3 SHOP PAINTING

A. General: Shop paint structural steel including those members or portions of members to be embedded in concrete or mortar. Steel members indicated to fireproofed with cementitious fireproofing do not require priming. Steel members indicated to be fireproofed with intumescent fireproofing shall be primed as specified in 2.1 I.1.a., with no top coat.

1. Do not paint surfaces which are to be welded. High-strength bolted locations with friction-type connections may be painted using a slip critical primer as specified.

2. Apply 2 coats of paint to surfaces which are inaccessible after assembly or erection.

3. Apply specified coats in paragraph 2.1 I. to all steel embedded into masonry or foundation concrete and steel columns encased in concrete, unless galvanizing is indicated.

B. Surface Preparation: After inspection and before shipping, clean steel work, to be painted. Remove loose rust, loose mill scale, and spatter, slag or flux deposits. Clean steel in accordance with Steel Structures Painting Council (SSPC) as follows:

1. For building steel members: SP-6 "Commercial Blast Cleaning".

PART 3 - EXECUTION

3.1 INSPECTION

A. Erector must examine areas and conditions under which structural steel work is to be installed, and notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the Erector.

3.2 ERECTION

A. Surveys: Employ a registered professional engineer or land surveyor for accurate erection of structural steel. Check elevations of concrete bearing surfaces, and locations of anchor bolts and similar devices, before erection work proceeds, and report discrepancies to the Designer. Do not proceed with erection until corrections have been made, or until compensating adjustments to structural steel work have been agreed upon with the Designer.

B. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds.

C. Anchor Bolts: Furnish anchor bolts and other connectors required for securing structural steel to foundations and other in-place work.

1. Furnish templates and other devices as necessary for presetting bolts and other anchors to accurate locations.

2. Refer to Division 3 and Division 4 of these specifications for anchor bolt installation requirements in concrete.

D. Setting Bases and Bearing Plates: Clean concrete bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.

1. Set loose and attached base plates and bearing plates for structural members on wedges or other adjusting devices.

E. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.

F. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.

1. For proprietary grout materials, comply with manufacturer's instructions.

G. Field Assembly: Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure within specified AISC tolerances.

2. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowance for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.

3. Splice members only where indicated and accepted on shop drawings.

H. Erection Bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds and grind smooth at exposed surfaces.

I. High Strength Bolts: Installation shall be performed by using pneumatic powered impact wrenches with sufficient capacity and on adequate supply of compressed air, or installation shall be performed in accordance with the turn-of-the-nut method outlined in the AISC "Specification for Structural Joints using ASTM A-325 or A 490 Bolts", with the following modification:

1. Use a hardened washer under either the bolt head or nut, whichever is turned in tightening.

J. Welding: Field welding shall be executed in accordance with all requirements of AWS. All field welding shall be done by manual shielded metal-arc welding, only.

1. All groove welds shall be continuous and full penetration welds unless otherwise shown on the design plans. Welds made without the aid of a backing shall have their roots chipped, ground or gouged out to sound metal from the second side, before welding is done from the second side.

K. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

1. Do not enlarge unfair holes in members by burning or by use of drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.

L. Gas Cutting: Do not use gas cutting torches in field for correcting fabrication errors in primary structural framing. Cutting will be permitted only on secondary members which are not under stress, as acceptable to Designer. Finish gas-cut sections equal to a sheared appearance when permitted.

M. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply primer and topcoat paints to exposed areas on perimeter columns and spandrel beams, using same materials as used for shop painting.

1. Apply by brush or spray to provide minimum dry film thickness as specified for shop painting.

N. Galvanizing: All steel indicated to be "galvanized" shall be cleaned and hot dipped galvanized in strict accordance with ASTM A123.

O. Temporary Track Protective Shield: The shield shall be installed in accordance with the manufacturer's specifications and instructions. The protective shield shall be erected below the span of the pedestrian overpass extension within the allowable clearances and shall extend a minimum of 6 feet beyond the limits of work. The barrier shall be erected at a level below the work so as not to exceed the barrier rating under the barrier design load.

The Contractor shall install and maintain life lines and safety belts as an additional personal safeguard. The Engineer will permit removal of the protective shield where no longer required.

The care, maintenance, and storage of the shield shall be in accordance with the manufacture's recommendations. Due attention shall be given to the factors affecting net life. Nets shall be inspected weekly. Nets shall be tested immediately following installation, relocation or major repair and when left in one location, at 6-month intervals, in accordance with ANSI A.10.11 Part 9.

Shield and debris shall be protected from sparks and hot slag resulting from welding and cutting operations. All debris shall be removed at least daily.

The Contractor shall not allow the protective shield and debris net to carry more than 5 pounds per square foot of weather elements (rain, snow, ice, etc.)

3.3 QUALITY CONTROL

A. The Contractor shall employ and pay an independent testing and inspection agency to perform all specified testing, and to submit full reports of each test conducted. The testing agency shall be responsible for interpreting the results of each test, and shall state in each report whether or not the test specimens comply with the specified requirements, and shall include any deviation therefrom. Test results will be reported in writing to Designer within 24 hours after tests.

1. Testing agency shall conduct and interpret tests and state in each report whether test specimens comply with requirements, and specifically state any deviations therefrom.

2. Provide access for testing agency to places where structural steel work is being fabricated or produced so that required inspection and testing can be accomplished.

3. Testing agency may inspect structural steel at plant before shipment; however, Designer reserves the right, at any time before final acceptance, to reject material not complying with specified requirements.

B Welded Connection Testing:

1. Visually inspect all welds for size, length, and location in accordance with AWS D1.1. Measure and record the size and length of 25 percent of all welds at random locations.

2. Test 25 percent of all fillet welds at random locations by magnetic particle testing in accordance with ASTM E709.

3. Test 100 percent of all full or partial penetration welds by ultrasonically testing in accordance with AWS D1.1 and ASTM E164.

C. Bolted Connection Testing:

1. Visually inspect all bolted connections for bolt and nut size and grade, and for snug contact of all connected elements in accordance with AISC Manual of Steel Construction.

2. Test 25 percent of bolts (but not less than 2 bolts) in each connection by calibrated torque wrench in accordance with AISC Manual of Steel Construction.

D. Correct deficiencies in structural steel work which inspections and laboratory test reports have indicated to be not in compliance with requirements. Perform additional tests, at Contractor's expense, as may be necessary to reconfirm any non-compliance of original work, and as may be necessary to show compliance of corrected work.

3.4 CLEAN-UP

A. All work provided under this Section shall be cleaned of all oil, dirt, debris, and other foreign materials, and shall be ready to receive any scheduled finish coating, or attachment or other systems specified elsewhere.

B. The Contractor providing the Work of this Section shall maintain the effected work area neat and clean at all times.

END OF SECTION 05 10 00

SECTION 05 30 00 - METAL DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish all labor, materials, and equipment required for the complete installation of all steel deck shown on the Contract Plans and herein specified and as needed for a complete and proper installation. Provide and install the following deck types:

1. Steel roof decking.
2. Galvanized Composite Steel floor decking.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Carefully examine Contract Documents for requirements that affect work of this section.

B. Other specifications sections that directly relate to work of this section include, but are not limited to, the following:

1. Section 03 30 00 – Cast-in-Place Concrete
2. Section 05 10 00 - Structural Metal Framing.

1.3 MEASUREMENTS

A. Contractor shall take all necessary measurements at building before executing the work and shall be responsible for proper fitting.

1.4 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Codes and standards: Comply with the provisions of the following codes and standards as otherwise specified:

1. American Iron and Steel Institute, "Specification for the Design of Cold-Formed Steel Structural Members".
2. American Welding Society, "Structural Welding Code - Sheet Steel, D-1.3".
3. Steel Deck Institute, "Design Manual for Composite Floor Deck, Non-composite Form Deck and Roof Deck".
4. American Society for Testing and Materials , ASTM.
5. Factory Mutual Insurance Company - Norwood, MA

C. Qualification of Welding Work:

1. Qualify welding processes and welding operators in accordance with the AWS "Standard Qualification Procedure".
2. The Contractor shall employ and pay an independent testing agency, acceptable to the Department, to test welding and steel deck work. Decking welded in place shall be subject to

inspection and testing. Expense of removing and replacing any portion of decking for testing purposes will be borne by the Department if welds are found to be satisfactory. Remove work found to be defective and provide acceptable work.

3. Provide certification that welders to be employed in work meet the requirements of Article 6.03.03, section 6, subsection (a) of the Form 816.

1.6 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 deck, accessory, and product specified.

1. Material list of items to be provided under this Section.

2. Manufacturer's specifications and other data needed to demonstrate compliance with the specified requirements.

C. Shop Drawings showing layout and types of deck panels, anchorage details, reinforcing channels, pans, with details of materials, gages, accessories, openings, finishes, welds, and other pertinent conditions.

1. Manufacturer's recommended installation procedures which, when approved by the Designer, will become the basis for accepting or rejecting actual installation procedures used on the work.

D. Welder certificates signed by Contractor.

E. Product test reports from qualified independent testing agency.

1.7 PERFORMANCE REQUIREMENTS

A. Compute the properties of steel deck sections on the basis of the effective design width as limited by the provisions of the AISI Specifications. Provide not less then the deck section gage shown.

B. Allowable deflection: Design and fabricate roof deck for a maximum deflection of 1/240 of the clear span under the total uniform dead and live load.

C. Uplift loading: Install and anchor roof deck units to resist gross uplift loading of 40 pound per square foot.

1.8 DELIVERY, STORAGE AND PROTECTION

A. Refer to Form 816 Article 1.06.03 and Form 816 Article 1.20-1.06.03 for additional information.

B. Deliver materials to the site at such intervals as to ensure uninterrupted progress of the work.

C. Store material to permit easy access for inspection and identification. Keep steel deck units off the ground using pallets, platforms, or other supports and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

D. Do not store materials on structure in a manner that might cause distortion or damage to supporting structures.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Miscellaneous steel shapes: ASTM A36.
B. Steel Roof Decking: Galvanized Steel Roof Decking: Sheet steel for roof decks and accessories shall conform to ASTM A653, structural steel minimum yield of 33 ksi, Roof decks shall be 1 1/2 inch deep, 22 gage as noted on Plans for "Rail Facility Upgrade (Site No. 1)" and "Rail Facility Upgrade (site No. 2)". Type 1.5B (wide rib) configuration for 1-1/2 inch deep as manufactured by Vulcraft or approved equal.

C. Galvanized Composite Steel Floor Deck:

a. Galvanized sheet steel for floor deck and accessories shall conform to ASTM A653, structural steel with minimum yield strength of 33 ksi. Galvanizing shall conform to ASTM A924 with a minimum coating thickness G60 (Z180) as defined in ASTM A653. The Floor deck at the pedestrian overpass, elevator lobby at "Rail Facility Upgrade (Site No.1)" shall be 2" deep, 16 Gage where noted on Drawings, Type 2VLI as manufactured by Vulcraft or approved equal.

Composite floor deck shall have integral locking lugs or embossments to provide a mechanical lock between the steel deck and the concrete slab.

b. Galvanized Composite Steel Floor Decking: Galvanized Sheet steel for roof decks and accessories shall conform to ASTM A653, structural steel minimum yield of 33 ksi, Roof deck at the elevator tower at "Rail Facility Upgrade (Site No.1)" shall be 3" deep 18 Gage where noted on the Drawings, Type 3VLI as manufactured by Vulcraft or approved equal.

Composite floor deck shall have integral locking lugs or embossments to provide a mechanical lock between the steel deck and the concrete slab.

D. Sheet Metal Accessories: ASTM A653, commercial quality, galvanized, 16 gage minimum.

E. Galvanized Repair Paint: Touch up damaged or abraded galvanized surfaces with ZRC Cold Galvanizing Compound as manufactured by ZRC Products Company, ZiRP Cold Galvanizing Compound as manufactured by Duncan Industries, Brite Zinc Galvanizing Compound as manufactured by Brite Products or approved equal.

F Welding: AWS D1.1.

G.. Reinforcing to be welded shall conform to ASTM A706.

2.2 FABRICATION/ACCESSORIES

A. Deck Types as indicated on Plans:

1. Roof Deck: Galvanized, 22 gage, depth equal to 1.5 inches; ribs spaced approximately six inches on center; width of rib opening at roof surface not over 2-1/2 inches; width of bottom rib surface not less than 1-3/4 inches.
2. Composite Floor Deck:

a. Galvanized 16 gage, depth equal to 2 inches; ribs spaced approximately 12 inches on center; width of rib opening at top deck surface not over 5 inches; width at bottom rib surface not less than 5 inches.
b. Galvanized 18 gage, depth equal to 3 inches; ribs spaced approximately 12 inches on center; width of rib opening at top deck surface not over 4.75 inches; width at bottom rib surface not less than 4.75 inches.

B. Roof Sump Pans: Fabricate from a single piece of not less than 14-gage galvanized sheet steel of the same quality as the deck units; with level bottoms and sloping sides to direct water flow to the drain, unless otherwise shown. Provide sump pans of adequate size to receive roof drains and with bearing flanges not less than three inches wide. Recess pans not less than 1-1/2 inches below the roof deck surface, unless otherwise shown or required by the deck configuration. Holes for drains will be cut in the field.

C. Steel Closure Strips: Fabricate steel closure strips of not less than 16-gage, unless otherwise noted, galvanized sheet steel of the same quality as the deck units. Form to the configuration required to provide tight-fitting closures at open ends and sides of decking.

D. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

E. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

F. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

G. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0598-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

H. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 30 for overhang and slab depth.

I. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.

J. Repair Paint: Utilize Manufacturer's primer specified above of same color for touch up of deck panels.

PART 3 - EXECUTION

3.1 INSPECTION AND TESTING

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install steel deck units and accessories in accordance with Steel Deck Institute specifications and recommendations, manufacturer's recommendations and final Shop Drawings, and as specified herein.

1. All O.S.H.A. State and Local rules for erection must be followed.

3.3 PLACING STEEL DECK UNITS

A. Place steel deck units on supporting steel framework and adjust to final position with ends bearing on supporting members and accurately aligned end-to-end before being permanently fastened. Lap ends not less than two inches. Do not stretch or contract the side-lap interlocks. Place deck units flat and square, secured to adjacent framing without warp or excessive deflection.

B. Coordinate and cooperate with structural steel erector in locating decking bundles to prevent overloading of structural members.

C. Do not use deck units for storage or working platforms until permanently secured.

3.4 FASTENING DECK UNITS

A. Permanently fasten steel deck units with metal thickness equal to or greater than 0.0598 inches (16 gage) to steel supporting members by not less than 5/8" diameter fusion welds, or minimum 1" elongated welds of equal strength.

B. Permanently fasten steel deck units with metal thickness less than 0.0598 inches (16 gage) through manufacturer's welding washers with weld pattern shown on design plans or where recommended by deck manufacturer.

C. Comply with AWS requirements and procedures for manual shielded metal-arc welding, the appearance and quality of welds, and the methods used in correcting welding work.

D. Mechanical fasteners, either power actuated or pneumatically driven, or screws may be used in lieu of welding to fasten deck to supporting framing, provided they have been specifically approved.

E. Steel roof deck units shall be fastened to the supporting structure (minimum requirements) as follows:

1. Panel ends and end laps: Welded.
   Maximum spacing of six (6) inches.

2. Intermediate supports: Welded.
   Maximum spacing of twelve (12) inches.

3. Side laps of adjacent units: Welded or mechanically fastened between supports at intervals not exceeding eighteen (18) inches.

F. Steel floor deck units shall be fastened to the supporting structure (minimum requirements) as follows:

1. Panel ends and end laps: Welded.
   Maximum spacing of twelve (12) inches.

2. Intermediate supports: Welded.

Maximum spacing of eighteen (18) inches.

3. Side laps of adjacent units: Welded or mechanically fastened between supports at intervals not exceeding thirty six (36) inches.

3.5 CUTTING AND FITTING

A. Cut and fit steel deck units and accessories around other work projecting through or adjacent to the decking, as shown on the Plans. Provide neat, square and trim cuts.

3.6 REINFORCEMENT AT OPENINGS

A. Provide additional steel reinforcement and closure pieces as required for strength, continuity of decking and support of other work, unless otherwise shown.

B. Reinforce roof / floor decking around openings less than 15" in any dimension by means of a flat steel sheet placed over the opening and fusion welded to the top surface of the deck. Provide steel sheet of the same quality as the deck units, not less than 16 gauge, and at least 12" wider and longer than the opening. Provide welds at each corner and spaced not more than 12" on centers along each side.

3.7 CLOSURE STRIPS

A. Provide steel closure strips at all open uncovered ends and edges of steel decking, and in the voids between decking and other construction. Weld into position to provide a complete decking installation.

3.8 ROOF INSULATION SUPPORT

A. Provide steel closure strips for the support of roof insulation where the rib openings in the top surface of the roof decking occur adjacent to edges and openings. Weld closure strips into position.

3.8 TOUCH-UP PAINTING

A. Upon completion of the steel decking installation, clean and paint scarred areas, welds and rust spots on the top and bottom surfaces of decking units and supporting steel members using a wire brush.

B. Touch-up galvanized surfaces with zinc-rich paint, as recommended by the deck manufacturer.

END OF SECTION 05 30 00

SECTION 05 40 00 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. The work of this section includes, but is not limited to, furnishing and installation of the following:

1. Light gauge structural framing system for exterior walls above grade where indicated on the plans used for the following:

a. Metal Wall Panels
b. Metal Ceiling Panels

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Carefully examine all of the Contract Documents for requirements which affect the work of this section.

B. Other specifications sections which directly relate to the work of this section include, but are not limited to, the following:

1. Section 05 50 00 - Metal Fabrications; lintels and supporting structure not shown on structural plans.
2. Section 07 60 00 - Flashing and Sheet Metal; sheet metal flashing.

1.3 SHOP DRAWINGS AND ENGINEERING COMPUTATIONS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS.

B. The contractor shall engage the services of a professional engineer, registered in the State of Connecticut to prepare complete shop drawings and structural computations of all work of this Section based on, and closely following, the layouts and details on the plans. The shop drawings and the structural computations, with the Engineer's seal affixed thereto, shall be submitted to Designer for approval in accordance with the requirements of Form 816, Division One. The shop drawings and structural computations shall be sufficient, in conjunction with this specification, to provide the complete basis for the fabrication and installation of the work of this Section. Do not order materials or begin fabrication or erection of light gauge steel framing work until Designer's approval of these submissions has been obtained.

B. The shop drawings shall show complete framing elevations and sections of all installations, shall include complete large scale details of all typical and special conditions of construction; shall clearly indicate type of materials, sizes, shapes, sections, gauges, thicknesses, spacings, and finishes of all members; shall clearly indicate all materials and methods used in the connecting and anchoring of the work, including locations, and spacing of all welds and mechanical anchors; and shall indicate proposed section tolerances. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging splices, accessories, connection details, and attachment to adjoining work.

C. The structural computations shall provide a complete structural analysis of all typical and special conditions of construction, and shall certify the various conditions as designated as conforming to the applicable building code, with specific added statement that seismic and wind forces have been taken into full account.

D. Wind loading shall be based on design pressure specified in the referenced International Building Code with Connecticut Supplements. Seismic loading shall comply with State of Connecticut Building Code.

E. Framing system shall limit stud deflection to L/720, without consideration of the stiffness of attached water resistant gypsum sheathing, masonry veneer, or precast elements.

F. Framing system shall incorporate a deflection type header track with slip connections to resist vertical deflection in combination with horizontal strapping to keep studs properly positioned and aligned in track during assembly.

G. Approval of shop drawings will be for size and arrangement of items and strength of connections. Errors in dimensions shown on the shop drawings shall be the responsibility of the light gauge metal Contractor.

H. Do not work without approved shop drawings. Fabrication of any material or performing any work prior to final approval of shop drawings shall be entirely at thee Contractor's risk.

1.4 QUALITY ASSURANCE

A. Qualifications/Certification:

1. The framing contractor shall provide documentation of no less than three successfully completed projects which utilized framing systems similar in scope to the application shown on the Contract Documents.

2. Provide certification that welding procedures will be in accordance with requirements of the current edition of the American Welding Society (AWS) "Specification for Welding Sheet Steel in Structures", D1.3)

3. Provide certification that welders to be employed in work meet the requirements of Article 6.03.03, section 6, subsection (a) of the Form 816.

B. Pre-Installation Meeting: A site meeting shall be held with representatives of the Contractor, Designer the Framing Contractor, and the Department's Testing Laboratory Three days prior to the start of light gauge steel framing work to inspect substrata and review installation requirements.

1. The Pre-Installation Meeting shall be in compliance with the requirements of Form 816 Article 1.20-1.05.24 subsection 2.

C. Obtain current versions of FM Global requirements, data sheets, applications, and certification forms as required directly from FM Global.

1.5 SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS.

B. Prior to commencement of work, the Contractor shall submit the following items for the approval of the Designer of record.

1. Drawings: For field assembled installations, the Contractor shall provide drawings addressing the construction of each unique framing condition and connection. The drawings shall include descriptions, locations and spacing of each framing component and fastener.

   a. For prefabricated applications, include frame drawings depicting shape, dimensions, components, locations and construction sequence.

2. Structural Calculations: Structural calculations shall be submitted which include development of loading requirements and structural analysis of each unique framing and connection condition.

3. Literature: Submit current technical literature prepared by the framing manufacturer. The structural properties and load tables shall be prepared in accordance with contents of the current AISI "Specifications for the Design of Cold Rolled Steel Structural Members".

4. Certifications: Submit Mill Certificates from the framing manufacturer certifying conformance with the minimum requirements of Part 2 of these Specifications. Provide certification of welding procedures and personnel.

5. Samples: Submit 12" long sections of all galvanized steel stud and runner members and full size samples of all connection accessories.

1.6 REFERENCE SPECIFICATIONS

A. In addition to other requirements, the work for this Section shall comply with all applicable provisions of the following standards. Copies of these publications shall be kept available in the shop and field.

1. "Specification for Design of Cold Formed Steel Structural Members", American Iron and Steel Institute, Latest Edition.
2. "Code of Standard Practice for Steel Buildings and Bridges", American Institute for Steel Construction, Latest Edition.
3. "Code for Welding Sheet Steel in Structures", American Welding Society, D1.3.
4. "Painting Manual, Vol. 1, Good Painting Practice" and "Painting Manual, Vol. 2, System and Specifications", Steel Structures Painting Council.
5. " State of Connecticut Building Code", 2005 Edition.
6. ASTM A 653, Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
7. ASTM A 1003, Steel Sheet, Carbon, Metallic and Nonmetallic-Coated for Cold Formed Framing Members
8. ASTM C 1007, Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories.
9. ASTM C 954, Steel Drill Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 inch to 0.112 inch In Thickness.
10. ASTM C 955, Load Bearing (Transverse and Axial) Steel Studs, Runners (Track), and Bracing or Bridging for Screw Application of Gypsum Board and Metal Plaster Bases.

11. ASTM C 754, Installation of Steel Framing Members to Receive Screw Attached Gypsum Board.
12. ASTM C 645, Nonstructural Steel Framing Members.

1.7 INSPECTION, TESTING AND QUALITY CONTROL

A. Testing: The Department will engage a qualified Independent testing agency to perform quality control testing.

B. Materials and workmanship, including welding and anchoring, shall be subject to inspection and testing in mill, shop, and /or field by the Designer and /or Testing Agency. Such inspection and testing shall not relieve the Contractor of his responsibility to provide his own inspection, testing, quality control and to furnish materials and workmanship in accordance with the requirements of the Contract Documents.

C. Any material or workmanship which is rejected by the Designer and/or Testing Agency in mill, shop, or field, shall be replaced promptly by the Contractor to the satisfaction of the Designer and /or Testing Agency, and at the Contractor's expense.

D. Acceptance of work in shop shall not prevent the final rejection of work at the job site, even after erection, if work is found to be defective in any way.

1.9 QUALIFICATIONS OF WELDERS

A. The Contractor shall only employ welders who qualify for the work they are to do by tests as prescribed in AWS D1.3.

B. Certificates of qualification of welders from a recognized agency whose tests, procedures and requirements are at least equal to those of the American Welding Society may be accepted.

1.10 DELIVERY, STORAGE AND HANDLING OF MATERIALS

A. Refer to Form 816 Article 1.06.03 and Form 816 Article 1.20-1.06.03 for additional information.

B. All manufactured materials shall be delivered to the site in original packages or containers bearing manufacturer's names and brand names, type of material and contents.

C. Steel framing and related accessories shall be stored and handled in accordance with A.I.S.I. “Code of Standard Practice”.

D. Protect materials against dampness. Store off the floor, under cover, away from sweating walls and other damp surfaces, and adequately protected against damage from all other sources.

1.11 COORDINATION

A. The Contractor shall examine all plans as to the requirements for accommodations and/or the installation of work of other trades and provide holes and connections as required for such work and for site assembly of metal work. Holes shall be drilled or punched and reamed in the shop. Show sizes and locations of all such holes on the shop drawings.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER'S

A. Acceptable manufacturer's of light gauge steel framing shall be as follows:

1. ClarkDietrich Building Systems.

2. Superstud

3. Marino Ware

4. Brady Construction Innovations, Inc.

5. Or approved equal

2.2 LIGHT GAUGE STEEL FRAMING SYSTEM

A. Steel Stud System: A complete proprietary load bearing steel stud framing system, consisting of:

1. Studs: Structural framing components shall be formed from steel meeting the requirements of ASTM A653 and ASTM A1003 as follows:

a. Studs - 12, 14 and 16 gauge with track and accessories 12 and 14 gauge: Yield strength shall be Fy = 50 KSI.

b. Studs - 18 and 20 gauge with track and accessories 16, 18, and 20 gauge: Yield strength shall be Fy = 33 KSI.

2. Galvanized Coating: Steel framing products shall be zinc coated in accordance with ASTM A653 for min. G90 coating.

3. Fasteners: Fasteners for steel stud framing system shall consist of framing screws, nuts, bolts, washers and other fasteners, welding, powder actuated fasteners, expansion bolts and adhesive anchors.

a. Framing Screws: All framing screws incorporated into the work shall be fluoropolymer coated. Screws shall be of diameter, length and drilling capacity as recommended by framing manufacturer for the intended application.

4. Sill and Track: 16 gauge minimum, 33 KSI yield strength steel channel sill and head runner track. Sill track shall have minimum 2" flange. Head tracks shall be deflection type with minimum 2-1/2" flanges.

a. Subject to compliance with requirements, provide: Dietrich Metal Framing SLP-TRK Slotted Deflection Track by Brady Innovations or approved equal.

5. Headers and Jambs: Manufacturer's proprietary shape used to form header beams and jambs, columns or posts, of web depths indicated, unpunched, with stiffened flanges and as follows:

a. ClarkDietrich Building Systems: Heavy Duty Studs - HDS and Header Bracket - HDSC
b. Brady Innovations ProX Header
c. Approved Equal From The Steel Network, Inc.

6. Tension Straps, Bridging and Girts: 33 or 50 KSI yield strength steel flat strap steel in thickness and width as required for joist bridging, shear walls and backer plates. Tension straps shall be used in conjunction with deflection head track to keep studs properly positioned and aligned in track during assembly.

7. Deflection Clips: Provide deflection clips by The Steel Network, Inc. Raleigh, NC (phone 888-474-4876), Dietrich Metal Framing or approved equal from manufacturer's listed above for attachment of framing studs to primary structure. Deflection clips shall be capable of providing lateral support for framing members while allowing for vertical deflection of the primary structure. Deflection clips shall have rigid attachment to structure and screw attachment to stud web using step-bushings to permit frictionless vertical movement. Clip shall allow for a maximum 3/4" of vertical primary frame movement and as much as 2" of horizontal displacement between stud wall and support angle.

    a. Subject to compliance with requirements, provide one of the following or approved equal:
        1) Dietrich Metal Framing: Fast Strut / Fast Top Clips / Fast Clip Slide Clips/ QuickClip /Side Clip (SD)

8. Vertical Deflection Connection: Provide VertiTrack deflection accommodating device by The Steel Network, Inc. Raleigh, NC (phone 888-474-4876), Dietrich Metal Framing SLP-TRK Slotted Deflection Track by Brady Innovations or approved equal from manufacturer's listed above for attachment of framing studs to primary structure. Products shall conform to the following properties and performance criteria:

    a. Code Criteria:
        1) Meet required head of wall connection criteria as required by applicable code (and as indicated in UL2079) for cyclic wall movement.
    b. Material Composition: Meeting ASTM A653/A, SS Grade 50, class 1, 50 ksi minimum yield strength, 65 ksi minimum tensile strength, G-60 hot dip galvanized coating.
    c. Material Thickness : 0.036 inch VertiTrack VTD series (interior walls), 0.068 inches for VertiTrack VTX series (exterior wall).
    d. Clips shall be designed for positive attachment to structure and stud web when using step bushing technology to provide frictionless vertical movement
    e. Provide clips with attached bushings and screws of the series, size, and configuration as recommended by the manufacturer.

9. Channel Bridging or Bracing: U-Channel Assembly; Base metal thickness of .0538 inch and minimum ½ inch wide flanges.

    a. Subject to compliance with requirements, provide one of the following or approved equal:
        1) Dietrich Metal Framing: Spazzer 5400 Bridging and Bracing Bar (SPZS), Spazzer Bar Guard (SPBG)
        2) U-Channel Assembly: ¾ inches, 1-1/2 inches, 2 inches - Dietrich Metal Framing; EasyClip, U-Series Clip Angle or equivalent.

10. Welding and Related Supplies: Provide all welding supplies and accessories, all anchors and fastening devices, and all other items required for complete installation. Comply with AWS Code.

11. Finishes: All parts of framing system including, but not limited to studs, bracing and bridging, sill and head channels shall be hot dipped galvanized in accordance with ASTM A653, G90 Coating Designation.

12. Galvanizing Repair: When galvanized surfaces are damaged, prepare and repair surfaces in accordance with procedures specified in Section 05 50 00 and as specified in ASTM A780.

B. Hot-rolled steel angles shall conform to ASTM A36, of sizes indicated on plans. All steel angles provided under this Section, except clip angles attached to rear flange of studs, shall be hot-dip galvanized in accordance with same requirements as specified under Section 05 50 00 - Metal Fabrications.

PART 3 - EXECUTION

3.1 GENERAL

A. Fabricate and install light gauge steel framing in conformance with approved shop drawings, and structural computations, the printed materials and workmanship standards of the manufacturer of the light gauge steel framing materials, and applicable ASTM, AISC and AWS printed standards. Tolerances shall conform to AISC tolerance standards for steel work except as otherwise shown on the approved shop drawings.

3.2 GENERAL INSTALLATION

A. Prefabricated wall panels shall be square, with components attached in a manner that will prevent racking and to minimize distortion while lifting.

B. Cutting of steel framing shall be by saw, shear or plasma cutting equipment. Conventional oxyacetylene torch cutting is not permitted.

C. Sheathing boards shall be installed in accordance with the most stringent requirement of the written specifications of the sheathing manufacturer or the current ASTM Specification addressing the same.

D. Temporary bracing shall be provided and remain in place until the work is completely stabilized.

E. All framing components shall be plumbed, aligned and leveled.

F. Back blocking for wall mounted fixtures shall be designed and anchored to resist the applied loads.

G. Insulation equal to that specified elsewhere within the wall system shall be furnished at multiple boxed members inaccessible to the insulation contractor.

3.3 WALL INSTALLATION

A. Provisions for Primary Frame Deflectors: The construction of the exterior wall assembly shall accommodate anticipated primary frame deflections.

1. Bypass Walls: Wall which bypass the primary frame shall be connected with accessories which accommodate the anticipated primary frame movements and provides for horizontal

adjustments to assure a plumb and aligned installation of the stud. Furnish deflection clips and deflection track by The Steel Network, Inc. Raleigh, NC (phone 888-474-4876), Dietrich Metal Framing; Pittsburgh, PA (phone 412-281-2805) or approved equal for connections to concrete slabs and deflection studs where attachment to structural steel members is required or as required by the steel stud manufacturer.

2. Infill Walls: Walls constructed between the primary frame shall be constructed using a deflection clips and deflection track as specified above. The studs shall be cut to a length equaling the wall height less the anticipated deflection allowance, with a cutting tolerance of +0, 1/8" maximum. A minimum 1-1/2" bearing width shall be provided at the end of the stud.

    a. The deflection clips shall be of gauge and steel grade as dictated by structural analysis. Continuous bridging shall be required by structural design calculations.

B. Mechanical bridging shall be installed prior to the attachment of sheathing materials. Bridging rows shall be spaced in accordance with manufacturer's recommendations or as dictated by structural analysis.

C. Stud ends must be square cut and installed seated in the top and bottom tracks. An exception is made where the stud end terminates at a deflection track.

D. Uniform and level bearing support shall be provided for track members.

E. Splicing of framing, other than the continuous track at top and bottom of the wall is not permitted.

F. Multiple framing components required at posts and jambs, sills and head conditions of framed openings, shall assemble with intermediate connections between the members.

3.4 CONNECTIONS

A. Fasteners Types: Fasteners shall be designed and installed in accordance with the manufacturer's written instructions or industry accepted standards. Concrete fasteners shall be installed after the design compressive strength of the Concrete has been obtained.

1. Framing Screws: Screw penetrations through joined materials shall not be less than three exposed threads. When screw attachments are made to framing components of different thicknesses, attachment shall be made through the thinner component into the heavier component. Screws shall provide adequate cutting to accommodate the thickness to be drilled. Drilling must be completed before the threads engage the material.

2. Welds: Welded connections shall be performed in accordance with the current edition of the AWS D1.3 Specification for Welding Sheet Steel in Structures. The minimum weld throat thickness must match or exceed the base metal thickness of the thinnest connected part unless noted otherwise. Welds shall be cleaned and painted with galvanizing repair paint.

    a. Welding details shall be designated by the Professional Engineer specified hereinbefore, who shall be familiar with welding practice. In general, the standards in the AISC, "Manual of Steel Construction" (latest addition) and the AWS standards specified herein above, will be acceptable

3. Power Actuated Fasteners (PAF):

   a. To Steel: PAF's used for the attachment of the framing system to hot rolled steel components shall possess knurled shanks. Full tip-penetration through the steel component is required. A 3/4 inch minimum edge distance shall be maintained.

   b. To Concrete: PAF's used for the attachment of framing to concrete shall be of adequate length to ensure minimum embedment requirements. Unless noted otherwise, a 3 inch minimum edge distance shall be maintained. Multiple fasteners shall not spaced more than 4 inches apart.

4. Expansion Bolts or Adhesive Anchors to Concrete: Anchors shall be installed in accordance with manufacturer's current printed instructions.

3.5 REPAIR, PROTECTION AND CLEANING

A. Damage done to concrete decks and/or slabs, by spalling or other means, shall be repaired and made good to satisfaction of Designer as work of this Section.

B. All shop and field welds, including those to structural steel members, shall be thoroughly cleaned of all flux and residue and given one touch-up coat of primer equivalent to shop coat applied to the structural steel. All galvanized steel-to-galvanized steel welds only, use zinc rich primer equivalent to that specified under Section 05 50 00.

C. During the erection of the light gauge steel framing work, protect the work of other trades against damage and soiling by the exercise of reasonable care and precautions. Repair or replace to the satisfaction of Designer any work so damaged or soiled.

D. Upon completion of this work, remove all rubbish, debris and tools from the work and leave the premises broom clean.

END OF SECTION 05 40 00

SECTION 05 50 00 - METAL FABRICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 General Requirements, apply to this Section.

1.2 SUMMARY

A. Section Includes but is not limited to:

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. Miscellaneous steel trims

4. Loose bearing and leveling plates for applications where they are not specified in other Sections.

5. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

6. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

7. Shelf Angles

B. Products furnished, but not installed, under this Section:

1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

1.3 RELATED SECTIONS

A. Section 03 30 00 - Cast-in-Place Concrete

B. Section 05 12 00 - Structural Steel Framing

C. Section 05 52 00 - Metal Handrail and Guardrail Systems

D. Section 10 14 00 - Signage

1.4 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.

B. Reference Standards:

1. American Institute of Steel Construction (AISC):

a. Specifications for the Design of Cold-Formed Steel Structural Members.

2. American Welding Society (AWS):

a. ANSI/AWS D1.1-Structural Welding Code.

3. American Society for Testing and Materials (ASTM):

a. A36/A36M, Specification for Carbon Structural Steel b.
A47, Specification for Ferritic Malleable Iron Castings c.
A48, Specification for Gray Iron Castings
d. A53, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
e. A123, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
f. A153, Specification for Zinc Coating (Hot-Dip) on Iron and Steel hardware
g. A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
h. A320/A320M, Specification for Alloy Steel Bolting Materials for Low-Temperature Service
i. A325, Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi minimum Tensile Strength
j. A336/A336M, Specification for Steel Forgings, Alloy, for Pressure and High-Temperature Parts
k. A489, Specification for Carbon Steel Lifting Eyes
l. A500, Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
m. A563, Specification for Carbon and Alloy Steel Nuts
n. A570/A570M, Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
o. A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
p. A786/A786M, Specification for Rolled Steel Floor Plates
q. F436, Specification for Hardened Steel Washers

4. Federal Specifications (FS)

a. FF-B-561, Bolts, (Screw), Lag
b. FF-B-588D, Bolt, Toggle: And Expansion Sleeve, Screw
c. FF-S-92B(1), Screw, Machine, Slotted, Cross Recessed or Hexagon Head.
d. FF-S-111D, Screw, Wood

e. FF-S-325, Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)
f. FF-T-276B, Thimbles, Rope
g. FF-T-791B, Turnbuckle
h. FF-W-84A, Washers, Lock (Spring)
i. FF-W-92B, Washer, Flat (Plain)
j. TT-P-641G, Primer Coating; Zinc Dust-Zinc Oxide (For Galvanized Surfaces)

5. American National Standards Institute (ANSI):

a. ANSI B.18.22.1, Plain Washers.
b. ANSI/ASME B.18.5, Round Head Bolts (Inch Series).
c. ANSI/ASME B.18.5.2.2M, Bolts, Metric Round Head Square Neck.

6. National Association of Architectural Metal Manufacturers (NAAMM)

C. Qualifications for Welding Work: Welds shall be made only by welders, tackers and welding operators who have been previously qualified by tests as prescribed in the Structural Welding Code, ANSI/AWS D1.1 of the American Welding Society to perform the type of work required.

1.5 SUBMITTALS

A. Shop Drawings: Show fabrication and installation details for metal fabrications.

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

B. Copies of manufacturer's catalog cuts, specifications, load tables, dimension diagrams, anchor details, setting diagrams and templates, and manufacturer's printed installation instructions, including paint products.

C. Certificates of welders' qualifications showing date of qualification, qualification grade and rating, and notarized signature of inspector.

D. Samples of materials and finishes of products as specified and if requested by the Engineer.

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.

F. Qualification Data: For qualified professional engineer.

G. Mill Certificates: Signed by manufacturers of stainless-steel certifying that products furnished comply with requirements.

H. Welding certificates.

I. 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: Installer of metal fabrication is a certified installer with at least a five (5) successfully completed projects of similar size and scope installing manufacturer's products according to manufacturer's specifications.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

3. AWS D1.6, "Structural Welding Code - Stainless Steel."

D. Verify dimensions at worksite before preparation of shop drawings and before product fabrication begins. Surfaces to receive metal fabrication shall be sound, square, and true; examine surfaces for defects that would impair installation of metal fabrications before metal fabrications are installed.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications 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 and steel weld plates and angles. 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.

1.9 DELIVERY, STORAGE AND

HANDLING A. DELIVERY:

1. Schedule delivery of materials at the site at such time as required for proper coordination of the work. Receive materials in manufacture's unopened packages and bearing manufacturer's label

B. STORAGE AND HANDLING:

1. Store materials in a dry and well ventilated place, adequately protected from damage and exposure to the elements.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

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.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.

C. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304

D. Steel Tubing: ASTM A 500, cold-formed steel tubing.

E. Steel Pipe: ASTM A 53/A 53M, standard weight unless otherwise indicated.

2.3 NONFERROUS METALS

A. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.

B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.

C. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.

D. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

E. Bronze Plate, Sheet, Strip, and Bars: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal, 60 percent copper).

F. Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (extruded architectural bronze).

G. Bronze Castings: ASTM B 584, Alloy UNS No. C83600 (leaded red brass) or No. C84400 (leaded semi-red brass).

H. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500.

I. Nickel Silver Castings: ASTM B 584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

2.4 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 aluminum.

2. Provide stainless-steel fasteners for fastening stainless steel.

3. Provide stainless-steel fasteners for fastening nickel silver.

4. Provide bronze fasteners for fastening bronze.

B. 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.

C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

D. Eyebolts: ASTM A 489.

E. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).

F. Lag Screws: ASME B18.2.1 (ASME B18.2.3.8M).

G. Wood Screws: Flat head, ASME B18.6.1.

H. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).

I. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).

J. 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.

K. 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.

L. 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.

2.5 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 Division 09 Section 09 91 00 Painting.

C. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

F. 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.

G. Concrete: Comply with requirements in Division 03 Section 03 30 00 Cast-in-Place Concrete for normal-weight, air-entrained, concrete.

2.6 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 will be 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.

1. 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.

2.7 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. Fabricate supports for operable partitions from continuous steel beams of sizes indicated with attached bearing plates, anchors, and braces as indicated. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

D. Galvanize miscellaneous framing and supports where indicated.

E. Prime miscellaneous framing and supports with primer specified in Division 09 Section 09 91 00 Painting where indicated.

2.8 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 miscellaneous steel trim.

D. Prime miscellaneous steel trim with primer specified in Division 09 Section 09 91 00 Painting.

2.9 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.

1. Provide mitered and welded units at corners.

2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches (50 mm) larger than expansion or control joint.

2.10 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.

C. Prime plates with zinc-rich primer.

2.11 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.

2.12 CAST IRON LEADERS

A. Provide round leaders made from cast iron in heights and diameter as noted on drawings.

B. Prime cast iron leaders with zinc-rich primer.

2.13 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.14 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.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with primers specified in Division 09 Section 09 91 00 Painting unless otherwise 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 Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

3. Items Indicated to Receive Primers Specified in Division 09 Section "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

4. 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.

2.15 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. As-Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).

C. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the areas and conditions under which miscellaneous metal items are to be installed. Surfaces that are to receive metal fabrications shall be free from defects. Embedded products shall have been installed where indicated.

B. Furnish setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

3.2 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.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

1. Cast Aluminum: Heavy coat of bituminous paint.

2. Extruded Aluminum: Two coats of clear lacquer.

3.3 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.

B. Anchor supports for operable partitions securely to and rigidly brace from building structure.

C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.

1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.4 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 grout.

1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations unless otherwise indicated.

2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.5 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded 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 Division 09 Section 09 91 00 Painting.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 50 00

SECTION 05 52 00 - METAL HANDRAIL AND GUARDRAIL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 General Requirements, apply to this Section.

1.2 SUMMARY

A. The work specified in this Section consists of furnishing and installing metal handrails, guardrails and railings to match existing as shown and as indicated on the Contract Drawings, including, but not limited to:

1. Painted Steel Guardrails

2. Stainless Steel Handrails

1.3 RELATED SECTIONS

A. Section 05 50 00 – Metal Fabrication

B. Section 09 91 00 - Painting

1.4 PERFORMANCE REQUIREMENTS

A. American Society for Testing and Materials (ASTM):

1. A36, Specification for Carbon Structural Steel.

2. A53, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

3. A153, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

4. A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

5. A312/312M - Seamless and Welded Austenitic Stainless Steel Pipes

6. A320, Specification for Alloy Steel Bolting Materials for Low-Temperature Service.

7. A449, Specification for Quenched and Tempered Steel Bolts and Studs.

8. A480/480M - General Requirements for Flat-Rolled Stainless and Heat Resisting Steel Plate, Sheet, and Strip

9. A484/484M - General Requirements of Stainless Steel Bars

10. A555/555M - General Requirements for Stainless Steel and Heat Resistant Steel Wire and Wire Rods

11. A563, Specification for Carbon and Alloy Steel Nuts.

12. A666 - Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar for Structural and Architectural Applications

13. E935, Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.

14. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs

B. American Welding Society (AWS):

1. ANSI/AWS D1.1 - Structural Welding Code.

2. AWS D1.6 Structural Welding code – Stainless Steel

C. NAAMM – National Association of Architectural Metal Manufacturers

1. Metal Finishes Manual; Code of Standard Practice for the Architectural Metal Industry

D. Steel Structures Painting Council (SSPC):

1. Steel Structures Painting Manual, Volume 2, "Systems and Specifications".

1.5 SUBMITTALS

A. In accordance with Chapter 14, Article 1, of the Contract Terms and Conditions, submit the following:

1. Shop Drawings: Show plans and sections; materials of construction; finishes; methods of fastening; locations of cuts, copes, connections, holes, and threaded fasteners; methods of joining components; type, size, and spacing of welds; and proposed marking of fabrications which will require field assembly.

2. Copies of manufacturer's catalog cuts and specifications.

3. Certificates of welders' qualifications showing date of qualification, qualification grade and rating, and notarized signature of inspector.

4. The Contractor shall provide one (1) each of the following for each fabrication shown: 12” square and / or lineal sample which will show adequately the quality of fabrication, welding and finish. These can also represent the required finish samples as noted elsewhere in the specification.

5. Provide certification by the passivator stating that the fabrication was passivated after the stainless steel was bent, cut and/or welded.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Installer of metal handrail and guardrail systems is a certified installer with at least a five (5) successfully completed projects of similar size and scope installing manufacturer's products according to manufacturer's specifications.

B. Stainless steel fabrications shall be from a manufacturer who has a dedicated facility for the assembly, welding, and polishing of stainless steel. The manufacturer should have dedicated tooling, fixtures, and machine tools, for the manufacturer of stainless steel products. Dedicated is defined as exclusively used for the use on stainless steel materials. This is to avoid contamination with other metals, especially carbon steel.

C. General: In engineering handrails and railings to withstand structural loads indicated, determine allowable design working stresses of handrail and railing materials based on the following:

1. Stainless Steel: ASCE 8, "Specification for the Design of Cold-Formed Stainless Steel Structural Members."

2. Structural Steel: AISC S335, "Specification for Structural Steel Buildings Allowable Stress Design and Plastic Design with Commentary."

D. Structural Performance of Handrails and Railings: Provide handrails and railings complying with requirements of ASTM E 985 for structural performance, based on testing performed according to ASTM E 894 and ASTM E 935.

E. Structural Performance of Handrails and Railings: Provide handrails and railings capable of withstanding structural loads required by ASCE 7 without exceeding allowable design working stresses of materials for handrails, railings, anchors, and connections.

F. Structural Performance of Handrails and Railings: Provide handrails and railings capable of withstanding the following structural loads without exceeding allowable design working stresses of materials for handrails, railings, anchors, and connections:

1. Top Rail of Guards: Capable of withstanding the following loads applied as indicated:

   a. Concentrated load of 200 lbf (890 N) applied at any point and in any direction.
   b. Uniform load of 50 lbf/ft. (730 N/m) applied horizontally and concurrently with uniform load of 100 lbf/ft. (1460 N/m) applied vertically downward.
   c. Concentrated and uniform loads above need not be assumed to act concurrently.

2. Handrails Not Serving As Top Rails: Capable of withstanding the following loads applied as indicated:

   a. Concentrated load of 200 lbf (890 N) applied at any point and in any direction.
   b. Uniform load of 50 lbf/ft. (730 N/m) applied in any direction.
   c. Concentrated and uniform loads above need not be assumed to act concurrently.

3. Infill Area of Guards: Capable of withstanding a horizontal concentrated load of 200 lbf (890 N) applied to 1 sq. ft. (0.09 sq. m) at any point in system, including panels, intermediate rails, balusters, or other elements composing infill area.

   a. Load above need not be assumed to act concurrently with loads on top rails in determining stress on guard.

G. Thermal Movements: Provide handrails and railings 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 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 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

H. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.7 DELIVERY, STORAGE AND HANDLING

A. Field Measurements: Where handrails and railings are indicated to fit to other construction, check actual dimensions of other construction by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabricating handrails and railing systems without field measurements. Coordinate other construction to ensure that actual dimensions correspond to guaranteed dimensions.

B. Deliver units and other components so they will not be subject to damage or deformation. Deliver panel units in crates designated for specific locations on the building as coordinated between GC and installer. Crates shall be able to withstand hoisting loads relevant to the project.

C. Storage: Stack components off the ground/floor on suitable skids in fully enclosed space. Protect against warpage, scratches, damage from moisture, exposure to direct sunlight and other surface contamination.

D. Handling: Exercise care in loading, unloading, storing, and installing units so as to preclude bending, warping, twisting, and surface damage.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Galvanized Steel square Tube for Guardrails and Supports: Seamless steel tube, conforming to ASTM A53, Type S, Grade A; dimensions as indicated on drawings; standard weight.

B. Stainless Steel shall be Austenitic Grade type 316/316L

C. Plate: Steel plate for anchor plates shall be standard steel plate, conforming to ASTM A36, weldable quality.

D. Welding Electrodes and Filler Metal: The Contractor shall use the type and alloy of filler metal and electrodes recommended by the producer of the metal to be welded, and as required to match colors, and strength and for compatibility with the individual components of fabricated items.

E. Anchors, Fasteners, and Accessories: Provide all required anchors, fasteners, miscellaneous components, and accessories as required for complete and finished railing installations. Bolts and studs, nuts, and washers shall conform to ASTM A307, A449, and A563.

1. Expansion Bolts: Where anchors are not included in the concrete construction, provide galvanized expansion type anchors with matching galvanized steel bolts or studs with nuts, of sizes as indicated or required. Provide washers under all bolt heads and nuts.

2. Miscellaneous fasteners: Refer to Section 05 50 00 "Metal Fabrication".

F. Paint: Corrosion-inhibitive protective metal primer as herein specified in Sections 09 99 00

G. Molded Pads: Molded pads shall be manufactured from new unvulcanized elastomer and unused synthetic fibers, with a weight proportion of fiber content equal to approximately one-half of the total weight of the pad. The pads shall be formed into single sheets of 1/8 inch minimum thickness, with a tolerance of plus or minus 10 percent. Pads shall have a Shore 'A' Durometer hardness within the range of 70 to 90, and shall have a minimum compressive breakdown of 7,000 psi

H. Fasteners for Anchoring Railings to Other Construction: Select fasteners of the type, grade, and class required to produce connections that are suitable for anchoring railing to other types of construction indicated and capable of withstanding design loadings.

1. Provide fasteners fabricated from type 304

I. Fasteners for Interconnecting Railing Components: Use fasteners of same basic metal as the fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.

1. Provide concealed fasteners for interconnecting handrail and railing components and for attaching them to other work, except where otherwise indicated.

2. Provide concealed fasteners for interconnecting handrail and railing components and for attaching them to other work, except where exposed fasteners are unavoidable or are the standard fastening method for handrail and railing system indicated. Provide Phillips flathead machine screws for exposed fasteners, unless otherwise indicated.

3. Provide non-metallic isolators between aluminum and all ferrous metals.

2.2 FABRICATION

A. Fabricate pipe railings to dimensions and details indicated with smooth bends and to other requirements specified herein. Form fabrications from material of size, thickness and shapes indicated, but not less than that needed to comply with the performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of material indicated or specified for various components of each metal fabrication.

B. Shear, punch, and laser cut metals cleanly and accurately. Remove burrs, sharp and rough areas on exposed surfaces.

C. Welded Connections: Fully weld connections, heat and bend bends without distorting metal. Cope intersections of rails and posts, weld joints and grind smooth. Butt-weld end-to-end joints of railings. In all cases, fabricate top rail continuous over posts, and posts continuous from base to top rail. Welding procedures and welding operations shall conform to, and welders and tackers shall be qualified, in accordance with ANSI/AWS D1.1.

D. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and resist corrosion of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

E. Form exposed work to line and level with angles and surface and with straight sharp edges. Ease exposed edges to radius of approximately 1/32 inch unless otherwise shown. Form bent-metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

F. Form exposed connections with hairline joints to exclude water and which are flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of the type shown, or if not shown, Phillips flathead (countersunk) screws or bolts.

G. Assemble railing systems in shop to the 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.

H. Form changes in direction of railing members as follows:

1. By radius bends of radius indicated.

2. By flush radius bends.

3. By bending.

4. By mitering at elbow bends.

5. By insertion of prefabricated flush elbow fittings.

6. By any method indicated above, applicable to change of direction involved.

I. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain profile of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.

J. Fabricator shall take all preventative measures to eliminate cross-contamination of stainless steel with ferrous metals during fabrication, machining, storage and delivery. All grinding, polishing, and buffing shall be performed so that no contamination occurs to affect the material's corrosion resistance or finish. Particular care shall be exercised to protect the material from coming in

contact with iron particles. All tools used in the fabrication and finishing process shall be tools dedicated only to use on those materials.

K. Hermetically seal all joints so as to exclude water, or provide weep holes where water may accumulate.

L. All stainless steel shall be passivated prior to packaging and shipping. Any area that has been cut, welded or bent shall be passivated to assure that the area does not show signs of rust discoloration created by the fabrication processes.

M. Finish:

1. Stainless Steel grain shall run in same direction for each fabrication.

2. Finish - Shall match existing brushed handrail finish for all components unless otherwise specified on the drawings.

3. When polishing is completed, passivate and rinse surfaces. Remove any embedded foreign matter and leave surfaces chemically clean.

N. When polishing is completed, passivate and rinse surfaces. Remove any embedded foreign matter and leave surfaces chemically clean

2.3 CLEANING AND

PAINTING A. General:

1. Exterior steel guardrails, where indicated to be painted on the drawings, non-galvanized and galvanized, shall be painted in accordance with Division 09 Section 09 91 00 Painting

B. Corrosion Control: Apply corrosion inhibitor to railing surface that will abut surfaces constituted of material other than that of the fabricated metal product.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Install metal handrails and guardrails in accordance with the Contract Drawings and the approved shop drawings.

B. Install metal handrails and guardrails with accessories furnished by the railing fabricator as required for complete and finished railing installations.

C. Install handrails and guardrails in accordance with approved shop drawings, true and horizontal, perpendicular, or at the required angle, as the case may be, level and square, with angles and edges parallel with related lines of the building or structure.

D. Adjust railing prior to securing in place to ensure proper matching of butting joints and correct alignment throughout their length. Secure posts not more than 8 feet on center, unless otherwise indicated. Plumb posts in each direction.

E. Secure posts and rail ends as follows:

1. Anchor rail ends into concrete and masonry with steel round flanges welded to rail ends and anchored into the wall construction with expansion bolts.

2. Anchor rail ends to steel with steel oval or round flanges welded to rail ends and bolted to the structural steel members, unless otherwise indicated.

3. Provide removable railing sections as indicated. Furnish slip-fit metal socket or sleeve for casting into concrete. Accurately locate sleeve to match post spacing.

4. Secure guardrail base plates to platform with through bolted connections including but not limited to leveling plates, and backing plates.

F. Other than field welded connections:

1. Assemble connections end-to-end and splice joints with internal sleeves.

2. Fitting assembly:

a. Assemble pipe at joints and drive together within 0.02 inch.
b. Assemble fittings into posts before pressing rails into fittings.

3.2 PREPARATION

A. Comply with AWS code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.

B. All welds shall be subjected to a visual inspection by an independent inspection agency, provided by and paid by the Contractor, for conformance with ANSI/AWS D1.1.

C. Field Measurements: Where handrails and railings are indicated to fit to other construction, check actual dimensions of other construction by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

D. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabricating handrails and railing systems without field measurements. Coordinate other construction to ensure that actual dimensions correspond to guaranteed dimensions

3.3 INSTALLATION, GENERAL

A. After installation, exposed painted surfaces, field welds, and other abraded or damaged primed surfaces shall be prepared as required and touched up with an additional coat of the same primers for ferrous and galvanized surfaces as previously specified for shop painting.

B. Lightly sand and feather out such damaged surfaces so that paint touch-up becomes invisible. Spray-paint all touch-up work.

C. Finish field painting as specified in Division 09 Section 09 91 00 Painting.

D. Clean after installation exposed pre-finished and plated items and items fabricated from stainless steel, as recommended by the metal manufacture and protect from damage until completion of the project.

END OF SECTION 05 52 00

SECTION 05 55 13 – METAL STAIR TREADS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 General Requirements, apply to this Section.

1.2 SUMMARY

A. This section includes the following:

1. Furnish all labor, materials, tools and equipment, and perform all operations related to abrasive stair treads, set in locations as indicated on the Contract Drawings and herein specified. Work includes:

a. Furnish and install abrasive cast aluminum treads

B. Related Sections:

1. Section 03 30 00 Cast in Place Concrete

2. Section 05 50 00 Metal Fabrication

1.3 SUBMITTALS

A. Submit six (6) sets of shop drawings showing plan and installation details including fastening for review.

B. Submit manufacturer's specifications, product data, and installation instructions for review.

C. Warranty Certificate.

1.4 WARRANTY

A. Manufacturer's standard warranty: Products will be free of manufacturing and material defects. Any defective product will be replaced or repaired free of any charge. Claim have to be brought to manufacturer's attention, in writing, within *One Year* following the date of Final Acceptance.

PART 2 - PRODUCTS

1.1 MANUFACTURERS

A. List of recommended manufactures:

1. Safe-T-Metal Company, Inc., Aluminum, Style B4

2. Wooster Products Inc., ALUMOGRIT; Type 101

3. Westfield Sheet Metal Works, Inc

4. American Safety Tread Co, Inc., ALUMACAST

5. American Abrasive Metals Company; Style A.

6. Or Engineer's Approved Equal

1.2 MATERIALS

A. Provide Cast Aluminum abrasive stair treads and landings, 3/8" thick for all stairs:

1. Abrasive shall be #20 virgin grain Aluminum Oxide (AL2O3) abrasive, integrally cast into the walking surface to a minimum depth of 1/32 inch (0.79 mm).

2. Safety nosing up to 6" deep with cross-hatched surface being installed into wet concrete shall have a feature strip along the back edge.

3. Concealed type anchors shall be slotted rivet type, integrally cast into the body of the nosing a minimum of 3/8". (Not mushroom type.)

4. Cast metals used shall conform to the following specification:

5. Abrasive Cast Aluminum:

6. No. 43 prime and secondary ingot; low copper content; corrosion resistant.

7. Any holes or countersinks shall be machine-made; cored holes or countersinks are not acceptable. Screw heads shall not protrude above tread surface.

8. Cross hatching and fluting shall be 1/16 inch (1.59 mm) deep minimum and shall be clean and well defined; treads and nosing's shall be manufactured, packed and shipped so as to arrive at the jobsite in good condition.

PART 3 - EXECUTION

1.1 PREPARATION

A. Transmit Submittals required by this Section

B. Furnish products as indicated

C. Ensure substrates are in suitable condition to receive work.

1.2 INSTALLATION

A. Treads shall be installed in accordance with the manufacturer's instructions.

B. At the completion of the work, all damaged, improperly installed and marred work shall be replaced or repaired to the satisfaction of the Engineer.

C. Nosings shall terminate not more than 3" from ends of steps for poured concrete stairs; for steel stairs, nosings shall be full length of steps less 1/8" (3.05 mm) clearance.

D. NOTE: Safety nosing's going into new poured concrete or cement fill shall be installed before "Initial Set" of the concrete or cement occurs.

END OF SECTION 05 55 13

SECTION 07 14 16 - COLD FLUID-APPLIED WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. The following specification outlines the requirements for a cold fluid-applied reinforced polyurethane waterproofing membrane coating and all other ancillary waterproofing work including, but not limited to, installation of drains, pipe flashings, penetration flashings, sealants and metal work. The work of this Section shall include, but not be limited to, the following:

1. Adhered cold fluid-applied reinforced polyurethane waterproofing system including, membrane, penetration flashings, base flashings, and expansion joints.

2. Substrate preparation, cleaning, leveling and patching

3. Temporary waterproofing and priming

4. Waterproofing membrane installation

5. Flashing installation

6. Protective surfacing

1.2 RELATED WORK SPECIFIED ELSEWHERE

A Carefully examine all of the Contract Documents for requirements which affect the work of this section.

B. Other specifications sections which directly relate to the work of this section include, but are not limited to, the following:

1. Section 03 30 00 - Cast-In-Place Concrete.

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM) C 836 Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane.

B. National Roofing Contractors Association (NRCA) Roofing and Waterproofing Manual.

C. ACI-308 - Recommended Practice for Curing Concrete

D. ASTM - D638 - Test Methods for Tensile Properties of Plastics

E. ASTM - D4258 - Standard Practice for Surface Cleaning Concrete for Coatings

F. ASTM - D4259 - Standard Practice for Abrading Concrete

G. ASTM - D4541 - Method for Pull-Off Strength of Coatings using Portable Adhesion Tester

H. ASTM - E96(A) - Test Methods of Moisture Transmission of Material

I. ASTM E-108, ANSI/UL 790 for fire resistance.

J. International Concrete Repair Institute Guideline 03732 Concrete Surface Preparation

K. Steel Structures Painting Council (SSPC)

1.4 SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS.

B. Membrane System Product Data: Provide current standard printed product literature indicating characteristics of membrane materials, flashing materials, components, and accessories product specification and installation.

C. Product Samples: Submit product samples of membrane and flashing materials showing color, texture, thickness and surfacing representative of the proposed system for review and approval by the Designer.

D. Submit sample copies of both the Manufacturer and Applicator warranties for the periods stipulated. Each specimen must be a preprinted representative sample of the issuing company's standard warranty for the system specified.

E. Submit copies of current Material Safety Data Sheets (MSDS) for all components of the work.

F. Membrane Shop Drawings: Submit shop drawings of cold fluid-applied reinforced polyurethane showing all a project plan, size, flashing details, and attachment for review and approval by the Designer.

G. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR - POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

2, Source quality-control test reports.

3. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Membrane Manufacturer: Company specializing in manufacturing the products specified in this section with documented experience. Membrane Manufacturer shall submit the following certifications for review:

1. Substrates and conditions are acceptable for purpose of providing specified warranty.

2. Materials supplied shall meet the specified requirements.

B. Applicator: Company specializing in performing the work of this section with (3) years documented experience and approved by system manufacturer for warranted membrane installation. Applicator shall submit the following certification for review:

1. Applicator shall submit documentation from the membrane manufacturer to verify contractor's status as an approved applicator for warranted installations.

C. Evaluate moisture content of substrate materials. Constructor shall determine substrate moisture content throughout the work and record with Daily Inspection Reports or other form of reporting acceptable to the Engineer, and Membrane Manufacturer.

D. Random tests to determine tensile bond strength of membrane to substrate shall be conducted by the Contractor at the job site using an Elcometer Adhesion Tester Model 106 or similar device, or by the performance of a manual pull test. Contractor shall perform tests at the beginning of the Work, and at intervals as required to assure specified adhesion with a minimum of three (3) tests per 5000 square feet. Smaller areas shall receive a minimum of three (3) tests. Test results shall be submitted to the Engineer and the Membrane Manufacturer. Contractor shall immediately notify the Engineer and Membrane Manufacturer in the event bond test results are below specified values.

1. Adequate surface preparation will be indicated by tensile bond strength of membrane to substrate greater than or equal to 220 psi for pedestrian traffic and 300 psi for vehicular (low speed) traffic and water flow/containment.

2. Adequate surface preparation will be indicated by 135℗ peel bond strength of membrane to substrate such that cohesive failure of substrate occurs before adhesive failure of membrane/substrate interface.

3. In the event the bond strengths are lower than the minimum specified, additional substrate preparation is required. Repeat testing to verify suitability of substrate preparation.

E. Monitor quantities of installed materials. Monitor application of resin mixture, reinforcing fleece and flashing. Perform Work in accordance with manufacturer's instructions.

1.6 REGULATORY REQUIREMENTS

A. Conform to applicable building and jurisdictional codes for roofing/waterproofing assembly and fire resistance requirements.

B. Comply with requirements of OSHA, NIOSH or local governing authority for work place safety.

C. Comply with authority or agency "Confined Space Policy" during and throughout all work to be performed.

1.7 PRE-INSTALLATION MEETING

A. Convene a pre-installation meeting at the job site (1) week before starting work of this section. Require attendance of parties directly affecting work of this section, including but not limited to, Designer, Department's Representative, Waterproofing Contractor, and Membrane Manufacturer's Representative. Review waterproofing preparation and installation procedures, coordination and scheduling required with related work.

1.8 FIELD INSPECTION SERVICES

A. Manufacturer's technical representative shall provide the following inspections of the membrane application:

1. Job start inspection at the beginning of each phase of the project, to review special detailing conditions and substrate preparation.

2. Periodic in-progress inspections throughout duration of the project to evaluate membrane and flashing application.

3. Final punch-list inspection at the completion of each phase of the project prior to installation of any surfacing or overburden materials.

4. Warranty inspection to confirm completion of all punch list items, surfacing, and overburden application.

1.9 DELIVERY, STORAGE, AND PROTECTION

A. Refer to Form 816 Article 1.06.03 and Form 816 Article 1.20-1.06.03 for additional information.

B. The Contractor together with the Engineer shall define a storage area for all components. The area shall be cool, dry, out of direct sunlight, and in accordance with manufacturer's recommendations and relevant regulatory agencies. Materials shall not be stored in quantities that will exceed design loads, damage substrate materials, hinder installation or drainage.

C. Store solvent-bearing solutions, resins, additives, inhibitors or adhesives in accordance with the MSDS and/or local fire authority. After partial use of materials replace lids promptly and tightly to prevent contamination.

D. Roll goods shall be stored horizontally on platforms sufficiently elevated to prevent contact with water and other contaminants. DO NOT use rolls that are wet, dirty or have damaged ends.

E. Roofing/waterproofing materials must be kept dry at all times. If stored outside, raise materials above ground or roof level on pallets and cover with a tarpaulin or other waterproof material. Plastic wrapping installed at the factory should **not** be used as outside storage covers.

F. Follow manufacturer's directions for protection of materials prior to and during installation. Do not use materials that have been damaged to the point that they will not perform as specified. Fleece reinforcing materials must be clean, dry and free of all contaminants.

G. Copies of all current MSDS for all components shall be kept on site. Provide any and all crew members with appropriate safety data information and training as it relates to the specific chemical compound he or she may be expected to deal with. Each crew member shall be fully aware of first-aid measures to be undertaken in case of incidents. Comply with requirements of OSHA, NIOSH or local governing authority for work place safety.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Do not apply waterproofing membrane during or with the threat of inclement weather.

B. Application of cold fluid-applied reinforced polyurethane waterproofing membrane may proceed while air temperature is between 40°F (5°C) and 85°F (30°C) providing the substrate is a minimum of 5°F above the dew point.

C. When ambient temperatures are at or expected to fall below 50°F (10°C), or reach 85°F (30°C) or higher, follow Membrane System Manufacturer's recommendations for weather related additives and application procedures.

D. Ensure that substrate materials are dry and free of contaminants. DO NOT commence with the application unless substrate conditions are suitable. Contractor shall demonstrate that substrate conditions are suitable for the application of the materials.

E. Odor control and elimination measures are not typically necessary, but where required by the Department or designated Representative, Contractor shall implement odor control and elimination measures prior to and during the application of the waterproofing materials. Control/elimination measures shall be field tested at off-hours and typically consists of one (1) or a multiple of the following measures:

1. Sealing of air intakes with activated carbon filters. Install filters in accordance with requirements and recommendations of the filter manufacturer. Seal filters at joints and against building exterior walls to prevent leakage of unfiltered air where required due to size of intake opening. Provide track system to secure filters.

2. Erection and use of moveable enclosure(s) sized to accommodate work area(s) and stationary enclosure for resin mixing station. Enclosure shall be field constructed or pre-manufactured of fire retardant materials in compliance with local code requirements in accordance with requirements of the Engineer. Equipment enclosure(s) with mechanical air intake/exhaust openings and Odor Control Air Cleaners, as required to clean enclosed air volume and to prevent odor migration outside the enclosure. Exhaust opening shall be sealed with activated carbon filter.

3. Placement of odor elimination stations inside and outside of the enclosure(s) as required by field condition, in coordination with the Engineer.

4. Protection of Contractor personnel and occupants of the structure and surrounding buildings as necessary to comply with requirements of OSHA, NIOSH and/or governing local authority.

F. When disposing of all refuse or unused materials, observe all EPA, OSHA or local disposal requirements.

1.11 COORDINATION & PROTECTION

A. Coordinate the work with the installation of associated metal flashings, accessories, appurtenances, etc. as the work of this section proceeds.

B. Building components shall be protected adequately (with tarp or other suitable material) from soil, stains, or spills at all hoisting points and areas of application. Contractor shall be responsible for preventing damage from any operation under its Contract. Any such damage shall be repaired at Contractor's expense to Engineer's satisfaction or be restored to original condition.

C. Provide barricades, retaining ropes, safety elements (active/passive) and any appropriate signage required by OSHA, NIOSH, and NSC and/or the Engineer.

D. Protect finished roofing/waterproofing membrane from damage by other trades. Do not allow waste products containing petroleum, grease, acid, solvents, vegetable or mineral oil, animal oil, animal fat, etc. or direct steam venting to come into direct contact with the membrane.

1.12 WARRANTY

A. Refer to Form 816 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

B. Manufacturer's Standard Warranty: Provide Twenty (20) year manufacturer's standard warranty under provisions of this section. This warranty provides for cost of labor and materials for loss of watertightness, limited to amounts necessary to effect repairs necessitated by either defective material or defects in related installation workmanship, with total expenditure limited to the original cost to the Department of waterproofing materials.

PART 2 - PRODUCTS

2.1 GENERAL

A. The products herein specified are totally pre-engineered products of the listed manufacturer and establish criteria for the approval of alternate products. Products must be part of a pre-engineered system, equivalent in function, quality, composition and method of application to be considered for approval as an "Approved Equal". Equal materials must meet or exceed the physical performance characteristics of the specified materials.

2.2 MANUFACTURERS - MEMBRANE

A. Membrane: Two-component, odorless, cold, fluid-applied reinforced polyurethane waterproofing membrane with a 360 degree needle punched non-woven 165 polyester reinforcing fleece, for a finished dry film membrane thickness of .070 inch nominal per ply. Provide products manufactured and supplied by Kemper System, Inc or approved equal meeting or exceeding the following:

1. Kemper System’s 2K-PUR resin for use in an adhered waterproofing system.

B. Physical Properties:

Property	**Typical Value**	**Test Method**
Color	Gray-Green	-
Physical state	Cures to solid	-
Nominal thickness (165 fleece)	70 mils	-
Tensile strength @ break	120 lb/in	ASTM D-751
Elongation	50%	ASTM D-751
Tearing strength	5.0 lbs	ASTM D-751
Puncture resistance	140 lbf	FTMS 101-2031
Dimensional stability	0.1%	ASTM D-1204
Water absorption	2.2%	ASTM D-471
Surface hardness	Shore A 85	ASTM D-2240

Water vapor transmission	0.04 perms	ASTM E-96
Usage time*	30 minutes	-
Rainproof after*	6 hours	-
Solid to walk on after*	24 hours	-
Solid to drive on with air rubber tires after*	48 hours	-
Overburden may be applied after	2 days	-
Completely hardened after	3 days	-
Crack spanning	0.08 inch	-
Resistance to temperatures up to (short term)	482°F	-
*all times are approximate and depend upon air flow, humidity and temperature.		

2.3 FLASHINGS

A. Membrane Flashings: A composite of the same resin material as field membrane with 165 fleece reinforcement.

2.4 ACCESSORIES

A. Polyurethane Primer: Two-component, solvent-free, high solids polyurethane resin for use in improving adhesion of membrane to wood, metal and bituminous substrate surfaces. Monitor application rate and adjust depending on substrate absorbency.

B. Epoxy Primer: Two-component, solvent-free epoxy coating for use in improving adhesion of membrane to cementitious/masonry substrate surfaces. Monitor application rate and adjust depending on substrate absorbency.

C. Topcoat Surfacing Aggregate: Silica sand, ceramic-coated quartz, or specialty aggregate shall be washed, kiln-dried, and dust-free with the following size specification:

1. Pedestrian Traffic: 0.0177 - 0.0216 inch

D. Leveling and Patching Aggregate: Silica sand shall be washed, kiln-dried, and dust-free, suitable for troweling or pourable self-leveling, round grain or angular with the following size specification:

1. For voids less than ¼ inch in depth: 0.0177 - 0.0216 inch
2. For voids ¼ inch to 2 inch in depth: 0.0275 - 0.0472 inch

Mixing Proportions shall be a ratio of resin to sand at 1:2 by volume or as approved by membrane manufacturer.

E. Backer Rod: Expanded, closed-cell polyethylene foam designed for use with cold-applied joint sealant.

F. Caulking: Single component, non-sag elastomeric polyurethane sealant, as recommended or supplied by membrane manufacturer for use in making airtight and watertight seals where required.

2.5 SURFACINGS AND COATINGS

A. Aggregate Finish Coating: Single component polyurethane-based resin suitable for use to both bond and seal aggregate. Provide the following or approved equal:

1. Kemper System, Inc.'s Kemcoat Granular. (Deko / Sand / Deko)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.

B. Verify deck/substrate openings, curbs, and protrusions through deck/substrate are in place and solidly set.

3.2 PREPARATION OF SUBSTRATE

A. General: Surfaces to be prepared as a substrate for the new waterproofing system as follows:

1. New concrete shall have cured a minimum of 28 days in accordance with ACI-308, or as approved by Waterproofing Manufacturer's Technical Department.

2. New concrete shall be free of oil, grease, curing compounds, loose particles, moss, algae growth, laitance, friable matter, dirt, bituminous products.

3. New concrete shall be dry with a maximum moisture content of five (5) percent. Determinations of moisture content shall be performed by the Contractor. Contractor shall be responsible to perform periodic evaluations of moisture content during the work. Moisture evaluation results shall be submitted in writing to the Department or designated Representative and Waterproofing manufacturer for acceptance.

4. Where required, concrete shall be abrasively cleaned in accordance with ASTM D4259 to provide a sound substrate free from laitance. Achieve an open concrete surface in accordance with ICRI surface profiles CSP 3-5.

5. The substrate shall be sound and all spalls, voids and blow holes on vertical or horizontal surfaces must be repaired prior to placement of the primer coat. Spalls and other deterioration shall be repaired in accordance with the requirements of the Membrane manufacturer.

B. Finish Leveling, Patching and Crack Preparation:

1. General: EP primer/sand mix is the preferred material for all concrete and masonry substrate finish leveling, crack and wall/deck preparation and patching. EP primer/sand patching mix provides a set time of approximately twelve (12) hours and does not require surface grinding. A primer/sand mix is typically applied in conjunction with general surface priming.

2. Concrete and Masonry Substrate Leveling & Patching: Substrate conditions are to be evaluated by the Contractor and Membrane manufacturer. Perform leveling and patching operations as follows:

a. Level uneven surfaces with a leveling mixture of primer and approved kiln-dried silica sand in a 1:2 primer to sand ratio by volume. Spread and plane this compound with a squeegee and trowel to achieve a flat surface.

b. Fill cavities with a patching mixture of primer and approved kiln-dried sand in a 1:3/1:3.5 primer to sand ratio by volume.
c. Silica sand must be kept absolutely dry during storage and handling.
d. Any surface to be leveled or filled must first be primed with an appropriate primer.

3. Joint and Crack Preparation: Joints, cracks and fractures in the structural deck/substrate shall be prepared as defined below prior to installation of the waterproofing membrane.

a. Non-Moving Cracks: Determine that crack is non-moving. Clean out crack by brushing and oil-free compressed air. Fill crack with polyurethane sealant. Allow for a minimum of twelve (12) hours cure or as required by sealant Manufacturer.
b. Moving Cracks: Determine that crack is moving. Clean out crack by brushing and oil-free compressed air. Fill crack with polyurethane sealant. Allow for a minimum of twelve (12) hours cure or as required by sealant Manufacturer. Apply resin and 4 inch wide strip of membrane (resin and fleece) in strict accordance with Membrane manufacturer's written instructions.

3.3 PRIMER APPLICATION

A. General:

1. Mix and apply two-component primer in strict accordance with written instructions of Membrane Manufacturer. Use only proprietary materials, as supplied by the membrane manufacturer.

2. The substrate surface must be dry, with any remaining dust or loose particles removed using clean, dry, oil-free compressed air, industrial vacuum, cloth wipe or a combination of methods.

3. Do not install primer on any substrate containing newly applied and/or active asphalt, coal-tar pitch, creosote or penta-based materials unless approved in writing by Membrane Manufacturer. Some substrates may require additional preparation before applying primer.

B. Mixing of Standard EP and D Primers:

1. Premix primer Component A thoroughly with a spiral agitator or stir stick. Pour primer Component B into Component A and mix the components for approximately 2 minutes with a clean spiral agitator on slow speed or stir stick without creating any bubbles or streaks. DO NOT AERATE. The Primer solution should be a uniform color, with no light or dark streaks present.

2. Do not thin primer. Determine required primer coverage for each substrate material/condition and apply in strict accordance with written instructions of Membrane Manufacturer.

3. Mix only that amount of primer components A & B that can be used in 30 minutes.

C. Application of Primer:

1. Apply primer at the rate of approximately 0.7 – 1.4 gallons per 100 square feet.

2. Roll or brush the primer evenly onto the surface to fully saturate the substrate in one application. Do not allow primer to pond or collect in low areas.

3. Apply primer only up to the edge of the membrane flashing terminations. Primer application past the membrane terminations requires surfacing with an approved material.

4. For EP primer applications over cementitious substrates where protection from substrate wetness is required, apply primer coat at a heavier application rate until pore saturation is achieved.

5. For all EP primer applications, apply kiln-dried sand into the final coat of EP primer while still wet at the rate of 30 lbs. per 100 square feet.

6. Allow standard primers to cure for a minimum of twelve (12) hours before membrane application. Allow methyl methacrylate primer to cure for a minimum of one (1) hour before membrane application. Membrane must be applied to primer only when completely dry and without tack.

7. Exposure of the primer in excess of eight (8) days or premature exposure to moisture may require removal and application of new primer. DO NOT apply new primer over exposed primer older than eight (8) days, primer prematurely exposed to moisture, or primer used as temporary waterproofing, unless approved in writing by the Membrane Manufacturer.

D. Disposal of Primer:

1. Cured primer may be disposed of in standard landfills. This is accomplished by thoroughly mixing all components.

2. Uncured primer is considered a hazardous material and must be handled as such, in accordance with local, state and federal regulation. Do not throw uncured resin away.

3.4 MEMBRANE APPLICATION

A. General:

1. Mix and apply cold fluid-applied reinforced polyurethane waterproofing membrane in strict accordance with written instructions of Membrane Manufacturer. Use only proprietary membrane resins and materials, as supplied by the membrane manufacturer.

2. The primed substrate surface shall be dry, with any remaining dust or loose particles removed using clean, dry, oil-free compressed air, industrial vacuum, cloth-wipe or a combination.

3. Protect all areas where membrane has been installed. Do not work off installed membrane during application of remaining work before forty-eight (48) hours of curing. Movement of materials and equipment across installed membrane is not acceptable. If movement is necessary, provide complete protection of affected areas.

4. Closely follow the Membrane Manufacturer's recommendation for hot and cold weather application. Monitor surface and ambient temperatures, including the effects of wind chill.

B. Mixing of Resin:

1. Mix resin Component A (cream formulation) with a spiral agitator until the liquid is a uniform cream color. If the ambient temperature is below 50°F, then a weather related additive should be combined and mixed into the Component A.

a. Accelerator should be added to resin Component A when the ambient temperature is 50°F and below. The accelerator should be mixed with the spiral agitator for 5 minutes or until both liquids are thoroughly blended.
    1) Mix resin Component B (dark brown formulation) with a separate spiral agitator until the color is a uniform dark syrup color.
    2) Pour resin Component A and Component B into a third clean bucket at a 4:1 ratio and thoroughly mix the components with a clean spiral agitator. The Resin solution should be a uniform color, with no light or dark streaks present.
    3) Mix only that amount of resin components A & B that can be used in 30 minutes.

C. Application of Resin/Fleece

1. Apply mixed resin to the prepared surface at the approximate rate of 4.5 gallons per 100 square feet. The resin should be rolled or brushed liberally and evenly onto the surface using a broad, even stroke. Cover one working area at a time, between 15 – 20 $ft.^2$.

2. Roll out dry polyester fleece onto the liquid resin mix, making sure the SMOOTH SIDE IS FACING UP (natural unrolling procedure), avoiding any folds and wrinkles. The fleece will begin to rapidly saturate with the liquid resin mix. Use a medium nap roller or brush to work the resin into the fleece, saturating from the bottom up, and eliminating air bubbles, wrinkles, etc. The appearance of the saturated fleece should be light opaque amber with no white spots. White spots are indications of unsaturated fleece or lack of adhesion. It is important to correct these faults before the resin cures.

3. Apply additional liquid resin mix on top of fleece at the approximate rate of 2 gallons per 100 square feet to finish the saturation of the fleece. Roll this final coating into the fleece, which will result in a glossy appearance. The fleece can only hold so much resin and all excess should be rolled forward to the unsaturated fleece, eliminating ponding or excessive build-up of the resin. Any excess resin left on the top of the fleece will weather and peel off. The correct amount of resin will leave no whiteness in fleece and there will be a slightly fibrous surface texture. The final resin coating should be smooth and uniform.

4. Prevent contact between mixed/unmixed resin and new/existing membrane. If any unmixed resin contacts membrane surface remove immediately and clean thoroughly with a cloth rag.

5. At all fleece seams, allow a 2” overlap for all side joints and a 4” overlap for all end joints.

6. At membrane tie-offs, clean in-place membrane with MEK (methyl ethyl ketone) solvent once resin has cured. Allow solvents to fully evaporate before application of new resin.

D. Disposal of Resin:

1. Cured resin may be disposed of in standard landfills. This is accomplished by thoroughly mixing all components.

2. Uncured resin is considered a hazardous material and must be handled as such, in accordance with local, state and federal regulation. Do not throw uncured resin away.

3.5 FLASHING APPLICATION

A. General:

1. Install flashing system in accordance with the requirements/recommendations of the Membrane manufacturer and as depicted on standard drawings and details. Provide system with base flashing, edge flashing, penetration flashing, counter flashing, and all other flashings required for a complete watertight system.

2. Wherever possible, install the flashings before installing the field membrane to minimize foot traffic over newly installed field membrane.

3. All membrane flashings shall be installed concurrently with the waterproofing membrane as the job progresses. Temporary flashings are not allowed without prior written approval from the Membrane manufacturer. Should any water penetrate the new waterproofing membrane because of incomplete flashings, the affected area shall be removed and replaced at the contractor's expense.

4. Provide a minimum vertical height of 8" for all flashing terminations.

5. All flashings shall be terminated as required by the Membrane Manufacturer

B. Metal Flashing – General:

1. Metal flashings shall be fabricated in accordance with the current recommendations of SMACNA and in accordance with standard drawings and project details.

2. Metal flashing flanges to which membrane is to be bonded shall be a minimum of four (4) inches in width, and secured to the substrate six (6) inches on center staggered with fasteners appropriate to the substrate type. The flanges shall be provided with a roughened surface that has been cleaned of all oil and other residue.

3. Metal edges that will be overlaid with membrane shall be provided with a 1/4” min. hemmed edge.

4. Apply primer, resin and fleece to metal flange, extending membrane to outside face of metal edging, and to vertical face of metal base/curb flashing.

C. Membrane Flashing – General:

1. Membrane flashings shall be fabricated with primer appropriate for the substrate surface, resin of the same base chemical type as the field membrane, and fleece of the same weight as the field membrane unless specified otherwise.

2. Primer, resin, and fleece mixing and application methods as specified for field membranes are also suitable for membrane flashing.

3. Fleece shall overlap 2” minimum for all joints. Fleece shall be cut neatly to fit all flashing conditions without a buildup of multiple fleece layers. Work wet membrane with a brush or roller to eliminate blisters, openings, or lifting at corners, junctions, and transitions.

D. Pipes, Conduits, and Unusually Shaped Penetrations:

1. Flash all penetrations using cold fluid-applied reinforced polyurethane waterproofing membrane. Flashing material shall be the same resin used in the field membrane with 165 fleece reinforcement.

2. Flashing is typically constructed as a two part assembly consisting of a vertical wrap and a horizontal target patch. There must be a minimum of a two (2) inch overlap between vertical and horizontal flashing components.

3.6 SURFACING AND FINISHES

A. Kiln-Dried Aggregate Finish Surfacing:

1. Where specified, provide and install approved kiln-dried silica sand, or other approved mineral surfacing to achieve an aesthetic and/or non-skid surface.

2. Broadcast specified and approved sand or aggregate in excess into a bonding coat application of Membrane Manufacturer's approved urethane-based aggregate coating system (1 k Deko) applied over clean, cured membrane at the rate of approximately 0.8 gal. per 100 square feet. Aggregate shall be applied at the rate of 60 lbs. per 100 square feet. Obtain uniform and full coverage.

3. Following minimum 24 hour cure time remove loose/un-embedded mineral aggregate by blowing with oil-free compressed air or with a vacuum. Re-broadcast clean mineral aggregate as required to provide full embedment and coverage of membrane.

4. Seal aggregate surface with a sealing coat application of Membrane Manufacturer's approved aggregate coating (1 k Deko), applied at the rate of approximately 0.8 gal. per 100 square feet. After completion of mineral aggregate broadcasting, avoid any traffic for a minimum of three (3) days to allow for surfacing to cure.

3.7 PROTECTION

A. Upon completion of waterproofing and flashings (including all associated work), institute appropriate procedures for surveillance and protection of waterproofing during remainder of construction period. Protect all areas where membrane has been installed.

3.8 CLOSEOUT

A. Correction of Work:

1. Work that does not conform to specified requirements including tolerances, slopes, and finishes shall be corrected and/or replaced. Any deficiencies of membrane application, termination and/or protection as noted during the Membrane manufacturer's inspections shall be corrected and/or replaced at Contractor's expense.

B. Clean-Up:

1. Site clean-up, including both interior and exterior building areas that have been affected by construction, shall be restored to preconstruction condition.

END OF SECTION 07 14 16

SECTION 07 21 00 - 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 General Requirements, apply to this Section.

1.2 SUMMARY

B. This Section includes the following:
   1. Glass Fiber Thermal Insulation for exterior walls

C. Related Sections include the following:
   1. Section 05 40 00 – Cold formed metal framing
   2. Section 09 29 00 - Gypsum Board

1.3 SUBMITTALS

D. Product Data: For each type of product indicated.

E. Samples for Verification: Full-size units for each type of exposed insulation indicated.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for insulation products.

G. Installation instructions for each product

H. Certification that product complies with specification requirements and is suitable for the use indicated.

I. Manufacturer's 30 Year Thermal Performance Warranty.

1.4 QUALITY ASSURANCE

J. Installer Qualifications: Installer of thermal insulation is a certified installer with a documented history installing manufacturer's products according to manufacturer's specifications.

K. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.

L. Insulation shall not be produced with, or contain, any of the United States EPA regulated CFC Compounds listed in the Montreal Protocol of the United Nations Environmental Program.

M. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Surface-Burning Characteristics: ASTM E 84.
2. Combustion Characteristics: ASTM E 136.

N. References: American Society for Testing and Materials (ASTM)

1. E 84 Test Method for Surface Burning Characteristics of Building Materials
2. E 96 Test Method for Water Vapor Transmission of Materials
3. E 136 Test Method for Behavior of Materials in a Vertical Tube Furnace at 750℃.
4. C 177 Test Method for Steady-State Thermal Transmission Properties by means of the Guarded Hot Plate
5. C 423 Test Method for Sound Absorption and the Sound Absorption Coefficient by the Reverberation Room Method
6. C 518 Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter
7. C 553 Standard Specification for Mineral Fiber Blanket and Felt Insulations
8. C 578 – Standard Test Method for Steady-State Thermal Transmission
9. C 612 Standard Specification for Mineral Fiber Block and Board Thermal Insulation
10. C 665 Specification for Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
11. D 1621 - Standard Test Method for Compressive Properties of Rigid Cellular plastic
12. D696 Standard Test Method for Coefficient of Thermal Expansion
13. C203 Standard Test Method for Breaking Load and Flexural Properties of Block-type Thermal Insulation
14. D2126 Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
15. C272 Standard Test Method for Water Absorption of Core Material of Structural Sandwich Constructions
16. C2842 Standard Test Method for Water Absorption of Rigid Cellular Plastics

1.5 DELIVERY, STORAGE, AND HANDLING

O. Protect insulation materials from physical damage and from deterioration by 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.

P. Handle boards carefully so corners are not broken off or boards otherwise damaged.

Q. Label insulation packages to include material name, production date and/or product code.

1.6 LIMITATIONS

R. Do not use unfaced insulation in exposed applications where there is potential for skin contact and irritation.

S. Kraft and standard foil facings will burn and must not be left exposed. The facing must be installed in substantial contact with the unexposed surface of the ceiling, wall or floor finish. Protect facing from any open flame or heat source.

1.7 WARRANTY

T. Provide manufacturer's standard written warranty that the actual thermal resistance of the extruded polystyrene insulation will not vary by more than 10% from its published thermal resistance.

U. Warranty period minimum 30 years after date insulation is purchased.

PART 2 - PRODUCTS

1.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.
3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

B. Available Manufacturers:

1. Dow Chemical Company
2. Owens Corning
3. Diversion Foam Products,
4. CertainTeed Corporation.
5. Guardian Fiberglass, Inc.
6. Johns Manville.
7. Knauf Fiber Glass.
8. Or Engineer's approved equal

1.2 GLASS-FIBER BLANKET INSULATION (GLASS FIBER THERMAL INSULATION FOR EXTERIOR WALL)

C. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

1. Size: R-value 15, When tested in accordance with ASTM C 518.
2. Surface Burning Characteristics:
   a. Maximum flame spread: 10
   b. Maximum smoke developed: 10
3. Dimensional Stability:
4. Linear shrinkage less than 0.1%

D. Recommended product: Thermal Batt Insulation by Owen Corning or Engineer's Approved Equal

1.3 AUXILIARY INSULATING MATERIALS

E. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates. Type recommended by insulation manufacturer.

F. Provide all material, no specifically described but required for a complete and proper installation of the work in this section.

PART 3 - EXECUTION

1.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

1.2 PREPARATION

B. Clean substrates of substances harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

1.3 INSTALLATION, GENERAL

C. Comply with insulation manufacturer's written instructions applicable to products and application indicated.

D. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.

E. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

F. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

G. For preformed insulating units, 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.

H. When unfaced insulation is used, and in applications without a cover material or where the stud depth is larger than the insulation thickness, use wire or metal straps to hold insulation in place. When faced insulation is used, the attachment flanges may be taped to the face of metal stud prior to applying the interior finish.

1. Provide supplementary support to hold the product in place until finish surface is applied when insulation is installed in heights over 8 feet.

2. Provide supplementary support to hold the product in place until finish surface is applied when insulation is installed in heights over 8 feet.

1.4 INSTALLATION OF GENERAL BUILDING INSULATION

I. 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.

J. Seal joints between foam-plastic insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

K. Install mineral-fiber insulation 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 cavity, 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.

1.5 PROTECTION

L. Protect installed insulation from 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.

M. Comply with manufacturer’s requirements for insulation protection.

1.6 CLEAN-UP

N. Remove and dispose of excess installation, wrapping and other waste materials

END OF SECTION 07 21 00

SECTION 07 22 00 - ROOF AND DECK INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Installation of tapered roof insulation on flat roof over elevator shaft.

B. Installation of tapered insulation to promote positive drainage at the platform canopies.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

A. Wood blocking and edge strips: Section 06 10 00, ROUGH CARPENTRY.

B. Sheet metal components: Section 07 60 00, FLASHING AND SHEET METAL.

C. Roofing installation: Section 07 53 00, SINGLE PLY MEMBRANE ROOFING

1.3 QUALITY ASSURANCE:

A. Insulation shall be approved for local use.

B. Source Limitation: Obtain each type of roof insulation through one source.

C. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Surface-Burning Characteristics: ASTM E 84.
2. Fire-Resistance Ratings: ASTM E 119.
3. Combustion Characteristics: ASTM E 136.

D. Supervision of work by persons that are knowledgeable and experienced in roofing. See submittals for documentation of supervisor’s qualification.

E. Unless specified otherwise, comply with the recommendations of the NRCA "Roofing and Waterproofing Manual" applicable to insulation for storage, handling, and application.

F. Insulation shall be in accordance with roofing manufacturer’s requirements.

G. Roof insulation on combustible or steel decks shall have a flame spread rating not greater than 75 and a smoke developed rating not greater than 150, exclusive of covering, when tested in accordance with ASTM E 84. Insulation bearing the UL label and listed in the UL Building Materials Directory as meeting the flame spread and smoke developed ratings will be accepted in-lieu-of copies of test reports. Compliance with flame spread and smoke developed ratings will not be required when insulation has been tested as part of a roof construction assembly of the type used for this project and the construction is listed as fire-classified in the UL Building Materials Directory or listed as Class I roof deck construction in the FM P7825. Insulation tested as part of a roof construction assembly shall bear UL or FM labels attesting to the ratings specified herein.

1.4 SUBMITTALS:

A. Submit in accordance with Section 01 33 00, SUBMITTAL PROCEDURES.

B. Manufacturer's Literature and Data:
   1. Roof insulation, each type
   2. Fastening requirements

C. Samples

   1. Roof insulation, each type

D. Certificates:

   1. Indicating type, thickness and thermal conductance of insulation. (Average thickness for tapered insulation).

E. Laboratory Test Reports: Thermal values of insulation products.

F. Layout of tapered roof system showing units required and slopes.

G. Documentation of supervisors training and experience showing knowledge of roofing procedures.

1.5 DELIVERY, STORAGE AND MARKING:

A. Deliver materials to the site in original sealed packages or containers marked with the name and brand, or trademark of the manufacturer or seller.

B. Keep materials dry, and store in dry, weathertight facilities or under canvas tarps. Use of polyethylene or plastic tarps to cover materials is not permitted. Store above ground or deck level on wood pallets. Cover ground under stored materials with plastic tarp.

   1. Store rolled materials (felts, base sheets, paper) on end. Do not store materials on top of rolled material.
   2. Store foam insulation away from areas where welding is being performed and where contact with open flames is possible.

C. Protect from damage from handling, weather and construction operations before, during, and after installation.

1.6 APPLICABLE PUBLICATIONS:

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. Federal Specifications (Fed. Spec.):
   UU-B-790A ..... Building Paper, Vegetable Fiber: (Kraft, Waterproofed, Water Repellent and Fire Resistant)

C. American Society for Testing and Materials (ASTM):
   C208-95 (R2001) ..... Cellulosic Fiber Insulating Board

C209-98 ..... Test Methods for Cellulosic Fiber Insulating Board

C552-03 ..... Cellular Glass Thermal Insulation

C726-00 ..... Mineral Fiber Roof Insulation Board

C1289-03 ..... Faced Rigid Cellular Polyisocynurate Thermal Insulation Board

D41-94 (R2000) ..... Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing

D312-00 ..... Asphalt Used in Roofing

D2822-91 (R-1997)..... Asphalt Roof Cement

D. Factory Mutual Global (FM):
1-28 ..... Winds Loads to Roof Systems and Roof Deck Securement

P7825-04..... Approval Guide

E. National Roofing Contractors Association (NRCA):
The NRCA Roofing and Waterproofing Manual - Fourth Edition.

F. Underwriters Laboratories, Inc. (UL):
Fire Resistance Directory (2003)

G. U.S. Department of Commerce (NBS):
PS 1-83..... Construction and Industrial Plywood

H. National Particleboard Association (NPA):
A208.1-93 ..... Mat-Formed Wood Particleboard

PART 2 - PRODUCTS

2.1 GENERAL

A. Manufacturer:

1. GAF
2. Soprema
3. or approved equal

2.2 Comply with roofing manufacturer’s requirements.

2.3 INSULATION

A. Tapered Rigid Insulation: Cellular polyisocyanurate-foam board, rigid, closed-cell, high-density with 50 PSI compressive strength, 6.3 inch maximum vapor transmission; 0.30 percent maximum water absorption; manufacturer's standard sizes.
1. Cut to provide high and low points with crickets and slopes as shown.

2. Minimum thickness of tapered sections; 13 mm (1/2 inch), unless manufacturers allow taper to zero mm (inch).

3. The roof shall have slope of not less than 1/4:12

B. Miscellaneous: Adhesives as recommended by insulation and roofing manufacturer.

C. Compatibility: Product to be compatible with the roof system and should be coordinated with roofing system manufacturer.

D. Joints: Butt all joints in insulation.

2.4 MISCELLANEOUS

A. Adhesive for Bonding Insulation:
1. Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

2. Adhesive to be provided by roofing manufacturer and applied in accordance with product manufacturer's standards and recommendations.

B. Protection Board: Premolded, semirigid asphalt/fiber composite board, 1/4 inch thick, formed under heat and pressure, of standard size. Board shall be compatible with the roof system and should be coordinated with roofing system manufacturer.

2.5 RECOVERED MATERIALS:

A. Comply with following minimum content standards for recovered materials:

Material Type	Percent by Weight
Plastic rigid foams: Polyisocyanurate/polyurethane	
Rigid foam	9 percent recovered material

B. The minimum-content standards are based on the weight (not the volume) of the material in the insulating core only.

PART 3 - EXECUTION

3.1 GENERAL:

A. Entire roof deck construction of any section of the building shall be completed before insulation system work is begun. Curbs, blocking, edge strips, and other components which insulation, roofing and base flashing is attached to shall be in place ready to receive insulation and roofing. Coordinate roof insulation operations with roofing and sheet metal work so that insulation is installed to permit continuous roofing operations.

B. Insulation system materials shall be dry and damage free when applied. Do not use broken insulation or insulation with damaged facings. Remove damaged insulation from the site immediately.

C. Dry out surfaces that become wet from any cause during progress of the work before roofing work is resumed. Apply materials only to dry substrates.

D. Except for temporary protection specified, do not apply materials during damp or rainy weather, during excessive wind conditions, nor while moisture (dew, fog, snow, ice) or frost is present in any amount in or on the materials when temperature is below 10 C (50 F). Do not apply materials to substrate having temperature of 10 C (50 F) or less.

E. Phased construction is not permitted. The complete installation of all flashing, insulation, and roofing shall be completed in the same day except for the area where temporary protection is required when work is stopped.

3.2 SURFACE PREPARATION:

A. Sweep decks to broom clean condition. Remove all dust, dirt or debris.

B. Remove projections that might damage materials.

C. Concrete Decks, Except Insulating Concrete:

1. Test concrete decks for moisture prior to application of materials.

2. Comply with roofing manufacture's installation requirements.

3. Prime concrete decks, including precast unit, with primer and allow to dry before application of vapor retarder and roof insulation.

3.4 SELECTION OF RIGID INSULATION:

A. Insulation Type:

1. Where tapered insulation is used, all insulation shall be factory tapered.

B. Insulation Thickness:

1. When thickness of insulation to be used is more or less than that required in specifications and/or shown on the drawings, make adjustments in the alignment and location of roof drains, flashing, gravel stops, fascias and similar items at no additional cost to the Government.

3. Where tapered insulation is used, the thickness of the insulation at high points and roof edges shall be as shown on the drawings; the thickness at the low point (roof edges) shall be not less than 38 mm (1-1/2 inches).

4. Use not less than two layers of insulation when insulation is 25 mm (one inch) or more in thickness unless specified otherwise.

3.5 GENERAL INSTALLATION OF INSULATION:

A. Lay insulating units with close joints, in regular courses and with cross joints broken. When laid in more than one layer, break joints of succeeding layers of roof insulation with those in preceding layer. Bed insulation layers in approved adhesive firmly pressed into the adhesive as per manufacturer's installation instructions.

B. Lay units with long dimension perpendicular to the rolled (longitudinal) direction of the roofing.

C. Do not install wet, damaged or warped insulation boards.

D. Cover all insulation installed on the same day by either:

1. The roofing membrane as specified.
2. Temporary protection as specified.

E. Seal all cut edges at penetrations and at edges against blocking with bitumen or roof cement.

F. Cut to fit tight against blocking or penetrations.

G. Over Vapor Retarder, or Concrete Deck: Lay insulation in adhesive as recommend by roofing manufacturer.

H. Do not apply roof insulation or roofing until all other work trades have completed jobs that require them to traverse the deck on foot or with equipment. A vapor retarder coated lightly with asphalt may be applied to protect the inside of the structure prior to the insulation and final roofing installation. Before the application of the insulation, any damage or deterioration to the vapor retarder must be repaired.

I. Do not install wet, damaged or warped insulation boards.

J. Install insulation boards with staggered board joints in one direction (unless taping joint).

K. Install insulation boards snug. Gaps between board joints must not exceed ¼" (6 mm). All gaps in excess of ¼" (6 mm) must be filled with like insulation material.

L. Wood nailers must be 3-1/2" (8.9 cm) minimum width or 1" (25 mm) wider than metal flange. They shall be of equal thickness as the insulation with a minimum 1" (25 mm) thickness. All nailers must be securely fastened to the deck.

M. Do not kick insulation boards into place.

N. Miter and fill the edges of the insulation boards at ridges, valleys and other changes in plane to prevent open joints or irregular surfaces. Avoid breaking or crushing of the insulation at the corners.

O. Do not install insulation over old lightweight insulating concrete decks without the use of a vapor retarder. Insulation should not be installed over new lightweight insulating concrete.

P. Cant strips must be installed at the intersection of the roof and all walls, parapets, curbs, or transitions approaching 90°, to be flashed. They shall be approximately 4" (10.2 cm) in horizontal and 4" (10.2 cm) in vertical dimension. The face of the cant shall have an incline of not more than 45 degrees with the roof.

Q. Roof tape, if required over insulation joints, must be laid evenly, smoothly and embedded in a uniform coating of hot steep asphalt with 4" (10.2 cm) end laps. Care must be taken to assure smooth application of tape, and full embedment of the tape in the asphalt.

R. Do not install any more insulation than will be completely waterproofed each day.

3.6 INSULATION – BASE LAYER

A. The substrate must be free of and debris, dust, dirt, oil, grease, and standing water before applying the adhesive.

B. Adhesive must be applied as per manufacturer's installation instructions.

C. Install insulation layers applied with bands of adhesive spaced 12" O.C. Allow the foam to rise ¾" to 1". Walk each board firmly into place. Stagger the joints of additional layers in relation to the insulation joints in the layer(s) below by a minimum of 6" (15.2 cm) to eliminate continuous vertical gaps.

3.7 INSULATION – SUBSEQUENT LAYERS

A. The substrate must be free of and debris, dust, dirt, oil, grease, and standing water before applying the adhesive.

B. Adhesive must be applied as per manufacturer's installation instructions.

C. Install insulation layers applied with bands of adhesive spaced 12" O.C. Allow the foam to rise ¾" to 1". Walk each board firmly into place. Stagger the joints of additional layers in relation to the insulation joints in the layer(s) below by a minimum of 6" (15.2 cm) to eliminate continuous vertical gaps.

END OF SECTION 07 22 00

SECTION 07 25 00 – WEATHER BARRIER

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Weather barrier membrane

B. Seam Tape

C. Flashing

D. Fasteners

1.2 REFERENCES

A. ASTM International

1. ASTM C920; Standard Specification for Elastomeric Joint Sealants
2. ASTM C1193; Standard Guide for Use of Joint Sealants
3. STM D882; Test Method for Tensile Properties of Thin Plastic Sheeting
4. ASTM D1117; Standard Guide for Evaluating Non-woven Fabrics
5. ASTM E84; Test Method for Surface Burning Characteristics of Building Materials
6. ASTM E96; Test Method for Water Vapor Transmission of Materials
7. ASTM E1677; Specification for Air Retarder Material or System for Framed Building Walls
8. ASTM E2178; Test Method for Air Permeance of Building Materials
9. ASTM E2357; Standard Test Method for Determining Air Leakage of Air Barrier Assemblies

B. AATCC – American Association of Textile Chemists and Colorists

1. Test Method 127 Water Resistance: Hydrostatic Pressure Test

C. TAPPI

1. Test Method T-410; Grams of Paper and Paperboard (Weight per Unit Area)
2. Test Method T-460; Air Resistance (Gurley Hill Method)

1.3 SUBMITTALS

A. Refer to Division 1 Submittals

B. Product Data: Submit manufacturer current technical literature for each component.

C. Samples: Weather Barrier Membrane, minimum 8-1/2 inches by 11 inch.

D. Quality Assurance Submittals

1. Design Data, Test Reports: Provide manufacturer test reports indicating product compliance with indicated requirements.

2. Manufacturer Instructions: Provide manufacturer's written installation instructions.

3. Manufacturer's Field Service Reports: Provide site reports from authorized field service representative, indicating observation of weather barrier assembly installation.

E. Closeout Submittals

1. Refer to Division 1 sumbittals

2. Weather Barrier Warranty: Manufacturer's executed warranty form with authorized signatures and endorsements indicating date of Substantial Completion.

1.4 QUALITY

ASSURANCE A.

Qualifications

1. Installer shall have experience with installation of commercial weather barrier assemblies under similar conditions.

2. Installation shall be in accordance with weather barrier manufacturer's installation guidelines and recommendations.

3. Source Limitations: Provide commercial weather barrier and accessory materials produced by single manufacturer.

B. Mock-up

1. Install mock-up using approved weather barrier assembly including fasteners, flashing, tape and related accessories per manufacturer's current printed instructions and recommendations.

   a. Mock-up size: 10 feet by 10 feet
   b. Mock-up Substrate: Match wall assembly construction, including window opening.
   c. Mock-up may [not] remain as part of the work.

2. Contact manufacturer's designated representative prior to weather barrier assembly installation, to perform required mock-up visual inspection and analysis as required for warranty.

C. Pre-installation Meeting

1. Refer to Section [01 31 19 Project Meetings] [insert section number and title].

2. Hold a pre-installation conference, two weeks prior to start of weather barrier installation. Attendees shall include Contractor, Architect, Engineer, Installer, Owner's Representative, and Weather Barrier Manufacturer's Designated Representative.

3. Review all related project requirements and submittals, status of substrate work and preparation, areas of potential conflict and interface, availability of weather barrier assembly materials and components, installer's training requirements, equipment, facilities and scaffolding, and coordinate methods, procedures and sequencing requirements for full and proper installation, integration and protection.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver weather barrier materials and components in manufacturer's original, unopened, undamaged containers with identification labels intact.

B. Store weather barrier materials as recommended by weather barrier manufacturer.

1.6 SCHEDULING

A. Review requirements for sequencing of installation of weather barrier assembly with installation of windows, doors, louvers and flashings to provide a weather-tight barrier assembly.S

B. chedule installation of weather barrier materials and exterior cladding within nine months of weather barrier assembly installation.

PART 2 - PRODUCTS

1.1 MANUFACTURER

A. DuPont; 4417 Lancaster Pike, Chestnut Run Plaza 728, Wilmington, DE 19805; 1-800-44-TYVEK (8-9835); http://www.construction.tyvek.com (Basis of Design)

B. Or approved Equal

1.2 MATERIALS

A. Basis of Design: spunbonded polyolefin, non-woven, non-perforated, weather barrier is based upon DuPont™ Tyvek® CommercialWrap® and related assembly components.

B. Performance Characteristics:

1. Air Penetration: 0.001 cfm/ft^2 at 75 Pa, when tested in accordance with ASTM E2178. Type I per ASTM E1677. ≤0.04 cfm/ft^2 at 75 Pa, when tested in accordance with ASTM E2357

2. Water Vapor Transmission: 28 perms, when tested in accordance with ASTM E96, Method B.

3. Water Penetration Resistance: 280 cm when tested in accordance with AATCC Test Method 127.

4. Basis Weight: 2.7 oz/yd^2, when tested in accordance with TAPPI Test Method T-410.

5. Air Resistance: Air infiltration at >1500 seconds, when tested in accordance with TAPPI Test Method T-460.

6. Tensile Strength: 38/35 lbs/in., when tested in accordance with ASTM D882, Method A

7. Tear Resistance: 12/10 lbs., when tested in accordance with ASTM D1117.

8. Surface Burning Characteristics: Class A, when tested in accordance with ASTM E 84. Flame Spread: 10, Smoke Developed: 10.

1.3 ACCESSORIES

A. Seam Tape: 3 inch wide, DuPont™ Tyvek® Tape for commercial applications.

B. Fasteners:

1. DuPont™ Tyvek® Wrap Cap Screws, as distributed by DuPont: 1-5/8 inch rust resistant screw with 2-inch diameter plastic cap or manufacturer approved 1-1/4" or 2" metal gasketed washer

C. Sealants

1. Provide sealants that comply with ASTM C920, elastomeric polymer sealant to maintain watertight conditions.

2. Products:

a. DuPont™ Commercial Sealant
b. DuPont™ Residential Sealant
c. Sealants recommended by the weather barrier manufacturer.

D. Adhesives:

1. Provide adhesive recommended by weather barrier manufacturer.

2. Products:

a. Liquid Nails® LN-109
b. Denso Butyl Liquid
c. 3M High Strength 90
d. SIA 655
e. Adhesives recommend by the weather barrier manufacturer.

E. Primers:

1. Provide flashing manufacturer recommended primer to assist in adhesion between substrate and flashing.

2. Products:

a. 3M High Strength 90
b. Denso Butyl Spray
c. SIA 655
d. Permagrip 105
e. ITW TACC Sta' Put SPH
f. Primers recommended by the flashing manufacturer

F. Flashing

1. DuPont™ FlexWrap™, as distributed by DuPont: flexible membrane flashing materials for window openings and penetrations.

2. DuPont™ Thru-Wall Surface Adhered Membrane with Integrated Drip Edge: Thru-Wall flashing membrane materials for flashing at changes in direction or elevation (shelf angles, foundations, etc.) and at transitions between different assembly materials.

3. Preformed Inside and Outside Corners and End Dams as distributed by DuPont: Preformed three-dimensional shapes to complete the flashing system used in conjunction with DuPont™ Thru-Wall Flashing.

PART 3 - EXECUTION

1.1 EXAMINATION

A. Verify substrate and surface conditions are in accordance with weather barrier manufacturer recommended tolerances prior to installation of weather barrier and accessories.

1.2 INSTALLATION – WEATHER BARRIER

A. Install weather barrier over exterior face of exterior wall substrate in accordance with manufacturer recommendations.

B. Install weather barrier prior to installation of windows and doors.

C. Start weather barrier installation at a building corner, leaving 6-12 inches of weather barrier extended beyond corner to overlap.

D. Install weather barrier in a horizontal manner starting at the lower portion of the wall surface with subsequent layers installed in a shingling manner to overlap lower layers. Maintain weather barrier plumb and level.

E. Sill Plate Interface: Extend lower edge of weather barrier over sill plate interface 3-6 inches. Secure to foundation with elastomeric sealant as recommended by weather barrier manufacturer.

F. Window and Door Openings: Extend weather barrier completely over openings.

G. Overlap weather barrier

H. Exterior corners: minimum 12 inches.

1. Seams: minimum 6 inches.

I. Weather Barrier Attachment:

1. Attach weather barrier to studs through exterior sheathing. Secure using weather barrier manufacturer recommended fasteners, space 12 -18 inches vertically on center along stud line, and 24 inch on center, maximum horizontally.

J. Apply 4 inch by 7 inch piece of DuPont™ StraightFlash™ or weather barrier manufacturer approved alternate to weather barrier membrane prior to the installation cladding anchors.

1.3 SEAMING

A. Seal seams of weather barrier with seam tape at all vertical and horizontal overlapping seams.

B. Seal any tears or cuts as recommended by weather barrier manufacturer.

1.4 THRU-WALL FLASHING INSTALLATION

A. Apply primer per manufacturer's written instructions.

B. Install preformed corners and end dams bedded in sealant in appropriate locations along wall.

C. Starting at a corner, remove release sheet and apply membrane to primed surfaces in lengths of 8 to 10 feet.

D. Extend membrane through wall and leave ¼ inch minimum exposed to form drip edge.

E. Roll flashing into place. Ensure continuous and direct contact with substrate.

F. Lap ends and overlap preformed corners 4 inches minimum. Seal all laps with sealant.

G. Trim exterior edge of membrane 1-inch and secure metal drip edge per manufacturer's written instructions.

H. Terminate membrane on vertical wall. [Terminate into reglet, counterflashing or with termination bar.]

I. Apply sealant bead at each termination.

1.5 THRU-WALL FLASHING / WEATHER BARRIER INTERFACE AT BASE OF WALL

A. Overlap thru-wall flashing with weather barrier by 6-inches.

B. Mechanically fasten bottom of weather barrier through top of thru-wall flashing.

C. Seal vertical and horizontal seams with tape or sealing membrane.

1.6 FIELD QUALITY CONTROL

A. Notify manufacturer's designated representative to obtain [required] periodic observations of weather barrier assembly installation.

1.7 PROTECTION

A. Protect installed weather barrier from damage.

END OF SECTION 07 25 00

SECTION 07 50 00 – SINGLE PLY MEMBRANE ROOFING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. The project consists of installing A Fully Adhered Roofing System as outlined below:

1.02 RELATED SECTIONS:

A. Section 07 22 00 – Roof Insulation

B. Section 07 60 00 – Sheet metal flashing and trim

C. Section 07 92 00 – Sealants and Caulking

1.03 EXTENT OF WORK

A. Provide all labor, material, tools, equipment, and supervision necessary to complete the installation of a 60-mil thick EPDM membrane Fully Adhered Roofing System including flashings and insulation as specified herein and as indicated on the drawings in accordance with the manufacturer's most current specifications and details.

B. The roofing contractor shall be fully knowledgeable of all requirements of the contract documents and shall make themselves aware of all job site conditions that will affect their work.

C. The roofing contractor shall confirm all given information and advise the building owner, prior to bid, of any conflicts that will affect their cost proposal.

D. Any contractor who intends to submit a bid using a roofing system other than the approved manufacturer must submit for pre-qualification in writing fourteen (14) days prior to the bid date. Any contractor who fails to submit all information as requested will be subject to rejection. Bids stating "as per plans and specs" will be unacceptable.

1.04 SUBMITTALS

A. Prior to starting work, the roofing contractor must submit the following:

1. Shop drawings showing layout, details of construction and identification of materials.
2. Sample of the manufacturer's Membrane System Warranty.
3. Submit a letter of certification from the manufacturer which certifies the roofing contractor is authorized to install the manufacturer's roofing system and lists foremen who have received training from the manufacturer along with the dates training was received.
4. Certification of the manufacturer's warranty reserve.

B. Upon completion of the installed work, submit copies of the manufacturer's final inspection to the Architect prior to the issuance of the manufacturer's warranty.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the job site in the manufacturer's original, unopened containers or wrappings with the manufacturer's name, brand name and installation instructions intact and legible. Deliver in sufficient quantity to permit work to continue without interruption.

B. Comply with the manufacturer's written instructions for proper material storage.

1. Store materials between 60 degrees F and 80 degrees F in dry areas protected from water and direct sunlight. If exposed to lower temperature, restore to 60 degrees F minimum temperature before using.
2. Store materials containing solvents in dry, well ventilated spaces with proper fire and safety precautions. Keep lids on tight. Use before expiration of their shelf life.

C. Insulation must be on pallets, off the ground and tightly covered with waterproof materials. Manufacturer's wrap does not provide sufficient waterproofing.

D. Any materials which are found to be damaged shall be removed and replaced at the applicator's expense.

1.06 WORK SEQUENCE

A. Schedule and execute work to prevent leaks and excessive traffic on completed roof sections. Care should be exercised to provide protection for the interior of the building and to ensure water does not flow beneath any completed sections of the membrane system.

B. Do not disrupt activities in occupied spaces.

1.07 USE OF THE PREMISES

A. Before beginning work, the roofing contractor must secure approval from the building owner's representative for the following:

1. Areas permitted for personnel parking.
2. Access to the site.
3. Areas permitted for storage of materials and debris.
4. Areas permitted for the location of cranes, hoists and chutes for loading and unloading materials to and from the roof.

B. Interior stairs or elevators may not be used for removing debris or delivering materials, except as authorized by the building superintendent.

1.08 EXISTING CONDITIONS

If discrepancies are discovered between the existing conditions and those noted on the drawings, immediately notify the owner's representative by phone and solicit the manufacturer's approval prior to commencing with the work. Necessary steps shall be taken to make the building watertight until the discrepancies are resolved.

1.09 JOB SITE PROTECTION

A. The roofing contractor shall adequately protect building, paved areas, service drives, lawn, shrubs, trees, etc. from damage while performing the required work. Provide canvas, boards and sheet metal (properly secured) as necessary for protection and remove protection material at completion. The contractor shall repair or be responsible for costs to repair all property damaged during the roofing application.

B. During the roofing contractor's performance of the work, the building owner will continue to occupy the existing building. The contractor shall take precautions to prevent the spread of dust and debris, particularly where such material may sift into the building. The roofing contractor shall provide labor and materials to construct, maintain and remove necessary temporary enclosures to prevent dust or debris in the construction area(s) from entering the remainder of the building.

C. Do not overload any portion of the building, either by use of or placement of equipment, storage of debris, or storage of materials.

D. Protect against fire and flame spread. Maintain proper and adequate fire extinguishers.

E. Take precautions to prevent drains from clogging during the roofing application. Remove debris at the completion of each day's work and clean drains, if required. At completion, test drains to ensure the system is free running and drains are watertight. Remove strainers and plug drains in areas where work is in progress. Install flags or other telltales on plugs. Remove plugs each night and screen drain.

F. Store moisture susceptible materials above ground and protect with waterproof coverings.

G. Remove all traces of piled bulk materials and return the job site to its original condition upon completion of the work.

1.10 SAFETY

A. The roofing contractor shall be responsible for all means and methods as they relate to safety and shall comply with all applicable local, state and federal requirements that are safety related. Safety shall be the responsibility of the roofing contractor. All related personnel shall be instructed daily to be mindful of the full time requirement to maintain a safe environment for the facility's occupants including staff, visitors, customers and the occurrence of the general public on or near the site.

1.11 WORKMANSHIP

A. Applicators installing new roof, flashing and related work shall be factory trained and approved by the manufacturer they are representing.

B. All work shall be of highest quality and in strict accordance with the manufacturer's published specifications and to the building owner's satisfaction.

C. There shall be a supervisor on the job site at all times while work is in progress.

1.12 QUALITY CONTROL

A. The EPDM membrane roofing system must achieve a UL Class A and must have been

successfully tested to meet or exceed the calculated uplift pressure required by the International Building Code (ASCE-7) or ANSI/SPRI WD-1.

B. The manufacturer must have extensive documented experience in the manufacturing of vulcanized thermal set sheeting.

C. Unless otherwise noted in this specification, the roofing contractor must strictly comply with the manufacturer's current specifications and details.

D. The roofing system must be installed by an applicator authorized and trained by the manufacturer in compliance with shop drawings as approved by the manufacturer. The roofing applicator shall be thoroughly experienced and upon request be able to provide evidence of having successful experience installing single-ply EPDM roofing systems and having installed at least one (1) roofing application or several similar systems of equal or greater size within one year.

E. Provide adequate number of experienced workmen regularly engaged in this type of work who are skilled in the application techniques of the materials specified. Provide at least one thoroughly trained and experienced superintendent on the job at all times roofing work is in progress.

F. There shall be no deviations made from this specification or the approved shop drawings without the prior written approval of the Architect. Any deviation from the manufacturer's installation procedures must be supported by a written certification on the manufacturer's letterhead and presented for the Architect's consideration.

G. Upon completion of the installation, the applicator shall arrange for an inspection to be made by a non-sales technical representative of the membrane manufacturer in order to determine whether or not corrective work will be required before the warranty will be issued. Notify the building owner seventy-two (72) hours prior to the manufacturer's final inspection.

H. The EPDM membrane meets the CRRC (California Roof Rating Council) requirements for reflectance and emittance. When tested in accordance with ASTM C1549, the material has an initial solar reflectance of .76 and a 3-year aged reflectance of .64. The material has also been tested for emittance in accordance with ASTM C1371; an initial emittance of .90 and a 3-year aged emittance of .87 were achieved.

1.13 JOB CONDITIONS, CAUTIONS AND WARNINGS

A. Material Safety Data Sheets (MSDS) must be on location at all times during the transportation, storage and application of materials.

B. When positioning membrane sheets, exercise care to locate all field splices away from low spots and out of drain sumps. All field splices should be shingled to prevent bucking of water.

C. When loading materials onto the roof, the Authorized Roofing Applicator must comply with the requirements of the building owner to prevent overloading and possible disturbance to the building structure.

D. Proceed with roofing work only when weather conditions are in compliance with the manufacturer's recommended limitations, and when conditions will permit the work to proceed in accordance with the manufacturer's requirements and recommendations.

E. Proceed with work so new roofing materials are not subject to construction traffic. When necessary, new roof sections shall be protected and inspected upon completion for possible damage.

F. Provide protection, such as 3/4 inch thick plywood, for all roof areas exposed to traffic during construction. Plywood must be smooth and free of fasteners and splinters.

G. The surface on which the insulation or roofing membrane is to be applied shall be clean, smooth, dry, and free of projections or contaminants that would prevent proper application of or be incompatible with the new installation, such as fins, sharp edges, foreign materials, oil and grease.

H. New roofing shall be complete and weathertight at the end of the work day.

I. Contaminants such as grease, fats and oils shall not be allowed to come in direct contact with the roofing membrane.

1.14 WARRANTY

A. Provide manufacturer's 20 year Total System Warranty covering both labor and material with no dollar limitation. The maximum wind speed coverage shall be peak gusts of 90 mph measured at 10 meters above ground level. Certification is required with bid submittal indicating the manufacturer has reviewed and agreed to such wind coverage.

B. Pro-rated System Warranties shall not be accepted.

C. Evidence of the manufacturer's warranty reserve shall be included as part of the project submittals for the Architect's approval.

PART 2 - PRODUCTS

2.01 GENERAL

A. Manufactures:

1. Carlisle SynTec Incorporated; P.O. box 7000 Carlisle, PA 17013; 800-4-syntec (Basis of design)
2. Firestone building products; 250 West 96th street, Indianapolis, IN 46260; 800-428-4442
3. Johns Manville; 717 17th street Denver, CO 80202; 303-978-2000
4. Or Approved Equal.

B. Unless otherwise approved by the Architect and accepted by the membrane manufacturer, all products (including insulation, fasteners, fastening plates and edgings) must be manufactured and supplied by the roofing system manufacturer and covered by the warranty.

2.02 MEMBRANE

A. Furnish White 60-mil thick EPDM (Ethylene, Propylene, Diene Terpolymer) in the largest sheet possible. The membrane shall conform to the minimum physical properties of ASTM D4637. When a 10 foot wide membrane is to be used, the membrane shall be manufactured in a single panel with no factory splices to reduce splice intersections. EPDM membranes are available with Factory-Applied Tape (FAT).

2.03 INSULATION/UNDERLAYMENT

A. When applicable, insulation shall be installed in multiple layers. The first and second layer of insulation shall be mechanically fastened or adhered to the substrate in accordance with the manufacturer's published specifications.

B. Insulation shall be Tapered Polyiso Insulation,) See Specification 07 22 00 Roof and deck Insulation.

2.04 ADHESIVES, CLEANERS AND SEALANTS

All products shall be furnished by the manufacturer and specifically formulated for the intended purpose.

A. Bonding Adhesive: Low VOC Bonding Adhesive

B. Splicing Cement: White Splicing Cement

C. Splice Tape and Primer: White splice tape or Factory-Applied Tape (FAT) and Carlisle EPDM or Low VOC Primer

D. Cleaning Solvent: Weathered Membrane Cleaner

E. Internal Seam Sealant: Sure-Seal In-Seam Sealant (used with adhesive splices only)

F. External Seam Sealant: White Lap Sealant

G. Pocket Sealant: White Pourable Sealer

H. Insulation Adhesive: Carlisle FAST Adhesive, OlyBond 500 BA, or OlyBond Spot Shot – or approved equal

2.05 FASTENERS AND PLATES

To be used for mechanical attachment of insulation and to provide additional membrane securement:

A. CD-10 Concrete Fastener: a hammer-driven, non-threaded, black epoxy electro-deposition coated fastener for use with structural concrete decks rated 3,000 psi or greater.

B. HD 14-10 Concrete Fastener: a #14 threaded fastener used for minimum 3,000 psi

concrete decks.

C. HP Term Bar Nail-In: a 1-1/4" long expansion anchor with drive pin used for fastening Termination Bar or Seam Fastening Plates to concrete, brick or block walls. The fastener is set by hammering the drive pin into place.

D. Insulation Fastening Plate: a nominal 3" diameter FM approved metal plate used for insulation attachment in conjunction with Fasteners.

E. Seam Fastening Plate: a 2" diameter metal fastening plate used in conjunction with Reinforced Universal Securement Strip or EPDM membrane for additional membrane securement.

F. White Pressure-Sensitive Reinforced Universal Securement Strip: a 6" wide, nominal 45-mil thick clean, cured, white reinforced EPDM membrane with 3" wide Factory-Applied Tape laminated along one edge. Used on White Adhered Roofing Systems.

G. Reinforced Universal Securement Strip: a standard 6" or 9" wide, 100' long, strip of reinforced EPDM membrane.

H. The 6" wide standard Reinforced Universal Securement Strip can be utilized horizontally or vertically (in conjunction with Seam Fastening Plates) below the EPDM membrane for additional membrane securement on maximum 10-year warranty projects.

I. The 9" wide standard Reinforced Universal Securement Strip can be utilized in conjunction with gravel stops and metal edgings to allow the continuation of the EPDM deck membrane as flashing.

2.06 METAL EDGING AND MEMBRANE TERMINATIONS

A. Snap-on edge system consisting of a 24 gauge galvanized metal springclip water dam and 50-mil thick aluminum Kynar 500, colored anodized finish. The fascia is available in a variety of colors and heights varying from 5" to 10". Metal fascia color shall be as designated by the Owner's Representative.

B. Drip Edge: a metal fascia/edge system with a 24 gauge continuous anchor cleat and.032 inch thick aluminum fascia. Metal fascia color shall be as designated by the Owner's Representative.

C. Termination Bar: a 1" wide and .098 inch thick extruded aluminum bar pre-punched 6" on center; incorporates a sealant ledge to support Lap Sealant or Universal Sealant and provide increased stability for membrane terminations.

PART 3 - EXECUTION

3.01 GENERAL

A. Comply with the manufacturer's published instructions for the installation of the membrane roofing system including proper substrate preparation, jobsite considerations and weather restrictions.

B. Position sheets to accommodate contours of the roof deck and shingle splices to avoid bucking water.

3.02 INSULATION PLACEMENT

A. Install insulation or membrane underlayment over the substrate with boards butted tightly together with no joints or gaps greater than 1/4 inch. Stagger joints both horizontally and vertically if multiple layers are provided.

B. Secure insulation to the substrate with the required mechanical fasteners or insulation adhesive in accordance with the manufacturer's specifications.

3.03 MEMBRANE PLACEMENT AND BONDING

A. Unroll and position membrane without stretching. Allow the membrane to relax for approximately 1/2 hour before bonding. Fold the sheet back onto itself so half the underside of the membrane is exposed.

B. Apply the Bonding Adhesive in accordance with the manufacturer's published instructions, to both the underside of the membrane and the substrate. Allow the adhesive to dry until it is tacky but will not string or stick to a dry finger touch.

1. Roll the coated membrane into the coated substrate while avoiding wrinkles. Brush down the bonded half of the membrane sheet with a soft bristle push broom to achieve maximum contact.

2. Fold back the unbonded half of the membrane sheet and repeat the bonding procedure.

C. Install adjoining membrane sheets in the same manner, overlapping edges approximately 4 inches. Do not apply bonding adhesive to the splice area.

3.04 MEMBRANE SPLICING WITH TAPE

A. Tape splices must be a minimum of 2-1/2" wide using 3" wide tape extending 1/8" minimum to 1/2" maximum beyond the splice edge. Field splices at roof drains must be located outside the drain sump.

B. Position membrane sheet to allow for required splice overlap. Mark the bottom sheets with an indelible marker approximately 1/4" to 1/2" from the top sheet edge. The pre-marked line on the membrane edge can also be used as a guide for positioning splice tape.

C. Fold the top sheet back and clean the dry splice area (minimum 3" wide) of both membrane sheets by scrubbing with clean natural fiber rags saturated with Primer.

D. When Factory-Applied tape is not used, apply tape in accordance with the manufacturer's specifications and roll the top sheet onto the mating surface.

E. Immediately roll the splice using positive pressure when using a 2" wide steel roller. Roll across the splice edge, not parallel to it. When factory applied tape is used, a Stand-Up Seam Roller can be used to roll parallel to the splice edge.

F. At all field splice intersections, apply Lap Sealant along the edge of the membrane splice to cover the exposed tape 2" in each direction from the splice intersection. Install Pressure-Sensitive Joint Covers or a 6" wide section (with rounded corners) of Pressure-Sensitive Flashing over the field splice intersection.

3.05 MEMBRANE SPLICING WITH SPLICING CEMENT

Adhesive splices must be a minimum of 3" wide. Field splices at roof drains must be located outside drain sump.

A. Fold the top sheet back and clean the dry splice area (minimum 3" wide) of both membrane sheets by scrubbing with clean natural fiber rags saturated with Weathered Membrane Cleaner or Sure-Seal Primer

B. Apply Splicing Cement and In-Seam Sealant in accordance with the manufacturer's specifications and roll the top sheet onto the mating surface.

C. Roll the splice with a 2 inch wide steel roller and wait at least 2 hours before applying Lap Sealant to the splice edge following the manufacturer's requirements.

D. Field splices without In-Seam Sealant must be overlaid with uncured flashing.

3.06 FLASHING

A. Wall and curb flashing shall be cured EPDM membrane. Continue the deck membrane as wall flashing where practicable.

B. Follow manufacturer's typical flashing procedures for all wall, curb, and penetration flashing including metal edging/coping and roof drain applications.

3.08 DAILY SEAL

A. On phased roofing, when the completion of flashings and terminations is not achieved by the end of the work day, a daily seal must be performed to temporarily close the membrane to prevent water infiltration.

B. Complete an acceptable membrane seal in accordance with the manufacturer's requirements.

3.09 CLEAN UP

A. Perform daily clean-up to collect all wrappings, empty containers, paper, and other debris from the project site. Upon completion, all debris must be disposed of in a legally acceptable manner.

B. Prior to the manufacturer's inspection for warranty, the applicator must perform a pre-inspection to review all work and to verify all flashing has been completed as well as the application of all caulking.

END OF SECTION 07 53 00

SECTION 07 60 00 - FLASHING AND SHEET METAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 General Requirements, apply to this Section.

1.2 SUMMARY

A. Description: Provide Flashing and Sheet Metal, as shown and specified per Contract Documents; Including, but not limited to:

1. Metal through wall and base flashing.

2. Exterior wall flashing and expansion joints.

3. Gutters

4. Exposed metal trim and fascia units.

5. Sheet metal accessories.

1.3 RELATED SECTIONS

A. Section 07 41 00 – Manufactured wall panels

B. Section 07 53 00 – Single ply membrane roofing

C. Section 07 92 00 - Joint Sealants and Caulking

D. **SUBMITTALS**

E. General: Refer to Division 1 Section 01 33 00 Submittals.

F. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

G. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:

1. Identification of material, thickness, weight, and finish for each item and location in Project.

2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.

3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.

4. Details of termination points and assemblies, including fixed points.

5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.

6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counter flashings as applicable.

7. Details of special conditions.

8. Details of connections to adjoining work.

9. Detail formed flashing and trim at a scale of not less than 3 inches per 12 inches.

H. Samples: For each type of sheet metal flashing, trim, and accessory indicated with factory-applied color finishes involving color selection.

I. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.

J. Qualification Data: For qualified fabricator.

K. Closeout:

1. Guarantee: Provide, in required form, for a period of two (2) years from date of final acceptance by CTDOT

1.4 QUALITY ASSURANCE

A. General: Refer to Section 01 40 00 Quality Assurance.

B. References:

1. General: Refer to Section 01 42 19 Reference Standards.

2. National Roofing Contractors Association (NRCA): Roofing Manual.

3. Sheet Metal and Air Conditioning Contractors National Association (SMACNA): Architectural Sheet Metal Manual.

C. Installer Qualifications: Installer of flashing and sheet metal is a certified installer with a documented history installing manufacturer's products according to manufacturer's specifications.

D. Fabricator Qualifications: Shop that 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.

E. 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 roof eave, including gutter, fascia**,** and through wall flashing approximately 2 feet long, including supporting construction cleats, seams, attachments**,** underpayments**,** and accessories.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect/Engineer specifically approves such deviations in writing.

3. Approved mockups may become part of the completed Work if undisturbed at time of Final Acceptance.

1.5 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 the extent necessary for the period of sheet metal flashing and trim installation.

PART 2 - PRODUCTS

2.1 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.

B. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed.

1. Finish: 2B (bright, cold rolled).

2. Surface: Smooth, flat.

C. Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and pre-painted by the coil-coating process to comply with ASTM A 755/A 755M.

1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality.

2. 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.

2.2 UNDERLAYMENT MATERIALS

A. Polyethylene Sheet: 6-mil- (0.15-mm-) thick polyethylene sheet complying with ASTM D 4397.

B. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, non-perforated.

C. 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; stable after testing at 240 deg F (116 deg C).

2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C).

3. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Carlisle Coatings & Waterproofing Inc.; CCW WIP 300HT.
b. Grace Construction Products, a unit of W. R. Grace & Co.; Ultra.
c. Henry Company; Blueskin PE200 HT.
d. Metal-Fab Manufacturing, LLC; MetShield.
e. Owens Corning; WeatherLock Metal High Temperature Underlayment.
f. Or Engineer's approved equal

D. Slip Sheet: Building paper, 3-lb/100 sq. ft. (0.16-kg/sq. m) minimum, rosin sized.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item 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 or manufactured item.

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.
b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

2. Fasteners for Zinc-Tin Alloy-Coated Copper Sheet: Copper, hardware bronze or Series 300 stainless steel.

3. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

4. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.

5. Fasteners for Zinc-Tin Alloy-Coated Stainless-Steel Sheet: Series 300 stainless steel.

6. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329 or Series 300 stainless steel.

7. Fasteners for Zinc Sheet: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329 or Series 300 stainless steel.

C. Solder:

1. For Copper: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.

2. For Stainless Steel: ASTM B 32, Grade Sn60, with an acid flux of type recommended by stainless-steel sheet manufacturer.

3. For Zinc-Tin Alloy-Coated Stainless Steel: ASTM B 32, 100 percent tin.

4. For Zinc-Coated (Galvanized) Steel: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.

5. For Zinc: ASTM B 32, 40 percent tin and 60 percent lead with low antimony, as recommended by manufacturer.

D. 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.

E. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

H. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

I. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.4 MANUFACTURED SHEET METAL FLASHING AND TRIM

A. Through-Wall Ribbed Sheet Metal Flashing: Manufacture through-wall sheet metal flashing for embedment in masonry with ribs at 3-inch (75-mm) intervals along length of flashing to provide an integral mortar bond. Manufacture through-wall flashing with interlocking counter flashing on exterior face, of same metal as reglet.

1. Stainless Steel: 0.016 inch thick.

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) Cheney Flashing Company; Cheney Flashing (Dovetail).
   2) Cheney Flashing Company; Cheney Flashing (Sawtooth).
   3) Hohmann & Barnard, Inc.; STF Sawtooth Flashing.
   4) Keystone Flashing Company, Inc.; Keystone Three-Way Interlocking Thruwall Flashing.
   5) Sandell Manufacturing Company, Inc.; Pre-Formed Metal Flashing
   6) Or Engineer's approved equal

2.5 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the 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 without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed 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 as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

C. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.

D. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" for application, but not less than thickness of metal being secured.

G. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

H. Do not use graphite pencils to mark metal surfaces.

I. Form sections, per referenced standards, true to shape, accurate in size, square, and free from distortion or defects. Form pieces in single length sheets, not to exceed 10'-0" in length. Hem exposed edges on underside 1/2 inch; miter and seam corners.

J. Seams: Flat lock.

K. Corners: One piece with minimum 18 inch long legs; solder for rigidity, seal with sealant.

L. Cleats: Minimum 2 inches wide, interlockable with sheet.

M. Vertical Faces: Bottom edge formed outward 1/4 inch and hemmed to form drip.

N. Flashing Toe: Extend toe 2 inches over roofing; return and brake edges.

O. Soldering: Solder shop formed metal joints. After soldering, remove flux; wipe and wash solder joints clean. Weather seal joints.

P. Back Painting: Paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

2.6 ROOF DRAINAGE SHEET METAL FABRICATIONS

Q. Interior Gutters: Fabricate to cross section indicated, complete with end pieces, outlet tubes, pitch pan, and other accessories as required. Fabricate in minimum 96-inch- (2400-mm-) long sections. Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters.

1. Gutter Style: Box-Style, See drawings.

2. Expansion Joints: Built in.

3. Accessories: pitch pan

4. Gutters with Girth up to 15 Inches (380 mm): Fabricate from the following materials:

a. Copper: 16 oz./sq. ft..thick
b. Aluminum: 0.032 inch. thick
c. Stainless Steel: [0.016 inch thick.
d. Zinc-Tin Alloy-Coated Stainless Steel: 0.015 inch thick.
e. Zinc-Tin Alloy-Coated Copper: 16 oz./sq. ft thick.
f. Galvanized Steel: 0.022 inch thick.
g. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.
h. Zinc: 0.039 inch thick.

2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof-Edge Flashing and Fascia Cap: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 10-foot- (3-m-) long, sections.

1. Joint Style: flat snap lock seam

2. Finish: Refer to finish schedule..

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.

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.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Product handling:

1. Delivery: Schedule delivery of materials at the site at such time as required for proper coordination of the work. Receive materials in manufacturer’s unopened packages and bearing manufacturer’s label.

2. Storage: Store materials in a dry and well ventilated place, adequately protected from damage and exposure to the elements.

3.2 PREPARATION

A. Examination: Examine conditions of work in place before beginning work; report defects.

B. Measurements: Take field measurements; report variance between plan and field dimensions.

C. Storage: Stack preformed material to prevent twisting, bending or abrasion; slope to ensure drainage.

3.3 INSTALLATION, GENERAL

A. General: Install in conformance with referenced standards, manufacturer's written directions, as shown, and as specified.

B. Underlayment:

1. Apply one (1) layer of felt underlayment over surfaces as shown; lap all edges 6 inches minimum, in direction of slope.

2. Polyethylene Sheet: Install polyethylene sheet with adhesive for anchorage to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped and taped joints of not less than 2 inches (50 mm).

3. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Apply primer if required by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails 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 with roller. Cover underlayment within 14 days.

C. Application:

1. General: Make corners square, surfaces true and straight in planes, and lines accurate to profiles. Fit sheet metal tight in place; secure using concealed fasteners. Apply plastic cement compound between metal flashing and felt flashing. Seal metal joints watertight.

2. Expansion and Contraction: Allow for expansion and contraction over an ambient temperature range up to 150 degrees F; distortions resulting from fastening or expansion and contraction stresses not acceptable.

3. Dissimilar Metals: Isolate with heavy coat of bituminous paint. Coat all sheet metal in contact with roofing felts.

D. Assemblies:

1. Flashing:

a. General: Install flashing where shown; miter and solder joints at corners. Lap joints in counter flashing at least 6 inches and make watertight with sealing tape. Extend counter flashing down not less than 6 inches.
b. Exterior Metal Frame Flashing: Provide at frame heads, as shown

2. Roof Drainage:

a. Interior Gutter: Install with a minimum pitch of 1/16” per foot, pitch as shown on drawings, with joints and closed ends riveted and soldered; provide expansion joints as required. Secure with sheet metal straps.
b. Rainwater Leaders
1) Downspouts: Connect to gutter as shown. Fasten to column with metal straps located at the top, center point and bottom of each downspout; align straps on column face; maximum spacing 6'-0".

E. Sealants: As shown; per manufacturer's directions.

F. Galvanizing Repair Treatment: Repair damaged zinc coating with specified repair compound, as required.

3.4 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, welding rods, 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 and levels indicated. 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. Space cleats not more than 12 inches (300 mm) apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.

4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.

5. Install sealant tape where indicated.

6. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.

1. Coat back side of uncoated aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.

2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.

C. 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 (600 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.

D. Fastener Sizes: Use fasteners of sizes that will penetrate metal decking not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal joints as shown and as required for watertight construction.

1. Where sealant-filled joints are used, 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 moderate, 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 Division 07 Section 07920 "Joint Sealants and Caulking."

F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm), except reduce pre-tinning where pre-tinned surface would show in completed Work.

1. Do not solder metallic-coated steel and aluminum sheet.

2. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

3. Stainless-Steel Soldering: Tin edges of uncoated sheets using solder recommended for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

4. Copper Soldering: Tin edges of uncoated copper sheets using solder for copper.

G. Roof edge flashing / fascias to be installed as per roof panel manufacturer’s recommendations.

3.5 ROOF DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

B. Interior Gutters: Join sections with riveted and soldered joints or with lapped joints sealed with sealant. Provide for thermal expansion. Attach gutters at steel structure to firmly anchored gutter brackets spaced not more than 36 inches (900 mm) apart. Provide end closures and seal watertight with sealant. Slope to downspouts.

1. Anchor and loosely lock back edge of gutter to continuous cleat

2. Coordinate installation with roof panel manufacturer.

C. Downspouts: Join sections with 1-1/2-inch (38-mm) telescoping joints.

1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches (1500 mm) o.c. in between.

2. Provide elbows at base of downspout to direct water away from building.

3. Connect downspouts to underground drainage system indicated.

3.6 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated.

1. Brick Headwall: Sawcut reglet joint at existing mortar joints at minimum recommended height above roof plane. Full continuous seal at reglet joint.

3.7 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.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturers written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.

E. 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 07 60 00

SECTION 07 71 23 - ROOF SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Standard roof drains

1.2 RELATED SECTIONS

A. Section 07 53 00 – Single ply membrane roofing

1.3 REFERENCES

A. ANSI/ASME A112.6.4-2003 – Roof, Deck and Balcony Drains.

B. IAPMO IGC 187-2009 Roof Drains with Integral Overflow Drain

C. LC1021 Roof Drains with Integral Overflow Drain or air Vent

D. ASTM A 48 - Standard Specification for Gray Iron Castings.

1.4 SUBMITTALS

A. Comply with Section 01330 - Submittal Procedures.

B. Product Data: Submit manufacturer's product data, including installation instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Storage: Store materials in clean, dry area indoors in accordance with manufacturer's instructions.

C. Handling: Protect materials from damage during handling and installation.

PART 2 PRODUCTS

2.1

MANUFACTURER

A. Zurn
B. Jay R. Smith
C. Wade
D. Or approved equal.

2.2 MATERIALS

A. Standard Primary Drains Roof Drains:

1. Compliance: ANSI/ASME A112.6.4-2003,

2. Body: Powder coated, ASTM A 48, Class 25 cast iron body with anchor flange and fully cast sump which includes the outlet within the casting. Smooth sump walls for maximum flow ability no boss obstructions. Bolts holes drilled and tapped to1.5" depth

3. Dome Strainer: Cast Iron strainer.

4. Membrane Clamp Ring: 2.375-inch (61-mm) wide, ASTM A 48, Class 25 cast iron, waterproofing membrane clamp ring with 1.25" min. high integral gravel stop. 4 bolt anchorage and .25" nominal drainage free area height.

5. Pipe Size: 3 inches (76 mm)

6. Drain bolts 1.5" long threaded length with anti-seize pre-applied to threads

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas to receive roof drains. Notify Architect of conditions that would adversely affect installation or subsequent use. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install roof drains in accordance with manufacturer's instructions at locations indicated on the drawings.

B. Install roof drains plumb, level, and to correct elevation.

C. Install roof drains using manufacturer's supplied hardware.

3.3 PROTECTION

A. Protect installed roof drains from damage during construction.

3.4 WARRANTY

A. Standard warranty 1 year on all roof drain products

B. Optional 25 year Replacement Warranty contractor is required complete all requirements for warranty. Warranty will not be activated until all required paper work is submitted and invoice is paid in full. See website for details.

C. Optional 25 year Enhanced Installation and Replacement Warranty contractor is required complete all requirements for warranty. Warranty will not be not in effect until all required paper work is submitted, warranty and product invoice is paid in full. See website for details

END OF SECTION 07 05 00

SECTION 07 84 00 - FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Firestopping is required to prevent the passage of flame and the products of combustion through concealed spaces and openings including, but not limited to, providing firestops and smoke seals at all penetrations through floors and fire rated partitions, at expansion joints in floors in areas which are not exposed to view, above wall or partitions indicated to extend to underside of structure above, concealed furring spaces behind finished surfaces, openings related to fire-extinguisher cabinets, recessed water coolers, mechanical and electrical panels, and all other systems that penetrate or interrupt fire-rated assemblies and elsewhere as indicated on the plans. Materials and installation methods shall comply with the applicable requirements of FM Global.

B. Firestop and smokeseal systems specified in this Section shall include all labor, materials, equipment, and services necessary for the complete installation of Firestops and Smokeseals as required by code, as indicated on the Plans, and shall include, but not limited to, the following:

1. Single component, Silicone Firestop Sealant, Water Based Intumescent Sealant (which remains flexible after cure) or Putty for use in the following fire-rated and/or smoke barrier construction:

   a. With penetrations subject to movement including conduit, cable, bundles, buss duct, and non-combustible pipe.
   b. In control joints, in head of wall/floor assemblies, in floor edge wall voids, etc.
   c. As a sealant or caulking for smoke barrier construction, fire and smoke dampers, fire door frames in walls.

C. Compressible filler materials shall be furnished and installed for rated and non-rated masonry and gypsum board partition systems to close top of wall to deck locations, precast reveal infill at wall assembly intersections, wall and floor penetrations and other locations as required by code.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Attention is directed to the General Conditions, Supplementary Conditions, and all Sections within Division 1 - General Requirements, which are hereby made a part of this Section of the Specifications.

B. Specification sections which directly relate to the work of this section include, but are not limited to, the following:

1. Section 05 40 00 – Cold formed metal framing
2. Section 07 92 00 - Joint Sealants and caulking

1.3 QUALITY ASSURANCE

A. Qualifications of manufacturer: Products used in the work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production acceptable to the Designer.

B. Qualifications of installers: Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the application of fire stop materials and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section. Applicator shall be approved in writing by Manufacturer.

C. Single source: All firestop products used on this project shall be from one and the same manufacturer unless otherwise approved by the Designer.

D. Comply with pertinent codes and regulations of governmental authorities having jurisdiction.

1.4 SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS.

B. Samples: Submit two samples of each type of firestop, smokeseal and compressible filler materials to be incorporated into the work.

C. Schedule of Firestopping: List each type of penetration and the proposed UL system Number for firestopping each penetration.

D. Product Data:

1. Submit manufacturer’s product literature for each type of firestop and smokeseal material to be installed. Literature shall indicate product characteristics, typical uses, performance and limitation criteria, and test data.

2. Submit manufacturer's installation procedures for each type of product and construction/resistance required for the project.

3. Submit detail drawings for each firestop configuration, showing method of firestop and UL System Number.

E. For those applications that exist for which no UL tested system is available through a firestop manufacturer, a manufacturer’s engineering judgment derived from a similar UL system design or other test shall be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment drawings shall follow requirements set forth by the International Firestop Council.

F. On-Site Sample Installation to be included in Work: Minimum thirty days prior to application in any area, provide samples of firestop and smokeseal materials and installation in accordance with the following requirements.

1. Apply one sample of appropriate firestop and smokeseal material for each different penetration and fire rating required for the work.

2. Sample areas will comply with thickness, fire resistance ratings, and finished appearance of the project and applicable fire code.

3. Acceptance samples will constitute standard of acceptance for method of application, thickness, and finished appearance for firestop and smokeseal application. The sample(s) shall remain visible during completion of the work and shall remain as part of the completed work.

G. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR - POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.
2. Source quality-control test reports.
3. Field quality-control test reports.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Refer to Form 816 Article 1.06.03 and Form 816 Article 1.20-1.06.03 for additional information.

B. Deliver products to jobsite in manufacturer's original, unopened containers bearing proper U.L. labeling.

C. Material shall be stored off the ground in an area protected from weather, moisture, and freezing.

D. All materials shall be installed prior to expiration of shelf life.

1.6 PERFORMANCE CRITERIA

A. Provide materials and work to conform to Building Code Requirements in fire resistant wall and floor assemblies.

B. Testing Requirements:

1. All firestop/smokeseal material shall be tested by a recognized, independent testing agency and shall conform to both Flame (F) and Temperature (T) requirements of ASTM E-814.

2. Conform to UL Fire Hazard Classification Requirements.

3. Tested and classified non-combustible per ASTM E-136.

4. For head of wall construction joints, UL Listing per UL Standard 2079 with cycling.

C. Firestops in place shall be of sufficient thickness, width, and density to provide a fire resistance rating at least equal to the floor, wall, or partition construction into which it is installed.

D. Non-combustible dams shall be constructed:

1. As necessary to achieve fire rating as tested and rated.

2. In conformance with installation requirements for type of floor, wall, and partition construction.

3. As recommended by firestop/smokeseal manufacturer.

E. Combustible damming materials, if used, must be removed after proper curing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide products manufactured by Bio Fireshield, Inc. (978-369-7700) and Hilti Inc. (800-879-6000) or approved equal.

2.2 FIRESTOP SEALANT AND PUTTY

A. Provide single component, non-combustible silicone elastomer firestop sealant, Biotherm "100" (Gun Grade) or Biotherm "200" (Self Leveling), or water based intumescent sealant, Biostop "500" or Hilti FS One Elastomeric Firestop Sealant or approved equal.

B. Sealant shall have U.L. Classification as a "fill, void, or cavity material" for through penetration firestop system when tested in accordance with ASTM E-814/UL1479.

2.3 COMPRESSIBLE FILLER - (FIRE SAFING)

A. Compressible Filler Safing Insulation: Provide material tested, listed and labeled by UL and listed by UL in designs similar to applications indicated. Provide semi-rigid, non-asbestos mineral fiberboard, rated non-combustible when tested according to ASTM E184, complying with FS HH-I-558B form A, and having the following characteristics:

1. K-Value: 0.25 at 75°F.

2. Thickness: 4", unless indicated otherwise, and not less than the thickness necessary to obtain required fire-rating.

3. Density: Nominal 4 lbs/ft^3.

4. Acceptable Products: Provide Thermafiber safing insulation as manufactured by US Gypsum Company, Safing Insulation as manufactured by Fibrex, Inc., Roxul Safe moisture resistant mineral wool insulation as manufactured by Insulation Distributors Corporation, or approved equal to suit conditions and to comply with fire resistance and firestop manufacturer's recommendations.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where firestops are to be installed and notify the Designer of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface to receive firestops shall be free of dirt, dust, grease, oil, form release agents, or other matter that would impair the bond of the firestop material to the substrate or penetrating item(s).

B. Voids and cracks in substrate shall be filled and unnecessary projection removed prior to installation of firestops.

C. All penetrating items shall be permanently installed prior to firestop installation.

D. Substrate shall be frost, free and, when applicable, dry.

3.3 INSTALLATION

A. General:

1. Installation of firestops shall be performed by applicators/installers qualified and trained by the manufacturer. Installation shall be performed in strict accordance with manufacturer's detailed installation procedures.

2. Apply firestops in accordance with fire test reports, fire resistance requirements, acceptable sample installations, and manufacturer's recommendations. Meet building code requirements.

3. Coordinate with plumbing, mechanical, electrical, and other trades to assure that all pipe, conduit, cable, and other items which penetrate fire rated construction have been permanently installed prior to installation of firestops, schedule and sequence the work to assure that partitions and other construction which would conceal penetrations are not erected prior to the installation of firestops.

B. Installation of Single Component Silicone Firestop or Water Based Intumescent Firestop Caulk:

1. Apply with manual or powered caulking gun.

2. Apply to total thickness required per applicable UL system to equal fire resistance rating of assembly being penetrated. Apply to both sides of wall penetrations; one side only in floor penetrations.

3. Use incombustible insulation as required to achieve fire resistance rating.

4. Surface of gun grade silicone firestop may be tooled using clean, potable water.

5. Clean excess material off of adjacent surfaces and tools within 10 minutes using either water or Xylol where the use of such would not be hazardous.

F. Firesafing Insulation:

1. Install firestopping safing insulation on safing clips spaced as needed between each stud and floor slab, leaving no voids. Secure safing clips to slab using fasteners recommended by insulation manufacturer. Install sealant over mineral wool in accordance with test requirements.

2. At construction joints (perimeter openings) between floor or roof construction and aluminum wall system in which a continuous horizontal mullion does not occur at the floor or roof line, install U.S. Gypsum Glass Curtain Wall Fire Containment System or approved equal, Test CEG 1-16-90 in strict accordance with manufacturer's written instructions.

G. Installation of firestopping sealant at head of wall construction joints:

1. Apply Bio Fireshield Biostop 500 Firestop Caulk and Mineral wool filler or approved equal in strict accordance with manufacturer's instructions. Install fiberglass backer insulation full depth of partitions.

2. Similar systems produced by other specified manufacturers may be used providing such systems comply with all criteria required for such application, including firestop caulk to be free of lead, ethylene glycol, methylene chloride, ceramic fiber and asbestos, and firestop material must remain flexible when fully cured.

H. Installation of intumescent mastic at head of wall construction joints:

1. Install 4.0 pcf (minimum) mineral wool into joints.

2. Spray apply Biostop 700 or approved equal to a 1/8" dry thickness over mineral wool, and overlap both the wall and underside of floor above, 1/2".

3.4 FIELD QUALITY CONTROL

A. Testing: The Department reserves the right to employ an independent testing agency to conduct material evaluation and application tests. The Contractor shall cooperate fully and, when requested, permit samples of materials to be taken from containers as the materials are applied to building surfaces.

B. Cost of Testing: If tests indicate that materials or work does not comply with requirements, the Contractor shall pay for tests performed, all retesting, and shall remove and replace non-complying work.

3.5 CLEANING, AND PROTECTION

A. Finished surfaces adjacent to firestops shall be cleaned of excess sealant materials. Remove all excess materials and discarded packaging from the building. Remove and replace work that cannot be successfully cleaned.

B. Provide temporary protection to ensure work being without damage or deterioration at time of final acceptance. Remove protections as necessary immediately before final acceptance.

END OF SECTION 07 84 00

SECTION 07 92 00 - JOINT SEALANTS AND CAULKING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 General Requirements, apply to this Section.

1.2 SUMMARY

A. Description: This Section includes but is not limited to sealants for the following applications:

1. Exterior joints in the following vertical surfaces and non-traffic horizontal surfaces:

a. Joints between different materials to prevent infiltration of weather elements.

b. Perimeter joints between frames of doors and windows.

c. Control and expansion joints in sheet metal work, ceilings and overhead surfaces.

d. Other joints as indicated or otherwise required to complete the Work of this Section and the Work of other Sections.

2. Interior joints in the following vertical surfaces and horizontal non-traffic surfaces:

a. Perimeter joints of exterior openings where indicated.

b. Perimeter joints between interior wall surfaces and frames of interior doors and windows.

c. Other joints as indicated or otherwise required to complete the Work of this Section and the Work of other Sections.

3. Primers: Applications of manufacturers' recommended primers or system component Primers to joint surfaces prior to sealant installation.

1.3 RELATED SECTIONS

A. Section 07 41 00 – Manufactured wall panels

B. Section 08 51 00 – Aluminum windows

C. Section 08 80 00 - Glazing

D. Section 13 34 19 – Pre-engineered Platform Shelters and Windscreen

1.4 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and air tight continuous joint seals without staining or deteriorating joint substrates.

1.5 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. 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.

C. Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.

D. 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.

E. 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.

F. Warranties: warranties specified in this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Installer of joint sealants and caulking is a certified installer with a documented history installing manufacturer’s products according to manufacturer’s specifications.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.

2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.

3. Test elastomeric joint sealants according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in peel, and indentation hardness.

4. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.

D. Mockups: Provide a full-scale field mock-up of each type sealant application indicated, consisting of a minimum of 10 linear feet of installed primer and sealant, and indicating the proposed

installation methods and proposed finished conditions of each material, component and system required. Install individual components complete, and in the sequence required, in full accordance with Manufacturer's written instructions (where applicable), and in compliance with requirements of Contract Documents.

1. Preparation: Notify Engineer of intention to install mock-ups required and obtain Engineer's acceptance for proposed mock-up locations. Install mock-ups in place within the Work unless other locations are requested by Engineer.

2. Where Engineer requests an opportunity to view the installations in progress, notify Engineer of exact schedule of mock-up installations, at least 24-48 hours in advance.

3. Reinstall or revise mock-ups where requested by Engineer until satisfactory results and Engineer's acceptance are obtained.

4. Provide precise and consistent match to accepted mock-ups in subsequent work. Where requested by Engineer, remove non-matching work and replace with new work.

5. Protect accepted mock-ups until completion of Project Work. Accepted mock-ups may remain as part of the finished Work only at the discretion of the Engineer.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section 01 31 19 "Project Meetings."

1.7 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 multi-component 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.

1.8 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 ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40° F (4.4° C).

3. 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.

1.9 WARRANTY

A. General Warranty: 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 Design-Builder under requirements of the Contract Documents.

B. Installer's Warranty: Written warranty, signed by Installer 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: Two years from date of Final Acceptance.

C. Standard Manufacturer's Warranty: Written warranty, signed by elastomeric sealant manufacturer agreeing to furnish elastomeric joint sealants to repair or replace those 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 Final Acceptance.

D. Warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:

1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.

2. Disintegration of joint substrates from natural causes exceeding design specifications.

3. Mechanical damage caused by individuals, tools, or other outside agents.

4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include products of the following manufacturers:

1. Tremco

2. Dow Corninng Corporation

3. Pecora

4. GE Silicon

5. Or Engineer’s approved equal

2.2 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. Fire rated assemblies: Verify with the manufacturer for the appropriate sealant and caulking.

C. Colors of Exposed Joint Sealants: As selected by Engineer/Architect from manufacturer's full range.

2.3 SEALANT MATERIALS

A. For purposes of establishing the standard of quality for sealants and related materials, the following specifications are based on products listed. Equivalent products from the acceptable manufacturers listed will be considered for use in this Project, subject to the approval of the Engineer.

2.4 SINGLE-PART URETHANE SEALANT (Sealant No. 1)

A. Polyurethane Sealant: Single component, chemical during, non-staining, non-bleeding, capable of continuous water immersion, non-sagging, self-leveling type; complying with Class A ASTM C 920, Type S, Grade NS, Class 25, Use NT, M, A, O.

B. Products: Subject to compliance with requirements, provide the following:

1. Low Modulus Expansion Joint Sealant: Dymonic, product of Tremco or Engineer’s approved equal

2.5

2.6 SINGLE-PART SILICONE SEALANTS (Sealant No. 2)

A. Silicone Sealant: Single component, neutral-cure, solvent curing, cold-applied, non-sagging, non-staining, fungus resistant, non-bleeding; complying with ASTM C 920, Type S, NS, Class 25.

B. Products: Subject to compliance with requirements, provide one of the following:

1. Silicone Sealant:

a. Dow 795 Silicone Building Sealant, product of Dow Corning Corporation.
b. Silpruf Silicone Sealant, product of GE Silicones.
c. Pecora 864 Silicone Sealant, product of Pecora.
d. Or Engineer’s approved equal

1.2 ACRYLIC LATEX SEALANT (Sealant No. 3)

A. Sealant for interior joints, exposed or paint-finished: Tremco Acrylic Latex sealant manufactured by the Tremco Manufacturing Company or Engineer’s Approved Equal meeting the requirements of ASTM C-834.

2.6 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.

1. 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:

2. Type O: Open-cell material.

B. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26° F (minus 32° C). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.

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.

2.7 PRIMERS AND MISCELLANEOUS MATERIALS

A. Primers: Materials recommended by joint sealant manufacturer for advancing or improving adhesion of sealant to joint substrates indicated, as determined from pre-construction joint-sealant-substrate tests and field tests.

B. Primer Use Required: Primer use is required throughout each application, unless unacceptable staining of adjacent materials results.

1. 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.

2. Masking Tape: Non-staining, 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 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.

   a. Metal.
   b. Glass.
   c. Porcelain enamel.
   d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates as recommended in writing by joint sealant manufacturer, based on pre-construction 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.

1. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

2. 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.

3. 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.

a. Do not leave gaps between ends of sealant backings.

b. Do not stretch, twist, puncture, or tear sealant backings.

c. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

4. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and back of joints.

5. Install sealants by proven techniques to comply with the following and at the same time backings are installed:

a. Place sealants so they directly contact and fully wet joint substrates.

b. Completely fill recesses provided for each joint configuration.

c. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

6. Tooling of Non-sag 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.

a. Remove excess sealants from surfaces adjacent to joint.

b. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

c. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

d. Provide flush joint configuration, per Figure 5B in ASTM C 1193, where indicated.

e. Provide recessed joint configuration, per Figure 5C in ASTM C 1193, of recess depth and at locations indicated. Use masking tape to protect adjacent surfaces of recessed tooled joints.

3.4 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.

3.5 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 Final Acceptance. 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.

3.6 MISCELLANEOUS SEALANT WORK AND REPAIRS

A. Examine existing sealant work to remain and new and existing sealant and other work at platform. Provide such additional sealant applications and installations as may be required to repair existing work, to restore the weather-impermeability of existing and new work, and to complete the work of other Sections.

3.7 SEALANT SCHEDULE

A. Interior and exterior joints requiring sealant work include, but are not limited to, the following:

1. Metal/metal joints: Sealant No. 2.

2. Masonry joints: Sealant No. 1.

3. Concrete joints: Sealant No. 1.

4. Glass/metal joints: Sealant No. 2.

5. Metal/concrete: Sealant No. 1.

6. Metal/wood joints: Sealant No. 3.

END OF SECTION 07 92 00

SECTION 08 45 23 - 2-3/4” TRANSLUCENT FIBERGLASS SANDWICH PANEL SKYLIGHT CANOPY SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the insulated translucent sandwich panel skylight system and accessories as shown and specified. Work includes providing and installing:

1. 2 ¾” curved factory prefabricated structural insulated translucent sandwich panels

2. Aluminum installation system

3. Aluminum flashing attached to skylights

B. Related Sections:

1. Roofing: Section 07 53 00

2. Flashing and Sheet Metal: Section 07 60 00

3. Sealants: Section 07 92 00

4. Glazing: Section 08 80 00

1.2 SUBMITTALS

A. Submit manufacturer’s product data. Include construction details, material descriptions, profiles and finishes of skylight components.

B. Submit shop drawings. Include elevations and details.

C. Submit manufacturer's color charts showing the full range of colors available for factory-finished aluminum.

1. When requested, submit samples for each exposed finish required, in same thickness and material indicated for the work and in size indicated below. If finishes involve normal color variations, include sample sets consisting of two or more units showing the full range of variations expected.

a. Sandwich panels: 14” x 28” units
b. Factory finished aluminum: 5” long sections

D. Submit Installer Certificate, signed by installer, certifying compliance with project qualification requirements.

E. Submit product reports from a qualified independent testing agency indicating each type and class of panel system complies with the project performance requirements, based on comprehensive

testing of current products. Previously completed reports will be acceptable if for current manufacturer and indicative of products used on this project.

1. Reports required are:

   a. International Building Code Evaluation Report
   b. Flame Spread and Smoke Developed (UL 723) – Submit UL Card
   c. Burn Extent (ASTM D 635)
   d. Color Difference (ASTM D 2244)
   e. Impact Strength (UL 972)
   f. Bond Tensile Strength (ASTM C 297 after aging by ASTM D 1037)
   g. Bond Shear Strength (ASTM D 1002)
   h. Beam Bending Strength (ASTM E 72)
   i. Fall Through Resistance (ASTM E 661)
   j. Insulation U-Factor (NFRC 100)
   k. Solar Heat Gain Coefficient (NFRC or Calculations)
   l. Air Leakage (ASTM E 283)
   m. Structural Performance (ASTM E 330)
   n. Water Penetration (ASTM E 331)
   o. Class A Roof Covering Burning Brand (ASTM E 108)

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications

1. Material and products shall be manufactured by a company continuously and regularly employed in the manufacture of specified materials for a period of at least ten consecutive years and which can show evidence of those materials being satisfactorily used on at least six projects of similar size, scope and location. At least three of the projects shall have been in successful use for ten years or longer.

2. Panel system must be listed by an ANSI accredited Evaluation Service, which requires quality control inspections and fire, structural and water infiltration testing of sandwich panel systems by an accredited agency.

3. Quality control inspections shall be conducted at least once each year and shall include manufacturing facilities, sandwich panel components and production sandwich panels for conformance with AC177 "Translucent Fiberglass Reinforced Plastic (FRP) Faced Panel Wall, Roof and Skylight Systems" as issued by the ICC-ES.

B. Installer's Qualifications: Installation shall be by an experienced installer, which has been in the business of installing specified skylight systems for at least two consecutive years and can show evidence of satisfactory completion of projects of similar size, scope and type.

1.4 PERFORMANCE REQUIREMENTS

A. The manufacturer shall be responsible for the configuration and fabrication of the complete skylight panel system.

1. When requested, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

2. Standard skylight system shall have less than 0.01 cfm/ft² air leakage by ASTM E 283 at 6.24 PSF (50 mph) and no water penetration by ASTM E 331 at 15 PSF; and structural testing by ASTM E 330.

3. Structural Loads; Provide skylight system capable of handling the following loads:

   a. Live Load: 30 PSF
   b. Snow Load: 30 PSF

   c. Wind Load: 35 PSF

1.5 DELIVERY STORAGE AND HANDLING

A. Deliver panel system, components and materials in manufacturer's standard protective packaging.

B. Store panels on the long edge; several inches above the ground, blocked and under cover in accordance with manufacturer's storage and handling instructions.

1.6 WARRANTY

A. Submit manufacturer's and installer's written warranty agreeing to repair or replace panel system work, which fails in materials or workmanship within one year of the date of delivery. Failure of materials or workmanship shall include leakage, excessive deflection, deterioration of finish on metal in excess of normal weathering and defects in accessories, insulated translucent sandwich panels and other components of the work.

B. Extended Warranty: 20 years on fiber bloom

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. The basis for this specification is for products manufactured by Kalwall Corporation. Other manufacturers may bid this project provided they comply with all of the performance requirements of this specification and submit evidence thereof. Listing other manufacturers' names in this specification does not constitute approval of their products or relieve them of compliance with all the performance requirements contained herein.

B. Kalwall Corporation, Tel: (800) 258-9777 – Fax: (603) 627-7905 – Email: info@kalwall.com

2.2 PANEL

COMPONENTS A. Face

Sheets

1. Translucent faces: Manufactured from glass fiber reinforced thermoset resins, formulated specifically for architectural use.

   a. Thermoplastic (e.g. polycarbonate, acrylic) faces are not acceptable.

b. Face sheets shall not deform, deflect or drip when subjected to fire or flame.

2. Interior face sheets:

a. Flame spread: Underwriters Laboratories (UL) listed, which requires periodic unannounced retesting, with flame spread rating no greater than 10 and smoke developed no greater than 450 when tested in accordance with UL 723.
b. Burn extent by ASTM D 635 shall be no greater than 1".

3. Exterior face sheets:

a. Color stability: Full thickness of the exterior face sheet shall not change color more than 3 CIE Units DELTA E by ASTM D 2244 after (5) five years outdoor South Florida weathering at 5° facing south, determined by the average of at least three white samples with and without a protective film or coating to ensure long-term color stability. Color stability shall be unaffected by abrasion or scratching.
b. Strength: Exterior face sheet shall be uniform in strength, impenetrable by hand held pencil and repel an impact minimum of 70 ft. lbs. without fracture or tear when impacted by a 3-1/4" diameter, 5 lb. free-falling ball per UL 972.

4. Appearance:

a. Exterior face sheets: Smooth, 0.070" thick and crystal in color to match existing.

b. Interior face sheets: Smooth, 0.070" thick and crystal or white in color to match existing.

c. Face sheets shall not vary more than ± 10% in thickness and be uniform in color.

B. Grid Core

1. Aluminum I-beam grid core shall be of 6063-T6 or 6005-T5 alloy and temper with provisions for mechanical interlocking of muntin-mullion and perimeter. Width of I-beam shall be no less than 7/16".

C. Laminate Adhesive

1. Heat and pressure resin type adhesive engineered for structural sandwich panel use, with minimum 25-years field use. Adhesive shall pass testing requirements specified by the International Code Council "Acceptance Criteria for Sandwich Panel Adhesives".

2. Minimum tensile strength of 750 PSI when the panel assembly is tested by ASTM C 297 after two exposures to six cycles each of the aging conditions prescribed by ASTM D 1037.

3. Minimum shear strength of the panel adhesive by ASTM D 1002 after exposure to four separate conditions:

a. 50% Relative Humidity at 68° F: 540 PSI
b. 182° F: 100 PSI
c. Accelerated Aging by ASTM D 1037 at room temperature: 800 PSI
d. Accelerated Aging by ASTM D 1037 at 182° F: 250 PSI

2.3 PANEL CONSTRUCTION

A. Provide sandwich panels of flat fiberglass reinforced translucent face sheets laminated to a grid core of mechanically interlocking I-beams. The adhesive bonding line shall be straight, cover the entire width of the I-beam and have a neat, sharp edge.

1. Thickness: 2-3/4”

2. Grid pattern: Nominal 12” x 24” Shoji.

3. Light transmission percentage: 35%

4. Solar heat gain coefficient: 0.52

5. Panel U-factor by NFRC certified lab: .53u

B. Standard panels shall deflect no more than 1.9” at 30 PSF in 10’ 0” span without a supporting frame by ASTM E 72.

C. Standard panels shall withstand 1200° F fire for minimum one hour without collapse or exterior flaming.

D. Skylight System:

1. Skylight system shall pass Class A Roof Burning Brand Test By ASTM E 108.

2. Skylight system shall be UL listed as a Class A Roof by UL 790, which requires periodic unannounced inspections and retesting by Underwriters Laboratories.

E. Skylight System shall meet the fall through requirements of OSHA 1910.23 as demonstrated by testing in accordance with ASTM E661, thereby not requiring supplemental screens or railings.

2.4 BATTENS AND PERIMETER CLOSURE

SYSTEM A. Closure system:

1. Extruded aluminum 6063-T6 and 6063-T5 alloy and temper clamp-tite screw type closure system.

2. Curved closure system may be roll formed.

3. Skylight perimeter closures at curbs shall be factory sealed to panels.

B. Sealing tape: Manufacturer's standard, pre-applied to closure system at the factory under controlled conditions.

C. Fasteners: 300 series stainless steel screws for aluminum closures, excluding final fasteners to the building.

D. Finish:

1. Manufactures factory applied finish which meets the performance requirements of AAMA 2604. Color to be selected from manufactures full range of standards

PART 3 - EXECUTION

3.1 EXAMINATION

A. Installer shall examine substrates, supporting structure and installation conditions.

B. Do not proceed with panel installation until unsatisfactory conditions have been corrected.

3.2

PREPARATION

A. Metal Protection:

Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

1. Where aluminum will contact concrete, masonry or pressure treated wood, protect against corrosion by painting contact surfaces with bituminous paint or method recommended by manufacturer.

3.3 INSTALLATION

A. Install the skylight system in accordance with the manufacturer's installation recommendations and approved shop drawings.

1. Anchor component parts securely in place by permanent mechanical attachment system.

2. Accommodate thermal and mechanical movements.

3. Set perimeter framing in a full bed of sealant compound, or with joint fillers or gaskets to provide weather-tight construction.

B. Install joint sealants at perimeter joints and within the panel system in accordance with manufacturer's installation instructions.

3.4 FIELD QUALITY CONTROL

A. Water Test: Installer to test skylights according to procedures in AAMA 501.2.

B. Repair or replace work that does not pass testing or that is damaged by testing and retest work.

3.5 CLEANING

A. Clean the skylight system inside and outside, immediately after installation.

B. Refer to manufacturer's written recommendations

END OF SECTION 08 45 23

SECTION 09 91 00 – PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. The work of this Section includes, but is not limited to, painting and finishing of all exposed surfaces, both interior and exterior, except the following:

1. Factory finished items, except as noted.

2. Finished metal surfaces of stainless steel, copper, brass, bronze, and aluminum, unless noted to be painted.

3. Finished metal surfaces that are plated such as finished hardware, no UL labels shall be painted.

4. Surfaces in concealed areas such as above ceilings, and the like.

5. Moving parts, code required labels, and equipment data plates.

6. Mechanical and electrical items not in public spaces.

7. Acoustical ceiling systems except existing acoustical ceilings indicated to be refurbished.

8. Finished masonry surfaces such as face brick, ground or split face concrete masonry and the like.

B. Where an item or surface is not specifically mentioned, paint the same color as adjacent materials or surfaces, including exposed surface-mounted conduit, piping and exposed ductwork.

C. Structural steel, steel joists and metal decking that will require a field applied top coat shall include, but not be limited to, the following locations:

1. Steel beams, steel joists, and steel deck at roof structure of the Main Shop Area.
2. Braced Frames exposed to view.
3. Bridge crane support steel.

1.2 WORK NOT INCLUDED

A. Interior and exterior surfaces as noted on finish schedule

1.3 QUALITY ASSURANCE

A. Single Source Responsibility: Provide primers and other undercoat paint produced by same manufacturer as finish coats. Use only thinners approved by paint manufacturer, and use only within recommended limits.

B. Coordination of Work: Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Upon request

from other trades, furnish information or characteristics of finish materials provided for use, to ensure that compatible coats are used.

1.4 TESTS

A. Testing Agency: The Department may employ an independent testing agency to perform tests, evaluations and certifications. Cooperate and permit samples of materials to be taken as they are used. The Contractor shall pay all costs of tests which show failure to comply with Contract Documents.

1.5 SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS.

B. Submit list of all materials proposed for use, indicating:

1. Manufacturer.

2. Product name.

3. Surface for which proposed.

C. Initial Selection Samples: Submit color swatches showing complete range of colors and finishes available for each paint and finish system.

D. Verification Samples: Submit representative samples of each material that is to be exposed in the finished work, showing the full range of color and finish variations expected. Prepare paint samples on gypsum drywall or poster board and make samples not less than 12 inches square.

1.6 DELIVERY, STORAGE AND HANDLING

A. Refer to Form 816 Article 1.06.03 and Form 816 Article 1.20-1.06.03 for additional information.

B. Deliver materials and products in unopened factory labeled packages. Store and handle in strict compliance with manufacturers' instructions and recommendations. Protect from freezing and damage.

C. Avoid the possibility of fire by removing flammable materials, solvents and spirits from the project site or by storing materials in UL approved fire-resistive cabinets. Keep work area free from flammable waste and soiled rags.

1.7 PROJECT CONDITIONS

A. Weather, Temperature, and Humidity: Perform work only when existing and forecasted conditions are within the limits established by manufacturers of the materials and products used.

1. Water-Base Paints: Apply only when temperature of surfaces to be painted and surrounding air temperatures are between 50°F and 90°F, unless otherwise permitted by manufacturer's printed instructions.

2. Solvent-Thinned Paints: Apply only when temperature of surfaces to be painted and surrounding air temperatures are between 45°F and 95°F, unless otherwise permitted by paint manufacturer's printed instructions.

3. Conditions: Do not apply paint in snow, rain, fog or mist, or when relative humidity exceeds 85%, or to damp or wet surfaces, unless otherwise permitted by paint manufacturer's printed instructions. Painting may be continued during inclement weather if areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer during application and drying periods.

B. Substrates: Proceed with work only when substrate construction and penetrating work is complete. Do not apply finish in area where dust is being generated.

C. Ventilation: Comply with manufacturer's requirements and recommendations.

D. Lighting: Since lighting conditions can change the appearance of the work, work only when permanent lighting system is operational and in use. If not in use provide temporary lighting that simulates as closely as possible permanent lighting system.

E. Protection: Cover or other wise protect finished work of other trades.

1.8 COORDINATION

A. Meeting: Convene a pre-installation meeting to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.

B. Coordinate this work with work specified in other sections. Furnish information on finish materials to be used in the field to ensure that correct prime coats are used in the shop.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Except as otherwise specified, materials shall be first line products of the following manufacturers or approved equal:

1. Conventional Paint Finishes:

a. Benjamin Moore
b. ICI Devoe
c. PPG, Pittsburgh Paints
d. Sherwin-Williams

2. Special Coatings:

a. Tnemec Company
b. Dupont
c. Hempel International Coatings
d. PPG Protective & Marine Coatings, Inc. (PPG PMC)

2.2 MATERIALS

A. Products specified are as manufactured by Benjamin Moore and Company and those of Tnemec Company unless otherwise indicated; approved equal products of acceptable manufacturers listed in Paragraph 2.1 may be furnished in lieu of those listed.

1. Quality: Select primary products of the system from the products of a single manufacturer.

2. Secondary products: Products not specified by name and required for the job, such as shellac, thinners, putty, shall be "best grade" or "first Line" products of a reputable manufacturer and acceptable to the manufacturer of the paint coatings.

3. Colors: Provide colors as directed by Designer; match Designer's color chips and numbers. Custom mix colors as directed. Deeptone, bright, and accent colors will be used. Public areas of the building shall be considered decorative and will require the use of several colors and accents.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION

A. Inspection: The Applicator shall examine substrates and conditions under which this work is to be performed and notify Contractor, in writing, of conditions detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning work means Applicator accepts substrates and conditions.

B. Responsibility: The Applicator shall be solely responsible for the finishing work and shall prepare substrates as needed to obtain the highest quality finished surfaces.

C. Manufacturer's Recommendations: Strictly comply with manufacturers' instructions and recommendations, except where more restrictive requirements are specified in this section.

D. Cleaning: Do not finish over dirt, rust, grease, moisture and other conditions detrimental to formation of a durable finish film. Clean surfaces to remove dirt, oil, grease, mildew, asphalt, concrete splatters, and all other foreign substances.

E. Removal and Protection: Remove finished hardware, fixtures, accessories, and similar items or provide adequate protection to ensure that these surfaces are not finished or splattered. Replace these items when finishing work is completed.

F. Shop Primers: Remove incompatible primers and reprime or provide barrier coats in compliance with finish manufacturer's instructions.

G. Masonry and Concrete: Prepare materials by removing laitance, efflorescence, form release agents, and surface glaze by cleaning and washing as recommended by finish manufacturer and approved by Designer. Brush surfaces to remove loose particles. Fill cracks and irregularities with Portland cement grout to provide uniform surface texture. Allow a minimum of 60 to 90 days curing time before finishing poured and precast concrete. Allow a minimum of 30 to 60 days curing time before finishing concrete masonry. Determine substrate alkalinity and moisture content and, if necessary, take appropriate remedial actions as recommended by manufacturers of primary finish materials.

H. Ferrous Metal: Prepare shop primed metal surfaces by solvent wiping, sanding and touching-up shop prime coats. Prepare bare metal surfaces by power tool cleaning [Steel Structures Painting Council SP-3]. Remove rust, welding flux and splatter, burrs, and all other surface defects and foreign substances. Clean surfaces by washing with water followed by phosphate rinsing. Apply prime coats immediately after completion of cleaning.

I. Galvanized Metal: Aggressively clean new unprimed galvanized surfaces with grease cutting solvent, such as mineral spirits, to remove fabricating oils. After cleaning provide a SSPC SP7 brush off blast of galvanized steel surfaces to create a 2mil profile for paint adherence. Touch-up abraded surfaces immediately with zinc-rich paint or rust-inhibiting paint acceptable to the Designer.

J. Galvanized, Shop Primed Metal: Solvent clean surfaces equal to SSPC SP-1.

K. Aluminum: Solvent clean surfaces equal to SSPC SP-1.

L. Doors: Finish tops, bottoms, and edges of doors the same as door faces.

M. Drywall: Clean surfaces free from dust and foreign substances. Joint treatment materials shall be thoroughly dry. Paint metal corner beads and trim with metal primer before application of water based finish coatings.

N. Ducts: Ducts visible through supply and return grilles shall be painted flat black.

3.2 APPLICATION

A. Manufacturer's Recommendations: Strictly comply with manufacturers' instructions and recommendations, except where more restrictive requirements are specified in this section.

B. Material Preparation: Mix and prepare materials in strict compliance with manufacturer's recommendations. Do not thin materials without Designer's approval. Keep foreign substances out of finishing materials.

C. Primers: Provide primers as recommended by finish system manufacturer for substrates encountered. Tint all primers and undercoats to the approximate shade of the finish coat, making each coat slightly darker and closer to the finished shade. Use deep base primers for deeptone, bright, and accent colors. Prime surfaces immediately after surface preparation to prevent contamination of substrate.

D. Application: Apply finish materials at the lowest coverage rates and the highest dry film thicknesses recommended by their manufacturers. Provide additional coats as needed to eliminate all show through and bleed through areas. Apply paint and finish systems as scheduled using brushes or rollers. Stain shall be applied with a brush and then wiped off at the proper time to produce the desired effect.

1. Spray Painting: Spray application of paint and finish systems is acceptable for metal doors and frames and interior steel joists, metal deck and mechanical ducts where Contractor can demonstrate adequate control of overspray, control of coats, and has first obtained Designer’s written permission.

E. Extent: Finish all surfaces behind removable items. Finish inside of ducts and grilles with flat black paint when these surfaces are visible.

F. Sanding: All painted woodwork and painted metal shall be finely sanded between coats as recommended by finish system manufacturer.

G. Recoat Time: Allow manufacturer's recommended waiting period between successive coats.

H. Finish Appearance: Provide uniform final finishes, free of runs, sags, wrinkles, streaks, shiners, brush/roller marks, color variations and other imperfections.

I. Mock-Up Matching: Provide final finishes which exactly match approved mock-ups.

J. Pipe Identification: Where exposed utility piping is required to be completely painted in code color under requirements of ANSI A13.l and ANSI Z535.l, paint such piping in proper color in accordance with aforementioned standards and as specified herein.

3.3 FIELD QUALITY CONTROL

A. Testing: The Department reserves the right to employ an independent testing agency to conduct material evaluation and application tests. The Contractor shall cooperate fully and, when requested, permit samples of materials to be taken from containers as the materials are applied to building surfaces.

B. Cost of Testing: If tests indicate that materials or work does not comply with requirements, the Contractor shall pay for tests performed, all retesting, and shall remove and replace non-complying work.

3.4 TOUCH UP, CLEANING, AND PROTECTION

A. Touch up damaged coatings and finishes to eliminate evidence of repair.

B. Clean finished surfaces and remove all finish splatters from adjacent work. Remove and replace work that cannot be successfully cleaned.

C. Provide signs and temporary protection to ensure work being without damage or deterioration at time of final acceptance. Remove protections and reclean as necessary immediately before final acceptance.

3.5 FINISH PAINTING SCHEDULE

A. The following finish systems refer to products of Benjamin Moore and the Tnemec Company, unless indicated otherwise. Provide these systems or approved equal systems from manufacturers listed in Paragraph 2.1.

1. EXTERIOR CONCRETE

Coat 1: Series 156 Tneme-Crete at 8-10 mils DFT (Dry Film Thickness)
Coat 2: Same as coat 1.

2. EXTERIOR FERROUS METAL

(Surface Preparation: SSPC-SP#6)
Coat 1: Tnemec Series 394 Onmithane Zinc (shop applied) at 3.0 mils DFT touch up.
Coat 2: Tnemec Series #27 WB Typoxy at 2.5 to 3.0 mils DFT.
Coat 3: Tnemec Series 1075U Endura-Shield at 3.0 mils DFT.

6. INTERIOR CONCRETE AND CMU (Epoxy System)

Coat 1: Tnemec Series 130 Envirofill at 100 square feet per gallon.
Coat 2: Tnemec Series 280 Tneme-glaze 6.0-8.0 mils DFT
Coat 3: Tnemec 1080 Endurashieild WB at 2.0 mils DFT

7. INTERIOR MISCELLANEOUS METAL (Alkyd System)

Surface Preparation; SSPC-SP#3
Coat 1: Tnemec Series 27 WB Typoxy at 2.5 mils DFT.
Coat 2: Tnemec Series 1028/1029 Enduratone at 2.0 mils DFT.
Coat 3: Same as coat 2.

8. EXTERIOR and INTERIOR FERROUS METAL AND GALVANIZED METAL EXPOSED TO UV LIGHT

Surface Preparation for Galvanized Surfaces: SSPC-SP#1 Solvent Wipe followed by SP#7
Surface Prep for Shop Primed Ferrous Metal: SSPC-SP#1
Coat 1: Tnemec Series #27 WB Typoxy at 2.5 to 3.0 mils DFT
Coat 2: Tnemec Series 1081 Endura-Shield at 3.0 mils DFT.

9. INTERIOR FERROUS METAL, NON-FERROUS AND GALVANIZED METAL

Surface Preparation: SSPC-SP#1 Solvent Wipe followed by SP-7
Coat 1: Tnemec Series 27 WB Typoxy at 3.0 to 4.0 mils DFT
Coat 2: Tnemec 1080 Endurashield WB at 2.0 mils DFT

10. ANTI- GRAFFITI - COATING OVER NEW CONCRETE BLOCK (Exterior Locations)

Coat 1: Chemprobe 626 Dur A Pell GS at 100-125 sq. ft. per gallon
Coat 2: Chemprobe 626 Dur A Pell GS at 100-125 sq. ft. per gallon

11. OVERHEAD DECK, JOISTS, PIPING, DUCTWORK ETC.

Surface prep for galvanized composite acoustical deck: Clean steel deck in accordance with manufacturer's specific directions for preparation of galvanized steel deck prior to coating.
Surface Prep for Shop Primed and Intermediate Coated Ferrous Metal: SSPC-SP#1
Coat 1: Tnemec Series N69 at 3.0 to 4.0 mils DFT
Coat 2: Same as coat 1.

13. INTERIOR FERROUS METAL, STEEL JOISTS, STEEL DECK

Surface Prep for Shop Primed and Intermediate Coated Ferrous Metal: SSPC-SP#1
Coat 1 and 2: Tnemec 394 Omni-Than and 27 WB Typoxy Shop Applied
Coat 3: Tnemec Series N69 at 3.0 - 4.0 mils DFT.

END OF SECTION 09 91 00

SECTION 09 96 23 - GRAFFITI-RESISTANT COATINGS

PART 1 GENERAL

1.1 SUMMARY

A. Description: Provide Graffiti Resistant Coatings, as shown and specified per Contract Documents to be applied to canopy column jackets.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Other specification sections which directly relate to the work of this section include, but are not limited to, the following:

1. Section 03 45 00 – Architectural Pre-Cast Concrete

1.3 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Samples: General: Submit specified colors for each surface-finishing product.
1. Field Samples:
   a. General: In place, on material scheduled to be finished, illustrating coating color, texture and finish. Locate where directed; accepted sample may remain as part of the Work.
   b. Size: One (1) entire unit as scheduled to be finished

C. Product Data: Submit manufacturer's specifications, data, and installation instructions for review.

D. Certificates: Submit statement of VOC compliance with state and local regulations.

E. Closeout:

1. Extra Stock: Deliver one percent (1%) or a minimum of five (5) gallons of each color, type and surface texture of paint installed. Label each container with color, type, texture and room locations.

2. Guarantee:
   a. General: Provide, in required form, for a period of one (1) year from date of final acceptance by Owner.
   b. Criteria: Color and finish appearance shall remain unchanged throughout entire guarantee period.
   c. Provide manufacturer’s warranty

3. Maintenance Data: Manufacturer's instructions.

1.4 QUALITY ASSURANCE

A. General: Refer to Section 01 40 00 - Contractor's Quality Control System.

B. References:

1. American Society of Testing Materials (ASTM):
   a. D 1653 Method B, Condition A, - Test method to determine perm rating.
   b. D3960-93 - Practice for determining volatile organic compound content.

C. Qualifications: Installer specializing in the work of this Section with documented experience on projects of similar size and scope.

1.5 DELIVERY, STORAGE AND HANDLING

A. Delivery

1. Schedule delivery of materials at the site at such time as required for proper coordination of the work. Receive materials in manufacturer’s unopened packages and bearing manufacturer’s label.

B. Storage:

1. General: Store materials in a dry and properly ventilated separate structure not less than 50'-0" from any other structure on the site. Adequately protect from damage and exposure to the elements.
2. Temperature: Maintain minimum of 45 degrees F and a maximum of 90 degrees F.
3. Fire Prevention: Take necessary precautions to prevent fire; remove paint-soiled rags and waste from building each day or store in metal containers with covers in the paint storage structure.

1.6 PROJECT/SITE CONDITIONS

A. Contractor shall be responsible for repairing damaged masonry prior to application of anti graffiti coating.

B. Repairs shall be made by qualified mechanics skilled in the type of repairs required, to the satisfaction of the owner’s representative.

C. Cover air intakes, air conditioning vents and similar openings that may come in contact with the anti graffiti coating and residues fumes. Leave covers in place until application of anti graffiti coating is completed in the area.

D. Protect trees, plants, foliage, storm sewers, and surrounding surfaces from anti graffiti coating.

E. Take appropriate precautions to avoid harm to building occupants, pedestrians and nearby property. Terminate work when wind drift may cause contact with passerby or vehicles and adjacent property.

PART 2 PRODUCTS

1.1 MATERIALS

A. Graffiti resistant coating unpainted concrete:

1. Manufacturers:
   a. PROSOCO, Inc., 3741 Greenway Circle, Lawrence, KS 66046. Phone: (800) 255-4255; Fax: (785) 830-9797. E-mail: CustomerCare@prosoco.
      1) Block-Guard & Graffiti Control Ultra
   b. Or approved equal.
      1) Approved equal product must dry clear with no milky or cloudy appearance.
      2) Approved equal product permeability data must be provided to Architect for review
2. Color: Clear

1.2 MIXING

A. General: Mix per manufacturers' instructions.

PART 3 EXECUTION

1.1 PERFORMANCE

A. Product Handling:

1. Delivery: Schedule delivery of materials at the site at such time as required for proper coordination of the work. Receive materials in manufacturer's unopened packages and bearing manufacturer's label.
2. Storage: Store materials in a dry and well ventilated place, adequately protected from damage and exposure to the elements.

1.2 PREPARATION

A. Environmental Requirements: Do not apply when temperature is below 40 Degrees F.

B. Examination: Examine conditions of work in place before beginning work; report defects.

C. Storage:

1. General: Store in properly ventilated separate structure not less than 50'-0" from any other structure on the site.
2. Temperature: Maintain minimum of 45 degrees F and a maximum of 90 degrees F.
3. Fire Prevention: Take necessary precautions to prevent fire; remove paint-soiled rags and waste each day or store in metal containers with covers in the storage structure.

D. Protection: Protect adjacent surfaces not scheduled for graffiti resistant finish from damage resulting from coating operations.

E. Surface Preparation: Prepare surfaces in strict compliance with manufacturer's instructions.

1.3 INSTALLATION

A. General: Install in conformance with referenced standards, manufacturer's written directions, as shown, and as specified.

A. Graffiti Resistant Coating:

1. General: Apply minimum two (2) coats; allow adequate drying time between coats.
2. Dry Film Thickness: Minimum 1-2 mils per coat; minimum 3 mills for 2 coat application.

1.4 CLEANING

A. General: Keep premises free from accumulation of waste and rubbish. At the completion of work remove surplus materials, rubbish, and debris.

END OF SECTION 09 96 23

SECTION 10 81 13 - BIRD CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. DESCRIPTION: Provide the following:

1. Provide bird control netting.

2. Provide bird control strips.

1.2 SUBMITTALS

A. GENERAL**:** Refer to Contract Terms and Provisions, Section 01 33 00 SUBMITTAL PROCEDURES.

B. Submit for approval shop drawings, product data, netting sample in each color, installation guidelines, attachment details, and project scope layout.

C. Submit for approval shop drawings of netting and bird control strips

1.3 QUALITY ASSURANCE

A. GENERAL**:** Refer to Section 01 40 00 QUALITY ASSURANCE

B. Installer Qualifications: Installer of bird deterrent system is a certified installer with experience installing manufacturer's products according to manufacturer's specifications.

C. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1

MATERIALS

A. Manufacturers:

1. Bird Control Depot 13 Linnell Circle, Billerica, MA 01821, Phone: 978.825.5706, Fax: 978.528.5709

2. NIXALITE of America Inc., 1025 16th Avenue, East Moline, IL 61244-1424, Ph: 888-624-1189

3. Bird-B-Gone, 23918 Skyline, Mission Viejo, California, 92692, Ph: 800-392-6915

4. Engineer's approved equal.

B. Products:

1. Models are to be per the manufacturer’s Recommended Surface Coverage Chart for each field condition.

2. Bird Netting System with Stainless Steel Cable and Hardware

2.2 MOUNTING SYSTEMS

1. Stainless steel fasteners and hardware as specified by the Manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections and discipline. Restore damaged finishes and test for proper operation. Clean and protect work from damage.

B. Drill and tap structural steel as required

C. Netting:

1. Features and Components:

a. 4’ zipper at all Light Fixtures and 2’ zipper at all Equipment.
b. See architectural drawings for zipper layout.
c. All clip, turnbuckles and other Hardware to be furnished by Bird Control Depot or approved equal.

3.2 INSPECTION

A. Visually inspect bird control strips and bird netting for debris. Inspect mounting systems and netting zippers.

END OF SECTION 10 81 13

SECTION 16 44 00 – PANEL BOARDS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Requirements for UPS panel board.

1.02 REFERENCED SECTIONS

A. None.

1.03 CITED STANDARDS

A. National Electrical Manufacturer's Association (NEMA):

PB1 Panel boards

PB1.1 General Instructions for Proper Installation, Operation, and Maintenance of Panel boards Rated 600 Volts or less

B. Underwriters Laboratories Inc. (UL):

50 Enclosures for Electrical Equipment

67 Panel boards

489 Molded Case Circuit Breakers and Circuit Breaker Enclosures

1.04 NOTED RESTRICTIONS

A. None.

1.05 QUALITY CONTROL

A. None.

1.06 SUBMITTALS

A. Product data for each specified product..

B. Shop drawings showing:

1. Front and side elevations, with dimensions and conduit entrance locations.

2. Nameplate legends.

3. Location of incoming feeder cable and material of busbars for phases, neutral, and ground.

4. Electrical characteristics, including circuit breaker schedule. Location and type of main circuit breaker and feeder circuit breakers.

1.07 DELIVERABLES

A. None listed.

PART 2 - PRODUCTS

2.01 PANELBOARDS

A. Panel boards shall conform to NEMA PB1, UL 67, and UL 489.

B. Panel boards shall be for 208V/120V single phase 3 wire system.

C. Panel boards shall have plated copper busbars of sufficient cross-section to conform to the temperature rise requirements of UL 67.

1. Busbars shall have sequentially phased branch circuit connectors suitable for bolt-on circuit breakers.

2. Panel boards shall have a neutral bus, an equipment ground bus.

D. Panel boards shall have main circuit breakers, vertically mounted, with sufficient space to accommodate incoming feeder cable termination.

E. Panel boards shall be field-convertible for top or bottom incoming feed.

F. Interiors shall be dead-front construction, with pre-formed twistouts covering unused mounting spaces.

G. Circuit breakers shall conform to the requirements of Section 16415.

H. Panel boards shall have provisions for spare capacity as indicated.

2.02 ENCLOSURES

A. Enclosures shall be galvanized steel and shall conform to UL 50.

B. Enclosures shall have removable endwalls with knockouts located on one end, and welded interior mounting studs.

C. Enclosures shall be NEMA Type 12.

2.03 TRIM FRONTS

A. Panel boards shall have fronts with hinged, one-piece doors, concealed door hinges, and trim screws. Fronts shall not be removable with the doors locked.

B. Trim fronts shall conform to the strength and rigidity requirements of UL 50. Trim fronts shall be painted ANSI 61 gray color, with uniform coating of edges and surfaces.

C. Mounting: Surface, as shown on Contract Drawings.

D. Fronts shall be furnished with a stainless steel catch and door pull, along with a staple hasp, suitable for insertion of a Railroad-furnished padlock.

E. Directory Card Holder: Clear plastic, mounted on the inside of door.

PART 3 - EXECUTION

3.01 PREPARATION

A. Transmit submittals and deliverables required by this Section.

B. Furnish products as indicated.

C. Ensure substrates are in suitable condition to receive the work of this Section.

END OF SECTION 16 44 00

SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electrical installation requirements.

1.2 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

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: For sleeve seals.

C. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR - POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.
2. Source quality-control test reports.
3. Field quality-control test reports.

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, duct, and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment per NFPA 70.

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.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section 08 31 00 "Access Doors and Panels."

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section 07 84 00 "Firestopping."

1.5 WARRANTY

A. Refer to Form 816 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – WARRANTIES for additional information.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Refer to Form 816 Article 1.06.03 and Form 816 Article 1.20-1.06.03 for additional information.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 80, galvanized steel, plain ends.

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

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:

    a. Advance Products & Systems, Inc.
    b. Calpico, Inc.
    c. Metraflex Co.
    d. Or approved equal.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Withstand Pressure: Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.

5. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

1. Withstand Pressure: Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. All electrical components shall be installed per requirements of NFPA 70, NFPA 70E, and other codes identified in the Contract Documents.

C. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

D. 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.

E. 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.

F. Right of Way: Give to piping systems installed at a required slope.

3.2 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. Acceptance Testing Preparation:

1. Test continuity of each circuit.

E. 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.

3.3 INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve for all electrical applications. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal for all below grade penetrations.

B. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

C. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

D. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both surfaces of walls.

G. Extend sleeves installed in floors 4 inches above finished floor level unless otherwise indicated.

H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise or unless seismic criteria require different clearance.

I. Seal space outside of sleeves with grout for penetrations of concrete, masonry, and with approved joint compound for gypsum board assemblies.

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section 07 92 00 "Joint Sealants."

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section 07 84 00"Firestopping."

L. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

M. Aboveground, Exterior-Wall Penetrations: Provide insulation equal to the architectural indicated "R" factor of the assembly and seal penetrations using non-shrink grout. Grout shall be applied on both the interior and exterior building face.

N. Underground, Exterior-Wall Penetrations: Install fiberglass reinforced epoxy pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal. The conduit shall be sealed on both the interior and exterior foundation face with the ability to withstand a minimum of 30 psig.

O. Underground, Floor Penetrations: See electrical details on plans for requirements.

3.4 SLEEVE-SEAL INSTALLATION

A. Install to seal underground, exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.5 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section 07 84 00 "Firestopping."

END OF SECTION 26 05 00

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.
3. Sleeves and sleeve seals for cables.

B. Related Sections include the following:

1. Division 27 Section 27 51 16, Public Address and Mass Notification Systems.

1.2 DEFINITIONS

A. EPDM: Ethylene-propylene-dieneterpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

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: For each type of product indicated.

C. Qualification Data: For testing agency.

D. Field quality-control test reports.

E. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR - POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.
2. Source quality-control test reports.
3. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability 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.

1. Testing Agency's Field Supervisor: 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.

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 NFPA 70.

1.5 COORDINATION

A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

1.6 WARRANTY

A. Refer to Form 816 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – WARRANTIES for additional information.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Refer to Form 816 Article 1.06.03 and Form 816 Article 1.20-1.06.03 for additional information.

PART 2 - PRODUCTS

2.1 NON-EMERGENCY CONDUCTORS AND CABLES

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:

1. American Insulated Wire Corp.; a Leviton Company.
2. General Cable Corporation.
3. Southwire Company.
4. Or approved equal.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 and UL 44 for Types XHHW-2.

D. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC; Type MC cable shall be allowed on and above the third floor only.

2.2 EMERGENCY CONDUCTORS AND CABLES

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:

1. Raychem.
2. BICC General.
3. Or approved equal.

B. Copper Conductors: Annealed copper designed to ensure tensile strength under fire conditions.

C. Conductor Insulation: Thermoset, low smoke, zero halogen silicone rubber, with cross-linked polyolefin jacket Type RHW, listed per UL 44 or compacted refractory magnesium oxide with seamless, phosphorous deoxidized copper sheath Type MI (mineral insulated). Individual ground conductor(s) shall be provided for each circuit.

D. The conductor shall be at a minimum listed 600V, 90 degree C dry or 75 degree C wet with ampacities derived from NFPA 70 Tables 310.16, 75 degree C Column. Termination temperatures shall be rated 90 degree C.

E. Two (2) hour fire-rated per UL 2196 and UL Fire Resistance Directory either installed in conduit or in free air and meeting the requirements of an "Electrical Circuit Protective System" as referred in NFPA 70 Articles 695 and 700. Either type material shall be capable of being installed in conduit sleeves.

F. The Contractor shall install the conductor or cable in accordance to all manufacturer recommendations which include but not limited to providing all terminations, junction boxes, and fittings. Support spacing shall be at maximum five (5) foot intervals.

G. Required emergency conductors are defined in the IBC, NFPA 70, NFPA 72, and NFPA 101. Additional emergency conductors are indicated on the Contract Plans.

2.3 CONNECTORS AND SPLICES

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:

1. O-Z/Gedney; EGS Electrical Group LLC.
2. 3M; Electrical Products Division.
3. Tyco Electronics Corp.
4. Or approved equal.

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. All conductors shall be Stranded. S

B. Branch Circuits: Copper. All conductors shall be Stranded.S

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW or Type XHHW-2, single conductors in raceway; Type RHW, or Type MI for emergency circuits, listed as 2-hour fire rated when installed in conduit or free air for Type MI.

B. Feeders Exposed: Type XHHW or Type XHHW-2, single conductors in raceway; Type RHW, listed UL 44 or Type MI for emergency circuits, listed as 2-hour fire rated when installed in conduit or free air for Type MI.

C. Feeders Concealed in Ceilings, Walls, Partitions: Type XHHW or Type XHHW-2, single conductors in raceway; Type RHW or Type MI for emergency circuits, listed as 2-hour fire rated when installed in conduit or free air for Type MI.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW or Type XHHW-2, single conductors in raceway; Type RHW for emergency circuits, listed as 2-hour fire rated when installed in conduit.

E. Branch Circuits Exposed: Type XHHW or Type XHHW-2, single conductors in raceway; Type RHW or Type MI for emergency circuits, listed as 2-hour fire rated when installed in conduit or free air for Type MI.

F. Branch Circuits Concealed above Acoustic Ceilings: Type XHHW or Type XHHW-2, single conductors in raceway or Type MC metal-clad listed UL 1596; Type RHW or Type MI for emergency circuits, listed as 2-hour fire rated when installed in conduit or free air for Type MI.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW or Type XHHW-2, single conductors in raceway; Type RHW for emergency circuits, listed as 2-hour fire rated when installed in conduit or free air for Type MI.

H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. 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.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Section 26 05 29 "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 26 Section 26 05 53 "Identification for Electrical Systems."

G. Install through walls and floors according to Division 26 Section 26 05 00 “Common Work Results for Electrical”.

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.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 FIELD QUALITY CONTROL

A. Inspect and test conductors and cables in accordance with Form 816 Article 1.20-1.05.10 and as follows:

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

C. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors to all equipment indicated on the one-line diagram including the critical equipment.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

D. 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.

E. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment.

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 indicated.

C. Other Informational Submittals:

1. Including the pedestrian bridge, canopy structures.

D. Qualification Data: For testing agency and testing agency's field supervisor.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:

1. Instructions for periodic testing and inspection of grounding features.

a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
b. Include recommended testing intervals.

1.3 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability 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.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authority having jurisdiction, and marked for intended use.

C. Comply with UL 467 for grounding and bonding materials and equipment.

1.4 WARRANTY

A. Refer to Form 816 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – WARRANTIES for additional information.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Refer to Form 816 Article 1.06.03 and Form 816 Article 1.20-1.06.03 for additional information.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors for other than bonding the rail (train track): Single conductor copper wire insulated for 600 V shall be sized as indicated on the Contract Plans and in accordance to the NFPA 70. The conductors shall be Type XHHW or XHHW-2.

B. Bare Copper Conductors (grounding and bonding):

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 4/0 AWG min. or as indicated on the Contract Plans, whichever is larger.
5. Bonding Conductor: 4/0 AWG min. or as indicated on the Contract Drawing, whichever is larger.
6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick or insulated conductor per NFPA 70.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches in cross section, unless otherwise indicated; with insulators, see details on plans.

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.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch diameter by10 feet long.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install stranded conductors, unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 4/0 AWG minimum unless otherwise indicated n the Contract Plans.

1. Bury at least 24 inches below grade.

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, Emergency Electrical, IT/Communication, and Security Rooms, in rooms housing service equipment, and elsewhere as indicated on the Contract Documents.

1. Install bus as indicated on the Contract Plan details.

E. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Exothermic welds.
3. Connections to Ground Rods at Test Wells: Exothermic welds.
4. Connections to Structural Steel: Exothermic welds.

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.
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.

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 physical damage.

B. Ground Rods: Drive rods until tops are 6 inches 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 rods spaced at least one-rod length from each other and located in at least the locations as indicated on the Drawings; provide additional grounding electrodes per the requirements of the National Electrical Code. Connect to the service grounding electrode conductor.

C. 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 so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

D. Grounding and Bonding for Piping:

1. Domestic 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, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, 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.

E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity. Coordinate locations with the Mechanical Contractor.

F. Grounding for Steel Building Structure: Install bonding jumpers as indicated on the Contract Plans.

3.4 FIELD QUALITY CONTROL

A. Inspect and test grounding and bonding systems in accordance with Form 816 Article 1.20-1.05.10 and as follows:

B. Testing Agency: The Contractor shall engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

1. 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 not less 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.

2. Prepare dimensioned plans 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.

C. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 5 ohms.
2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 5 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 5 ohms.
5. Substations and Pad-Mounted Equipment: 5 ohms.
6. Manhole Grounds: 5 ohms.

D. Excessive Ground Resistance: If resistance to ground exceeds specified values mentioned above, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

SECTION 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:

1. Division 26 Section 26 05 43 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.2 DEFINITIONS

A. RMC: Rigid Metal Conduit (also known as RGS; Rigid Galvanized Steel Conduit).

B. EMT: Electrical Metallic Tubing.

C. RNC: Rigid Nonmetallic Conduit.

D. PVC: Polyvinyl Chloride.

E. FRE: Fiberglass Reinforced Epoxy.

F. LFMC: Liquidtight Flexible Metal Conduit.

G. LFNC: Liquidtight Flexible Nonmetallic Conduit.

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: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

C. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

1. Custom enclosures and cabinets.

D. Coordination Plans: Conduit routing plans, 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. Structural members in the paths of conduit groups with common supports.

2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

E. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR - POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.
2. Source quality-control test reports.
3. 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.

1.5 WARRANTY

A. Refer to Form 816 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – WARRANTIES for additional information.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Refer to Form 816 Article 1.06.03 and Form 816 Article 1.20-1.06.03 for additional information.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

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:

1. Allied Tube & Conduit; a Tyco International Ltd. Co.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Electri-Flex Co.
4. Manhattan/CDT/Cole-Flex.
5. O-Z Gedney; a unit of General Signal.
6. Wheatland Tube Company.
7. Or approved equal.

B. RMC: Galvanized Steel, ANSI C80.1, UL 6.

C. EMT: Steel, ANSI C80.3, UL 797.

D. PVC-Coated Rigid Metal Conduit:

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.

E. LFMC: Flexible steel conduit with PVC jacket, UL 360.

F. Fittings for Conduit (Including all Types and Liquidtight), EMT and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Conduit Fittings for Hazardous (Classified) Locations as indicated on the Contract Plans: Comply with UL 886.
2. Fittings for EMT: Steel, set-screw or compression type.
3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.

G. Joint Compound for RMC or PVC-Coated Rigid Metal Conduit: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

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:

1. Electri-Flex Co.
2. Lamson & Sessions; Carlon Electrical Products.
3. RACO; a Hubbell Company.
4. Champion.
5. Or approved equal.

B. RNC: NEMA TC 2, Type EPC-80-PVC, UL 651, unless otherwise indicated.

C. FRE: Extra Heavy Wall type, all joints shall be inside tapered bell end and of even socket depth through out the raceway.

D. LFNC: UL 1660.

E. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.

F. Fittings for LFNC: UL 514B.

2.3 METAL WIREWAYS

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:

1. Cooper B-Line, Inc.
2. Hoffman.

3. Square D; Schneider Electric.
4. Or approved equal.

B. Description: Sheet metal sized and shaped as indicated, UL 870, NEMA 250, Type 12 in dry locations and 3R for wet or damp locations and as defined per NFPA 70, unless otherwise indicated.

C. Fittings and Accessories: Include 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: Screw-cover type or Flanged-and-gasketed type, as defined per NFPA 70, unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

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:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. Hoffman.
3. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
4. Or approved equal.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, with gasketed cover.

G. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

H. 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.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

2.5 HANDHOLES AND BOXES FOR UNDERGROUND WIRING

A. Description: Comply with SCTE 77.

1. Color of Frame and Cover: Gray.
2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC", "COMMUNICATION, or as identified on the Contract Plans.
6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
7. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.

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:
3. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

    a. Armorcast Products Company.
    b. Carson Industries LLC.
    c. CDR Systems Corporation.
    d. Or approved equal.

C. Fiberglass Handholes and Boxes with Polymer-Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester-resin enclosure joined to polymer-concrete top ring or frame.

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:
3. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

    a. Armorcast Products Company.
    b. Carson Industries LLC.
    c. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.
    d. Or approved equal.

2.6 SLEEVES FOR RACEWAYS

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section 07 84 00 "Firestopping."

2.7 SLEEVE SEALS

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:

1. Advance Products & Systems, Inc.
2. Metraflex Co.
3. Pipeline Seal and Insulator, Inc.
4. Or approved equal.

B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Stainless steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Exterior: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: RMC.
2. Concealed Conduit, Aboveground: RMC.
3. Concealed Conduit, Belowground: RMC or PVC. However, identified emergency and stand-by circuits shall always be in RMC.
4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R unless otherwise indicated.

B. Interior: Comply with the following applications, unless otherwise indicated:

1. Exposed: RMC from finished grade to at least ten (10) feet above finished floor. EMT may be substituted when mounted greater than ten (10) feet above finished floor.

2. Concealed in Ceilings and Interior Walls or partitions: RMC or EMT and as identified per Codes.
3. Risers between Floors: RMC.
4. Third floor and above, EMT unless otherwise indicated.
5. Connection to Vibrating Equipment (Including but not limited to Transformers, damp or wet locations, Hydraulic, Electric Solenoid, or Motor-Driven Equipment): LFMC, below ten (10) feet from finished floor and LFNC may be substituted when above ten (10) feet from finished floor and as identified per Codes.
6. Damp or Wet Locations: RMC.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Minimum Flexible Conduit Size: 1/2-inch trade size.

E. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. RMC: Use threaded rigid galvanized steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, rigid galvanized steel conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Plans or in this Article are stricter.

B. Keep raceways at least 6 inches 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. Support raceways as specified in Division 26 Section 26 05 29 "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Conceal conduit within finished walls, ceilings, and floors, unless otherwise indicated. Conduits in the shop area that travel perpendicular to the roof joists shall be mounted at least ten (10) feet above finished floor.

G. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings; see architectural and structural plans for maximum anticipated expansion.
3. Change from Type EPC-80-PVC to RMC before rising above the floor.

H. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Exterior Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating grounding bushings to protect conductors, including conductors smaller than No. 4 AWG.

J. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

K. Install raceway sealing fittings at suitable, approved, and accessible locations 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 at the following points:

1. Where conduits travel from interior to exterior locations.
2. Where otherwise required by NFPA 70.

L. Expansion/Deflection-Joint Fittings for RNC or EMT: Install in each run of conduit that has straight-run length that exceeds 100 feet. Install additional fittings as required per NEC.

1. Install expansion-joint fittings for each of the following locations:

   a. At building expansion locations indicated on the Electrical Plans, see architectural and structural plans for maximum anticipated expansion.

2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change.
3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.
4. Install fitting(s) that provide deflection of at least one (1) inch for each 100 foot run.

M. 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.

3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Issuance of Certificate of Compliance.

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 26 05 33

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. The work of this Section Includes furnishing and installation of the following:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground –line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.

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 electrical identification product indicated.

C. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

D. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.3 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.4 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Plans, 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.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

1.5 WARRANTY

A. Refer to Form 816 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Refer to Form 816 Article 1.06.03 and Form 816 Article 1.20-1.06.03 for additional information.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on an orange field
2. Legend: Indicate voltage and service.

C. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Colors for Raceways Carrying Circuits at 600 V and Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage.

C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.5 UNDERGROUND-LINE WARNING TAPE or BELOW CONCRETE SLAB

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE and HIGH VOLTAGE.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CCTV CABLE, COMMUNICATIONS CABLE, SECURITY CABLE, and OPTICAL FIBER CABLE.

C. Tag: Type I:

1. Pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the line, compounded for direct-burial service.
2. Thickness: 4 mils.

3. Weight: 18.5 lb/1000 sq. ft.
4. 3-Inch Tensile According to ASTM D 882: 30 lbf, and 2500 psi.

2.6 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Rigid Plastic Warning Signs:

1. Weather-resistant, nonfading, preprinted, .050 inch thick polystyrene material; and with colors, legend, and size required for application.
2. Standard with radius corners and pre-drilled corner mounting holes for self tapping stainless screws.
3. Standard size, 10 inches high by 14 inches wide.
4. Oversized custom signs size, 20” high by 28 inches wide, lettering shall be minimum 2 inch high.

D. Standard size warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
3. Equipment Warning per NEC: "DANGER - ELECTRICAL SHOCK HAZARD.”

E. Oversized warning signs shall include, but are not limited to, the following legends:

1. “FIRE ALARM CONTROL PANEL AND FIRE PUMP ROOM”
2. “BUILDING ELECTRIC DISCONNECT ROOM”
3. “DC POWER SYSTEM SHUNT TRIP DISCONNECT PUSH BUTTON”

2.7 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.

1. Self-Adhesive engraved legend with black letters on white face.
2. Punched or drilled for stainless steel self tapping screws.

2.8 EQUIPMENT IDENTIFICATION LABELS

A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed and punched or drilled for stainless steel self tapping screws, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.9 CABLE TIES

A. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

PART 3 - EXECUTION

3.1 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. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Exterior: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30A, and 120V to ground: Identify with self-adhesive vinyl tape applied in bands. Install labels at 10-foot maximum intervals.

B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for feeder and branch-circuit conductors.

   a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.

   b. Colors for 208Y/120-V Circuits:

      1) Phase A: Black.
      2) Phase B: Red.
      3) Phase C: Blue.
      4) Neutral: White.
      5) Ground: Green.

   c. Colors for 480Y/277-V Circuits:

      1) Phase A: Brown.
      2) Phase B: Orange.
      3) Phase C: Yellow.
      4) Neutral: Natural Gray.
      5) Ground: Green.

   d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches 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.

C. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

D. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

   1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
   2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
   3. Coordinate identification with Project Plans, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

E. Workspace Indication: Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated.

F. Warning Labels for Interior Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels punched or drilled for stainless steel self tapping screws.

   1. Comply with 29 CFR 1910.145.
   2. Identify system voltage with black letters on an orange background.
   3. Apply to exterior of door, cover, or other access.

4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

    a. Power transfer switches.
    b. Controls with external control power connections.
    c. Disconnects.
    d. UPS.

G. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

H. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch high letters for emergency instructions at equipment used for power transfer.

I. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the 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. Interior Equipment: Self-adhesive, engraved, laminated acrylic or melamine label punched or drilled for stainless steel self tapping screws. Unless otherwise indicated, provide a single line of text with 1/2-inch high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
    b. Exterior Equipment: Self-adhesive, engraved, laminated acrylic or melamine label punched or drilled for stainless steel self tapping screws.
    c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to be Labeled:

    a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification.
    b. Enclosures and electrical cabinets.
    c. Transformers: Label that includes tag designation shown on Plans for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    d. Enclosed switches and disconnects.
    e. Enclosed circuit breakers.

END OF SECTION 26 05 53

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Snap switches and wall-box dimmers.
3. Wall-switch and exterior occupancy sensors.

B. Related Sections includes the following:

1. NONE

1.2 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GF or GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

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: For each type of product indicated.

C. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.

D. Samples: One for each type of device and wall plate specified, in each color specified.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer in accordance with Form 816 Article 1.20-1.06.01. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

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 NFPA 70.

1.5 COORDINATION

A. Receptacles for Equipment furnished under other sections of the Contract Documents: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

1.6 WARRANTY

A. Refer to Form 816 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – WARRANTIES for additional information.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Refer to Form 816 Article 1.06.03 and Form 816 Article 1.20-1.06.03 for additional information.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to the compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).
4. Or approved equal.

2.2 STRAIGHT BLADE RECEPTACLES

A. Industrial Grade Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Available Manufacturers: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

    a. Cooper; Catalog Nos. 5251 (single), 5342 (duplex).
    b. Hubbell.
    c. Pass & Seymour.
    d. Or approved equal.

B. Industrial Grade Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Available Manufacturers: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

    a. Cooper; Catalog No. 5262 (color orange).
    b. Hubbell.
    c. Pass & Seymour.
    d. Or approved equal.

2. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, non-feed-through type. Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Industrial Grade Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Available Manufacturers: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

    a. Cooper; Catalog No. GF20.
    b. Pass & Seymour.
    c. Hubbell
    d. Or approved equal.

C. Hospital-Grade, Duplex GFCI Convenience Receptacles, 125 V, 20 A (located in the second floor medical suite spaces only, see Dwg E1-223: Comply with UL 498 Supplement SD.

1. Available Manufacturers: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

    a. Cooper; Catalog No. HGF20 (color blue).
    b. Hubbell.
    c. Pass & Seymour.
    d. Or approved equal.

2. Available Manufacturers: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper; Catalog No. IG8300HG (color blue).
b. Hubbell.
c. Leviton.
d. Or approved equal.

2.4 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

A. Wiring Devices for Hazardous (Classified) Locations: Comply with NEMA FB 11 and UL 1010.

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:

a. Cooper Crouse-Hinds.
b. EGS/Appleton Electric.
c. Killark; a division of Hubbell Inc.
d. Or approved equal.

2.5 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Industrial Grade Switches, 120/277 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper; Catalog Nos.2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
b. Hubbell.
c. Pass & Seymour.
d. Or approved equal.

C. Industrial Grade Pilot Light Switches, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper; Catalog No. 2221PL for 120 V and 277 V.
b. Hubbell.
c. Pass & Seymour.
d. Or approved equal.

2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

2.6 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.

C. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.7 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material: 0.035-inch-thick, satin-finished stainless steel.
3. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant thermoplastic with lockable cover rated for “in use” operation.

2.8 MULTIOUTLET ASSEMBLIES

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:

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Wiremold Company (The).
3. Or approved equal.

B. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles, UL 498.

C. Raceway Material: Metal, with manufacturer's standard finish.

D. Wire: No. 10 AWG.

2.9 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices Connected to Normal Power System: Ivory, unless otherwise indicated or required by NFPA 70.
2. Wiring Devices Connected to Emergency Power System: Ivory.
3. TVSS Devices: Blue.
4. Isolated-Ground Receptacles: Orange

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

    a. Cut back and pigtail, or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 20-A circuit, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions.

3.2 IDENTIFICATION

A. Comply with Division 26 Section 26 05 53 "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with white-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports in accordance with Form 816 Article 1.20-1.05.10 and as follows:

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 20-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 26 27 26

SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Non-fusible switches.
3. Receptacle switches.
4. Molded-case circuit breakers (MCCBs).
5. Molded-case switches.
6. Enclosures.

1.2 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers 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 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 enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for series rating of installed devices.

5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Submit on translucent log-log graph paper.

C. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

D. Qualification Data: For qualified testing agency.

E. Seismic Qualification Certificates: For enclosed switches and circuit breakers, 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 Plans 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.

F. 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.

G. Operation and Maintenance Data: For enclosed switches and circuit breakers 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. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Submit on translucent log-log graph paper.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer in accordance with Form 816 Article 1.20-1.06.01.

C. Product Selection for Restricted Space: Plans indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

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. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6,600 feet.

1.7 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 WARRANTY

A. Refer to Form 816 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – WARRANTIES for additional information.

1.9 SPARE PARTS

A. Furnish spare parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Fuse Pullers: Two for each size and type.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Refer to Form 816 Article 1.06.03 and Form 816 Article 1.20-1.06.03 for additional information.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Available Manufacturers: 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. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
2. Siemens Energy & Automation, Inc.
3. Square D; a brand of Schneider Electric.
4. Or approved equal.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified and indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified and indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
6. Hookstick Handle: Allows use of a hookstick to operate the handle.
7. Lugs: Mechanical type, suitable for number, size, and conductor material.
8. Service-Rated Switches: Labeled for use as service equipment.
9. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac, 24-V dc.

2.2 NONFUSIBLE SWITCHES

A. Available Manufacturers: 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. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
2. Siemens Energy & Automation, Inc.

3. Square D; a brand of Schneider Electric.
4. Or approved equal.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: Mechanical type, suitable for number, size, and conductor material.
7. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac, 24-V dc.

2.3 RECEPTACLE SWITCHES

A. Available Manufacturers: 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. General Electric Company, GE Consumer & Industrial - Electrical Distribution.
2. Siemens Energy & Automation, Inc.
3. Square D; a brand of Schneider Electric.
4. Or approved equal.

B. Type HD, Heavy-Duty, Single-Throw Nonfusible Switch: 600-V ac, size as indicated on the Contract Plans A; UL 98 and NEMA KS 1; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

C. Interlocking Linkage: Provided between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified, and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.

D. Receptacle: Polarized, three-phase, four-wire receptacle (fourth wire connected to enclosure ground lug).

2.4 MOLDED-CASE CIRCUIT BREAKERS

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:

1. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
2. Siemens Energy & Automation, Inc.
3. Square D; a brand of Schneider Electric.
4. Or approved equal.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I^2t response.

F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

G. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

H. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

I. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

J. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Compression type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay

settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.

5. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system, specified in Division 26 Section 26 09 13 "Electrical Power Monitoring and Control."
6. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
7. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
8. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
9. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.
10. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
11. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
12. Electrical Operator: Provide remote control for on, off, and reset operations.
13. Accessory Control Power Voltage: integrally mounted, self-powered; 120-V ac, 24-V dc.

2.5 MOLDED-CASE SWITCHES

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:

1. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
2. Siemens Energy & Automation, Inc.
3. Square D; a brand of Schneider Electric.
4. Or approved equal.

B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating. Comply with UL 489.

C. Features and Accessories:

1. Standard frame sizes and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
6. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
7. Alarm Switch: One NO contact that operates only when switch has tripped.
8. Key Interlock Kit: Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.
9. Zone-Selective Interlocking: Integral with ground-fault shunt trip unit; for interlocking ground-fault protection function.

10. Electrical Operator: Provide remote control for on, off, and reset operations.
11. Accessory Control Power Voltage: Integrally mounted, self-powered; 120-V ac, 24-V dc.

2.6 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, UL 489, and UL 50, to comply with environmental conditions at installed location.

1. Interior, Dry and Clean Locations: NEMA 250, Type 1.
2. Exterior Locations: NEMA 250, Type 3R.
3. Other Wet or Damp, Interior Locations: NEMA 250, Type 4.
4. Interior Locations Subject to Dust, Falling Dirt, and Dripping Non-corrosive Liquids: NEMA 250, Type 12.
5. Hazardous Areas Indicated on Plans: NEMA 250, Type 7.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with 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. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Division 26 Section 26 05 48 "Vibration and Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Division 26 Section 26 05 53 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections in accordance with Form 816 Article 1.20-1.05.10 and as follows:

C. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

D. 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.
3. Perform the following infrared scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After issuance of Certificate of Compliance, but not more than 60 days after issuance of Certificate of Compliance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of issuance of Certificate of Compliance.
    c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

E. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers 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 components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section 26 05 73 "Overcurrent Protective Device Coordination Study".

END OF SECTION 26 28 16

SECTION 26 51 00 – INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Luminaires, lamps, and ballasts.
2. Luminaire supports.

B. Related Sections include the following:

1. Division 26 Section 26 27 26 "Wiring Devices".
2. Division 26 Section 26 56 00 “Exterior Lighting” for exterior luminaires.

1.2 DEFINITIONS

A. BF: Ballast factor.

B. CRI: Color-rendering index. C.

CU: Coefficient of utilization.

D. HID: High-intensity discharge.

E. LER: luminaire efficacy rating.

F. Luminaire: Complete Luminaire, including ballast housing if provided.

G. RCR: Room cavity ratio.

H. FC: Footcandles.

I. IES: Illuminating Engineering Society

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: For each type of luminaire, arranged in order of luminaire designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire including dimensions.
2. Ballast.
3. Energy-efficiency data.

4. Life, lumen output, and energy-efficiency data for lamps.
5. Provide vibration and seismic mounting hardware where defined per Division 26 Section 26 05 48 "Vibration And Seismic Controls For Electrical Systems".
6. Photometric data, in IES format, based on laboratory tests of each luminaire type, outfitted with lamps, ballasts, and accessories identical to those indicated for the luminaire as applied in this Project.

    a. For indicated luminaires, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by the manufacturer.
    b. Photometric data shall have been performed within the last three (3) years from Contractor notice to proceed.
    c. Provide an IES formatted file for each type of luminaire submitted; this IES file shall have been prepared by an independent testing agency within the last three (3) years from Contractor's Notice to Proceed. Data to be provided in hard copy and in electronic format on a CD-ROM.

C. Shop Drawings:
1. Show details of nonstandard or custom luminaires. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.

2. Wiring Diagrams: Power and control wiring.

D. Samples for Verification: Luminaires designated for sample submission in Luminaire Schedule are to be provided in 120-volt and 277-volt for sample review only. Each sample shall include the following:

1. Lamps: Specified units installed.
2. Accessories: Cords and plugs.

E. Product Certificates: For each type of ballast for non-dimmer and dimmer-controlled luminaires, signed by product manufacturer.

F. Qualification Data: For agencies providing photometric data for luminaires.

G. Field quality-control test reports.

H. Operation and Maintenance Data: For lighting equipment and luminaires to include in emergency, operation, and maintenance manuals.

I. Warranties: Special warranties specified in this Section.

1.4 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 1910.7.

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 NFPA 70.

E. FMG Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

F. Mockups: Provide luminaires for room or module mockups, complete with power and control connections.

1. Obtain Lighting Designer's approval of luminaires for mockups before starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
3. Approved luminaires in mockups may become part of the completed Work if undisturbed at time of issuance of Certificate of Compliance.

1.5 COORDINATION

A. Coordinate layout and installation of luminaires and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.6 WARRANTY

A. Refer to Form 816 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – WARRANTIES for Additional information.

B. Special Warranty for Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Electronic Ballasts: 5 years from date of issuance of the Certificate of Compliance.

C. Special Warranty for T8 Fluorescent Lamps: Manufacturer's standard form, made out to the Department and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 2 years from date of issuance of the Certificate of Compliance.

D. Warranty Period for Luminaires: Manufacturer's standard form, made out to the Department and signed by the luminaire manufacturer agreeing to replace luminaire

components, other than lamps and ballasts, that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, with the warranty period indicated below.

1. Warranty Period: 5 years from date of issuance of the Certificate of Compliance

1.7 SPARE PARTS

A. Furnish to the Department spare parts described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
2. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
3. Ballasts: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
4. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: The design and installation for each luminaire is based on the product named. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to the manufacturers specified. Any manufacturers making a submission are responsible for making the necessary revisions to insure the luminaires can be mounted as shown in the drawings, otherwise all changes will be the responsibility of the Contractor.

2.2 LUMINAIRES AND COMPONENTS, GENERAL REQUIREMENTS

A. Fluorescent Luminaires: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

B. Metal Parts: Free of burrs and sharp corners and edges.

C. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

D. 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.

E. 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.
4. Laminated Silver Metalized Film: 90 percent.

F. Plastic Diffusers, Covers, and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

a. Lens Thickness: At least 0.125 inch minimum unless different thickness is indicated.
b. UV stabilized.

2. Glass: Annealed crystal glass, unless otherwise indicated.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. Electronic Ballasts: Comply with ANSI C82.11; programmed start type in all spaces controlled with motion sensors or photocells, unless otherwise indicated, and designed for type and quantity of lamps served. Ballasts shall be designed for full light output unless dimmer is indicated.

1. Sound Rating: A
2. Total Harmonic Distortion Rating: Less than 10 percent.
3. Transient Voltage Protection: IEEE C62.41, Category A or better.
4. Operating Frequency: 50/60 kHz or higher.
5. Lamp Current Crest Factor: 1.6 or less.
6. BF: 0.71 or higher.
7. Power Factor: .98 or higher.
8. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C 82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.
9. Starting Temperature of 0° F.

B. Electronic Instant-Start Ballasts shall be installed in fluorescent luminaires in all unconditioned spaces and shall comply with ANSI C82.11 and the following:

1. Sound Rating: A
2. Total Harmonic Distortion Rating: Less than 10 percent.
3. Transient Voltage Protection: IEEE C62.41, Category A or better.
4. Operating Frequency: 50/60 kHz or higher.
5. Lamp Current Crest Factor: 1.7 or less.
6. BF: 1.15 or higher.
7. Power Factor: .98 or higher.
8. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C 82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.
9. Starting Temperature of -20° F.
10. Shall be of a High Ballast Factor type with 1.2 BF, unless otherwise indicated.

C. Electronic Programmed-Start Ballasts for T5 and T5HO Lamps: Comply with ANSI C82.11 and the following:

1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41, Category A or better.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.95 or higher, unless otherwise indicated.
9. Power Factor: .98 or higher.
10. Shall have amalgam system for starting at -20° F.

2.4 FLUORESCENT LAMPS

A. Low-Mercury Lamps: Comply with EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.

B. T8 instant-start, low mercury lamps, rated 32 W maximum, nominal length of 48 inches, 3000 initial lumens (minimum), CRI 85 (minimum), color temperature 3500 K, and average rated life 36,000 hours, unless otherwise indicated.

C. T8 instant-start, low mercury lamps, rated 25 W maximum, nominal length of 36 inches, 3000 initial lumens (minimum), CRI 85 (minimum), color temperature 3500 K, and average rated life 36,000 hours, unless otherwise indicated.

D. T8 program-start, low mercury lamps, rated 32 W maximum, nominal length of 48 inches, 3100 initial lumens (minimum), CRI 85 (minimum), color temperature 3500 K and an average rated life 36,000 hours, unless otherwise indicated.

E. T5HO lamps, shall be amalgam type, rated 54 W maximum, nominal length of 45.8 inches, 4900 initial lumens (minimum), CRI 85 (minimum), color temperature 3500 K, and an average rated life 25,000 hours, unless otherwise indicated.

F. Compact Fluorescent lamps, rated 32 W maximum, 2300 initial lumens (minimum), CRI 82 (minimum), color temperature 3500 K. and average rated life 12,000 hours unless otherwise indicated.

G. Voltage Rating:

1. All linear fluorescent lamps for fixture Type “B” shall be rated at 277-Volt, 1 phase, 60 Hz.

2. Compact Flourescent lamps for fixture Type “H” (JAR Fixtures) shall be rated at 120-Volt, 1 phase, 60 Hz.

2.5 LUMINAIRE SUPPORT COMPONENTS

A. The electrical contractor is responsible for providing all mounting hardware required for properly mounting and wiring the luminaires in their respective location or locations.

2.6 The Contractor shall provide complete photometric data with a point-by-point illuminance calculation and IES file in accordance with the recommendations of IES and the criteria listed with each type luminaire; the more stringent of IESNA or criteria listed with each type luminaire shall be provide.

2.7 REQUIREMENTS FOR INDIVIDUAL LUMINAIRES

A. The Contractor shall select Type “H” and Type “B” fixtures exactly similar to the existing fixtures.

2.8 EXAMINATION

A. Examine elements and surfaces to luminaires, hanging systems, trims, etc. for compliance with installation tolerances, required clearances and other conditions affecting performance.

2.9 INSTALLATION

A. Luminaires: Set level, plumb, and square with ceilings and walls. Install lamps in each Luminaire.

2.10 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports in accordance with Form 816 Article 1.20-1.05.10 and as follows:

B. Test for Emergency Lighting: The Contractor shall notify the Designer, at least fourteen (14) days in advance, of the proposed testing date. The emergency lights shall be tested after dusk in the presence of the Designer and remain operational for at least one-hundred twenty (120) minutes. The test shall be acceptable to the Designer; if not, the Contractor shall provide additional testing at no additional cost to the Contract. Interrupt normal power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

C. 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 26 51 00