Electrical Code Requirements
for
Commercial
and
Residential Buildings
Presented
by
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State Electrical Inspector

Entrances
to and from
Electrical Equipment Rooms

- 2005 NEC Section 110.26(C)(2) *Large Equipment* = **For equipment rated 1200 amperes or more**, there shall be one entrance to the required working space **not less than 24 inches wide** and 6 ½ feet high.

2005 NEC
Section 110.26
Spaces About Electrical Equipment

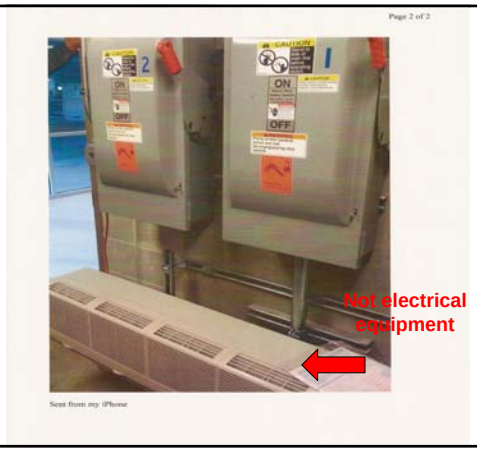
- **Sufficient access** and **working space shall be provided and maintained** about all electric equipment to permit ready and safe operation and maintenance of such equipment. Enclosures housing electrical apparatus that are controlled by a lock(s) shall be considered accessible to qualified persons.

Entrances to and from Mechanical and Electrical Rooms

- 2003 IMC Section 306.2 *Appliances in rooms* = Rooms containing appliances requiring access shall be provided with a door and **an unobstructed passageway** measuring not less than 36 inches wide and 80 inches high.

2005 NEC Section 110.26(3) Height of Working Space

- The work space shall be clear and extend from the grade, floor, or platform to the height required by 110.26(E) "*6 ½ feet*". Within the height requirements of this section, other equipment **that is associated with the electrical installation** and is **located above or below** the electrical equipment shall be permitted to extend not more than 6 inches beyond the front of the electrical equipment.



NEC 230.2(E)
Number of Services

- Identification – Where a building or structure is supplied by more than one service, or any combination of branch circuits, feeders, and services, a **permanent plaque or directory** shall be installed at each service disconnecting location denoting all other services, feeders, and branch circuits supplying that building or structure and the area served by each.
- See 225.37 Outside Branch Circuits and Feeder Identification

2005 NEC
Section 110.26(B)
Clear Spaces

- Working space required by this section **shall not be used for storage**. When normally enclosed live parts are exposed for inspection or servicing, the working space if in a passageway or general open space, shall be suitably guarded.

2005 NEC Section 110.26(C)(2)
Large Equipment
Rated 1200 Amperes
Single Entrance

- A single entrance to the required working space shall be permitted where either of the conditions in
  110.26(C)(2)(a) or (C)(2)(b) is met

110.26(C)(2)(a)
Large Equipment
Unobstructed Exit

- Where the location permits a continuous and unobstructed way of exit travel, a single entrance to the working space shall be permitted.

110.26(C)(2)(b)
Extra Working Space

- Where the depth of the working space is twice that required by 110.26(A)(1), a single entrance shall be permitted. **It shall be located so that the distance from the equipment to the nearest edge of the entrance** is not less than the minimum clear distance specified in Table 110.26(A)(1) for equipment operating at that voltage and in that condition.

Table 110.26(A)(1)
Working Spaces

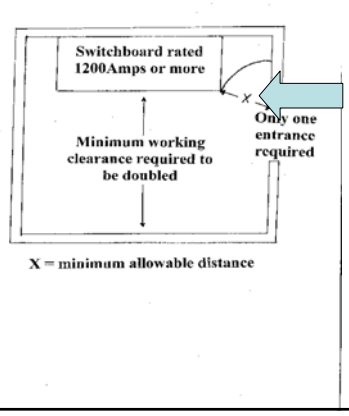
Nominal Voltage to Ground

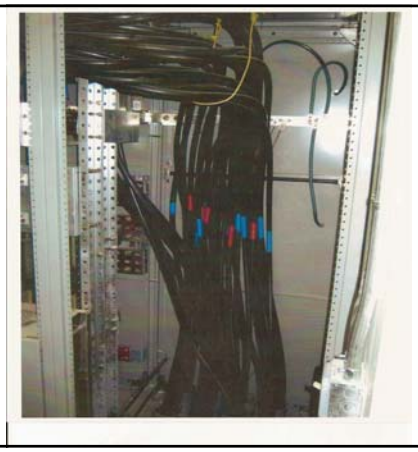
	Condition #1	Condition #2	Condition #3
0-150 Volts	3 feet	3 feet	3 feet
151-600 Volts	3 feet	3 ½ feet	4 feet

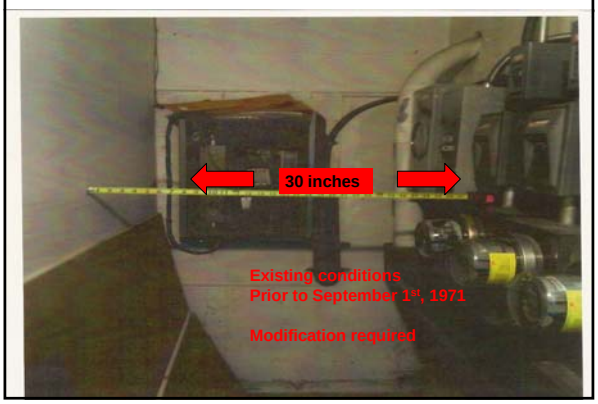
Condition #1 – Exposed live parts on one side of the working space and no live or grounded parts on the other side of the working space, or exposed live parts on both sides of the working space that are effectively guarded by insulating materials.

Condition #2 – Exposed live parts on one side of the working space and grounded parts on the other side of the working space. Concrete, brick, or tile walls shall be considered as grounded.

Condition #3 – Exposed live parts on both sides of the working space.

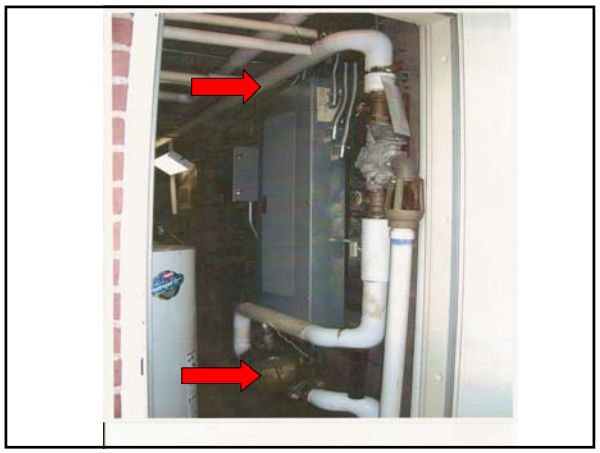


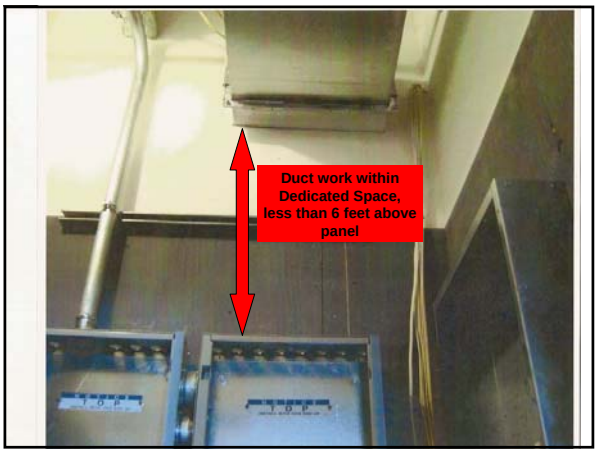


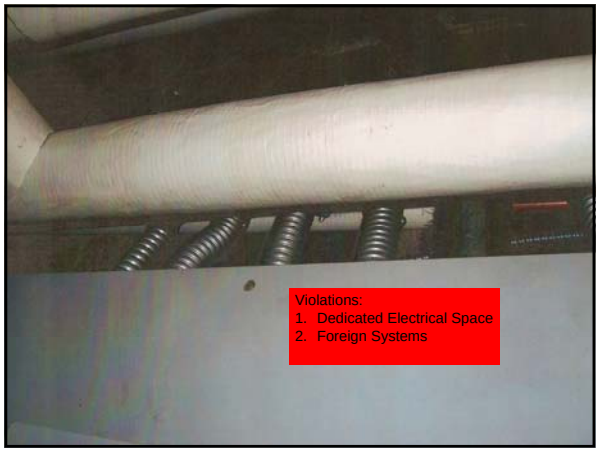


NEC 110.26
Dedicated Equipment Space

- (a) Dedicated Electrical Space = The space equal to the width and depth of the equipment and extending from the floor to a height of 6 feet above the equipment or to the structural ceiling, whichever is lower, shall be dedicated to the electrical installation. **No piping, ducts, leak protection apparatus, or other equipment foreign to the electrical installation shall be located in this zone**.
- *Exception: Suspended ceilings **with removable panels** shall be permitted within the 6 foot zone.*

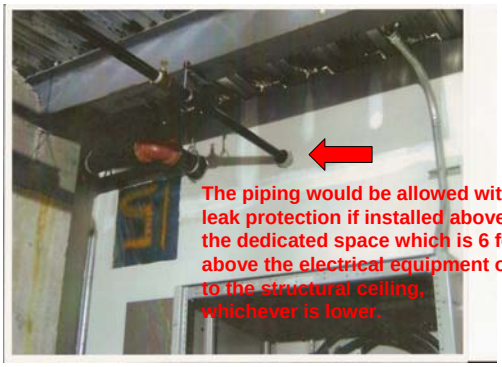






2005 NEC Section 110.26(F)(1)(c) Sprinkler Protection

- Sprinkler protection shall be permitted for the dedicated space where the piping complies with this section *"Dedicated Equipment Space"*



NEC 200.6
Means of Identifying Grounded Conductors "Neutral"

Grounded conductor = **White or Gray** conductor

- **Sizes 6 AWG or Smaller (#14, #12, #10, #8**: An insulated grounded conductor of #6 AWG or smaller shall be identified by a continuous white or gray outer finish or by three continuous white stripes on other than green insulation along its entire length.
- **Sizes Larger Than #6 AWG = (#4 and larger):** An insulated grounded conductor larger than #6 AWG shall be identified by one of the following means:

1. By a continuous white or gray outer finish
2. By three continuous white stripes along its entire length on other than green insulation
3. At the time of installation, by a distinctive white or gray marking at its terminations. This marking shall encircle the conductor or insulation.

2005 NEC Section 110.26(F)(1)(d)
Suspended Ceilings

- A dropped, suspended, or similar ceiling **<u>that does not add strength</u>** to the building structure shall not be considered a structural ceiling.

NEC 210.12(B)
Arc-Fault Circuit-Interrupter Protection
2009 Ct State Amendments

- **As Amended: Dwelling unit bedrooms**
  All 120-volt, single-phase, 12- and 20-ampere branch circuits supplying outlets installed in dwelling unit bedrooms shall be protected by arc-fault circuit interrupter, listed to provide protection of the entire branch.

Smoke Detectors, Recess lights, Receptacles, Pilot-light type switches, Paddle Fans, Wall Sconces, **<u>are considered outlets</u>**.

NEC 230.8
Raceway Seal

- Where a service raceway enters a building or structure from an underground distribution system, it shall be sealed in accordance with 300.5(G) *Raceway Seal*. Spare or unused raceways shall also be sealed. **Sealants shall be identified for use with the cable insulation,** shield, or other components.

NEC 230.95
Ground-Fault Protection of Equipment

- Ground-fault protection of equipment shall be provided for solidly grounded wye electrical services of more than 150 volts to ground but not exceeding 600 volts phase-to-phase for each service disconnect rated 1000 amperes or more.

NEC 230.95(C)
Performance Testing

- A ground-fault protection system shall be performance tested when first installed on site. The test shall be conducted in accordance with instructions that shall be provided with the equipment. A written record of this test shall be made and shall be available to the authority having jurisdiction.

  "This test is also know as a Primary Injection Test"

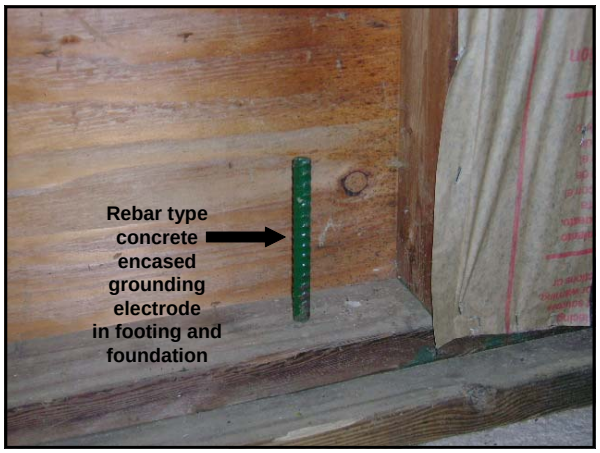
NEC 250.50
Grounding Electrode System
(2005 Supplement Amended)

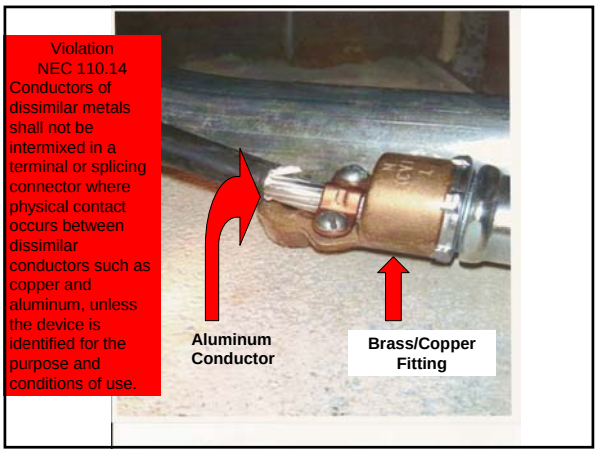
- If available on the premises at each building or structure served, each item in 250.52(A)(1) through (A)(6) shall be bonded together to form the grounding electrode system. Where none of these grounding electrodes are available, one or more of the grounding electrodes specified in 250.52(A)(4) through (A)(7) shall be installed and used.

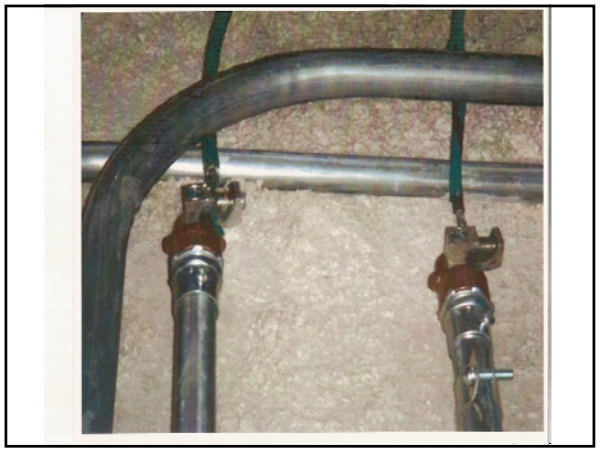
Ground-Fault Protection
277/480 volts Service rated breaker
more than 1000 amperes

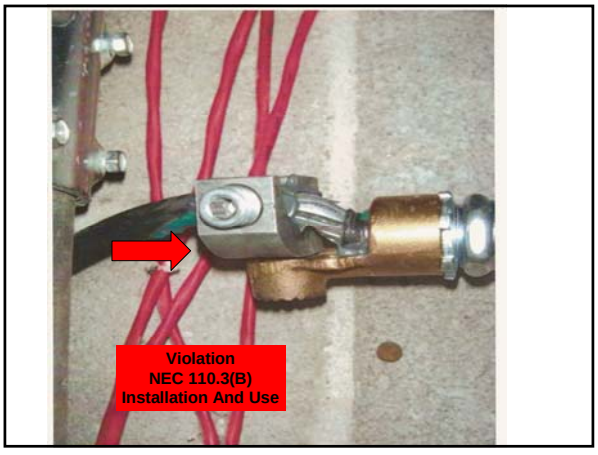
NEC 250.50
Grounding Electrode System

- *Exception: Concrete-encased electrodes of existing buildings or structures shall not be required to be part of the grounding electrode system where the steel reinforcing bars or rods are not accessible for use without disturbing the concrete.*


Rebar type concrete encased grounding electrode in footing and foundation


Violation
NEC 110.14
Conductors of dissimilar metals shall not be intermixed in a terminal or splicing connector where physical contact occurs between dissimilar conductors such as copper and aluminum, unless the device is identified for the purpose and conditions of use.
Aluminum Conductor
Brass/Copper Fitting




Violation
NEC 110.3(B)
Installation And Use

NEC 250.104(A)
Bonding of Piping Systems and Exposed Structural Steel

- **Metal Water Piping:**

  The metal water piping system shall be bonded as required in (A)(10, (A)(2), or (A)(3) of this section. The bonding jumper(s) shall be installed in accordance with 250.64(A), (B), and (E). **The points of attachment of the bonding jumper(s) shall be accessible.**

NEC 250.64(E)
Enclosures for Grounding Electrode Conductors

- Ferrous metal enclosures for grounding electrode conductors shall be electrically continuous from the point of attachment to cabinets or equipment to the grounding electrode and shall be securely fastened to the ground clamp or fitting. Nonferrous metal enclosures shall not be required to be electrically continuous. Ferrous metal enclosures that are not physically continuous from cabinets or equipment to the grounding electrode shall be made electrically continuous by bonding each end of the raceway or enclosure to the grounding conductor. Bonding shall apply at each end and to all intervening ferrous raceways, boxes, and enclosures between the service equipment and the grounding electrode. **The bonding jumper for a grounding electrode conductor raceway or cable armor shall be the same size as, or larger than, the required enclosed grounding electrode conductor.** Where a raceway is used as protection for a grounding electrode conductor, the installation shall comply with the requirements of the appropriate raceway article.

NEC 250.104(B)
Bonding of Piping Systems and Exposed Structural Steel
continued

- **Other Metal Piping**:

  Where installed in or attached to a building or structure, metal piping system(s), including gas piping, that is likely to become energized shall be bonded to the service equipment enclosure, the grounded conductor at the service, the grounding electrode conductor where of sufficient size, or to the one or more grounding electrodes used. The bonding jumper(s) shall be sized in accordance with 250.122, using the rating of the circuit that is likely to energize the piping system(s). ***The equipment grounding conductor for the circuit that is likely to energize the piping shall be permitted to serve as the bonding means***. **The points of attachment of the bonding jumper(s) shall be accessible**

NEC 250.104(B)(1)
Bonding of Piping Systems and Exposed Structural Steel
(2009 Amendment)

- **Corregated Stainless Steel Tubing (CSST):**
  CSST gas piping shall be bonded in accordance with manufacturer's installation instructions**.**

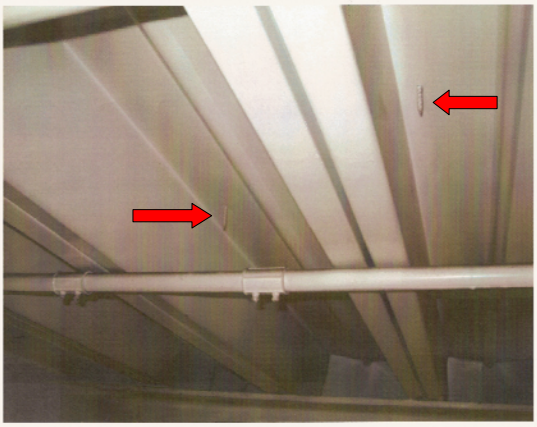
Wrong
Not Listed as a
Direct Burial Connector

NEC 250.52
Metal Underground Water Pipe

- A metal under ground water pipe in direct contact with the earth for 10 feet or more (including any well casing effectively bonded to the pipe) and electrically continuous (or made electrically continuous by bonding around insulated joints or insulating pipe) to the points of connection of the grounding electrode conductor and the bonding conductors. **Interior metal water piping located more than 5 feet from the point of entrance to the building shall not be used as part of the grounding electrode system** or a conductor to interconnect electrodes that are part of the grounding electrode system.

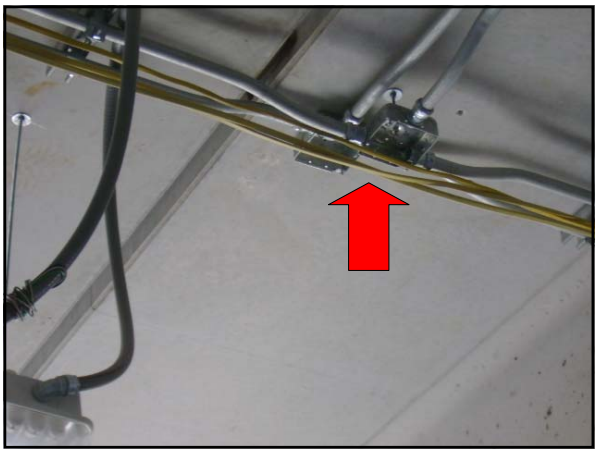
NEC 300.4(G)
Cables and Raceways Installed Under Roof Decking
2009 CT State Amendments

- (Add) A cable or raceway-type wiring method, installed in exposed or concealed locations under metal-corrugated sheet roof decking, shall be installed and supported so the nearest outside surface of the cable or raceway is not less than 1 ½ inch from the nearest surface of the roof decking.
- *Exception: Rigid metal conduit and intermediate metal conduit shall not be required to comply with 300.4(G).*



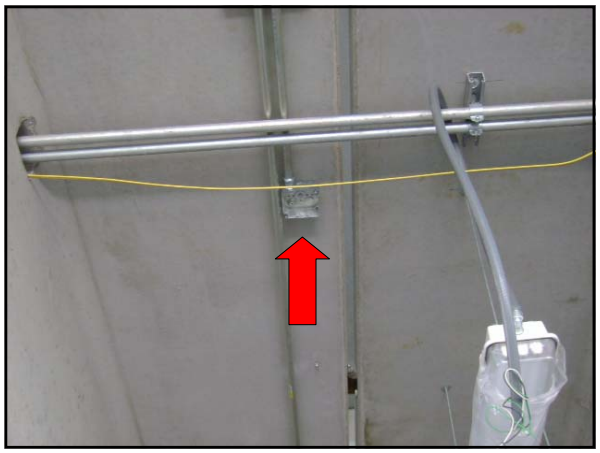
Definition of DAMP LOCATION

- Locations protected from weather and not subject to saturation with water or other liquids but subject to moderate degrees of moisture. Examples of such locations include partially protected locations under canopies, marquees, roofed open porches, and the like locations, and **interior locations subject to moderate degrees of moisture,** such as some basements, some barns, and some cold storage warehouses.



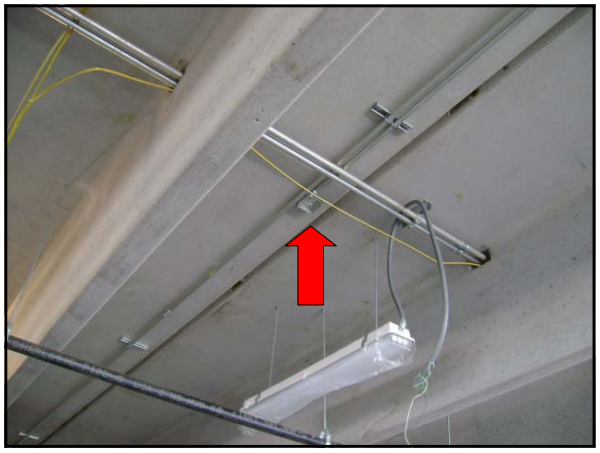
NEC 314.15(A) Damp or Wet Locations

- In damp or wet locations, boxes, conduit bodies, and fittings shall be placed or equipped so as to prevent moisture from entering or accumulating within the box, conduit body, or fitting. Boxes, conduit bodies, and fittings installed in wet locations **shall be listed for use in wet locations.**



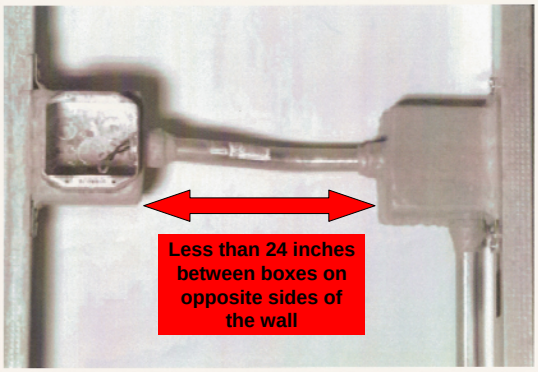
NEC 300.21
Spread of Fire or Products of Combustion

- Electrical installations in hollow spaces, vertical shafts, and ventilation or air-handling ducts shall be made so that the possible spread of fire or products of combustion will not be substantially increased. Openings around electrical penetrations through fire-resistant-rated walls, partitions, floors or ceilings shall be firestopped using approved methods to maintain the fire resistance rating.



NEC 300.21
Spread of Fire or Products of Combustion continued

An example is membrane penetrations on opposite sides of a fire-resistance-rated wall assembly, such as, 24 inch minimum horizontal separation that usually applies between boxes installed on opposite sides of the wall.



2003 IBC
712.3.2
Membrane Penetrations

- Membrane penetrations shall comply with Section 712.3.1. Where walls and partitions are required to have a minimum 1-hour fire-resistance rating, **recess fixtures shall be installed such that the required fire resistance will not be reduced.**

2003 IBC
Section 712.3.1.2
Through-penetration firestop system

- States in part:

  Through penetration shall be protected by an approved penetration firestop system installed as tested in accordance with ASTM E 814 or UL 1479

2003 IBC
712.3.2
Membrane Penetrations
continued

Exceptions:

1. Steel electrical boxes that do not exceed 16 square inches in area provided the total area of such openings does not exceed 100 square inches for any 100 square feet of wall area. Outlet boxes on opposite sides of the wall shall be separated as shown:

2003 IBC
712.3.2
Membrane Penetrations
continued (exceptions)

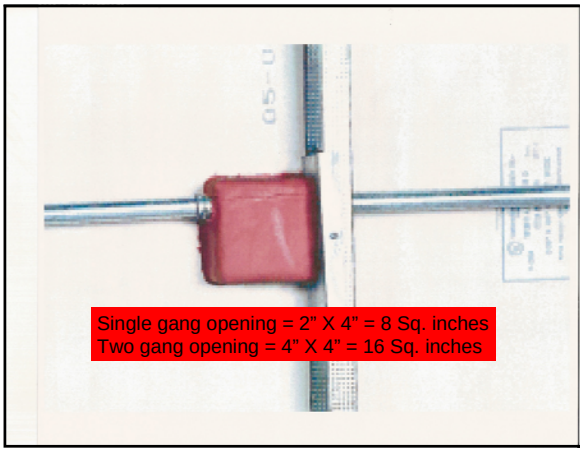
1.1. By a horizontal distance of not less than 24 inches;

1.2. By a horizontal distance of not less than the depth of the wall cavity where the wall cavity is filled with cellulose loose fill, rockwool or slag mineral wool insulation;

1.3. By solid fireblocking in accordance with Section 717.2.1;

1.4. By protecting both outlet boxes with listed putty pads; or

1.5. By other listed materials and methods.



2003 IBC
712.3.2
Membrane Penetrations
continued (exceptions

2. Membrane penetrations for listed electrical outlet boxes of any material are permitted provided such boxes have been tested for use in fire-resistance-rated assemblies and are installed in accordance with the instructions included in the listing. Outlet boxes on opposite sides of a wall shall be separated as follows:

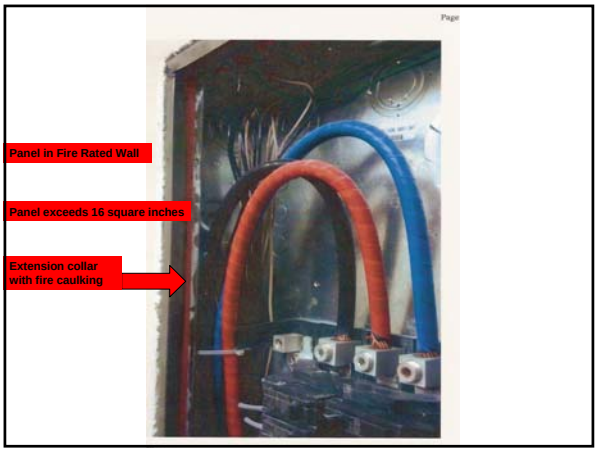
2003 IBC
712.3.2
Membrane Penetrations
continued (exceptions

2.1. By a horizontal distance of not less than 24 inches;

2.2. By solid fireblocking in accordance with Section 717.2.1;

2.3. By protecting both outlet boxes with listed putty pads; or

2.4. By other listed materials and methods.



2003 IBC
712.3.2
Membrane Penetrations
continued (exceptions)

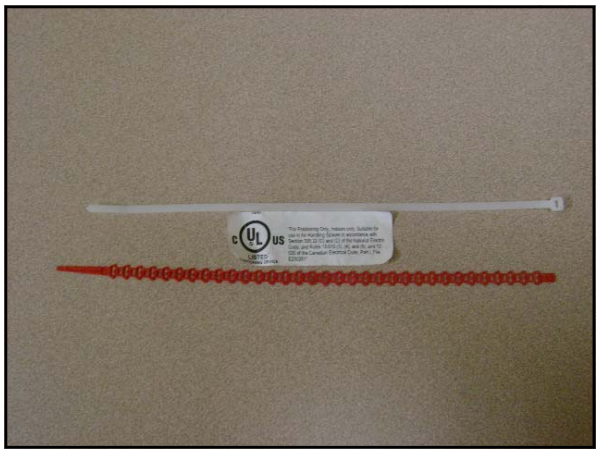
3. The annular space created by the penetration of a fire sprinkler provided it is covered by a metal escutcheon plate.

NEC 300.22
Wiring in Ducts, Plenums, and Other Air-Handling Spaces

- The provisions of this section apply to the installations and uses of electric wiring and equipment in ducts, plenums, and other air-handling spaces.

NEC 300.22(A)
Ducts for Dust, Loose Stock, or Vapor Removal

- No wiring systems of any type shall be installed in ducts used to transport dust, loose stock, or flammable vapors. **No wiring system of any type shall be installed** in any duct, **or shaft** containing only such ducts, **used for vapor removal or for ventilation of commercial-type cooking equipment.**



NEC 300.22(C)
Other Space Used for Environmental Air

- This section applies to space used for environmental air-handling purposes other than ducts and plenums as specified in 300.22(A) and (B). It does not include habitable rooms or areas of buildings, the prime purpose of which is not air handling.

FPN: The space over a hung ceiling used for environmental air-handling purposes is an example of the type of other space to which this section applies.

Tie wraps that are **Listed for Use** in accordance with NEC Section 300.22(C) are permitted above the ceiling being used for environmental air.

NEC 310.15(2) Adjustment Factors

(a) More Than Three Current-Carrying Conductors in a Raceway or Cable

Where the number of current-carrying conductors in a raceway or cable exceeds three, or where single conductors or multiconductor cables are stacked or bundled **longer than 24 inches without maintaining spacing** and are not installed in raceways, the allowable ampacity of each conductor shall be reduced as shown in Table 310.15(B)(2)(a). Each current-carrying conductor of a paralleled set of conductors shall be counted as a current-carrying conductor.

NOTE: There are several exceptions too lengthy to be shown.

Question

Six #12 AWG THHN current carrying conductors in a raceway, what size breaker is allowed ?

Table 310.15(B)(2)(a) Adjustment Factors for More Than Three Current-Carrying Conductors in a Raceway or Cable

Number of Current-Carrying Conductors	Percent of Values in Tables 310.16 through 310.19 as Adjusted for Ambient Temperature if Necessary
4-6	80 %
7-9	70%
10-20	50%
21-30	45%
31-40	40%
41 and above	35%

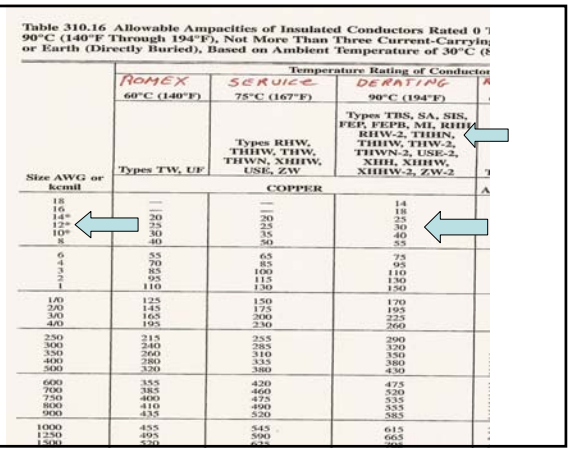


Table 310.16 Allowable Ampacities of Insulated Conductors Rated 0 7
90°C (140°F Through 194°F), Not More Than Three Current-Carryin
or Earth (Directly Buried), Based on Ambient Temperature of 30°C (8

	Temperature Rating of Conductor		
	ROMEX 60°C (140°F)	SERVICE 75°C (167°F)	DERATING 90°C (194°F)
Size AWG or kcmil	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, USE, ZW	Types TBS, SA, SIS, FEP, FEPB, MI, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE-2, XHH, XHHW, XHHW-2, ZW-2
	COPPER		
18	—	—	14
16	—	—	18
14*	20	20	25
12*	25	25	30
10*	30	35	40
8	40	50	55
6	55	65	75
4	70	85	95
3	85	100	110
2	95	115	130
1	110	130	150
1/0	125	150	170
2/0	145	175	195
3/0	165	200	225
4/0	195	230	260
250	215	255	290
300	240	285	320
350	260	310	350
400	280	335	380
500	320	380	430
600	355	420	475
700	385	460	520
750	400	475	535
800	410	490	555
900	435	520	585
1000	455	545	615
1250	495	590	665
1500	520	625	705

Number of Current-Carrying Conductors	Percent of Values in Tables 310.16 through 310.19 as Adjusted for Ambient Temperature if Necessary
4-6	80 %
7-9	70%
10-20	50%
21-30	45%
31-40	40%
41 and above	35%

Question

Fifteen #12 AWG THHN current carrying conductors in a raceway, what size breaker is allowed ?

Answer

Six #12 AWG THHN current carrying conductors in a raceway, what size breaker is allowed ?

30 amps X 80% = 24.00 amps = 20 amp breaker

Number of Current-Carrying Conductors	Percent of Values in Tables 310.16 through 310.19 as Adjusted for Ambient Temperature if Necessary
4-6	80 %
7-9	70%
10-20	50%
21-30	45%
31-40	40%
41 and above	35%

Answer

Fifteen #12 AWG THHN current carrying conductors in a raceway, what size breaker is allowed ?

30 amps X 50% = 15.00 amps = 15 amp breaker

Question

- We have nine two wire #12 Romex cables through a hole and the hole will be filled with ASTM 136 thermal caulking, what size breaker will be allowed?

NEC 334.80 Ampacity
NM, NMC,& NMS
(Romex)

- The ampacity of types NM, NMC, and NMS cable shall be determined in accordance with 310.15. The ampacity shall be in accordance with the 60°C (140°F) conductor temperature rating. The 90°C (194°F) rating shall be permitted to be used for ampacity derating purposes, provided the finial derated ampacity does not exceed that for a 60°C (140°F) rated conductor. The ampacity of Types NM, NMC, and NMS cable installed in cable tray shall be determined in accordance with 392.11.
- Where more than two NM cables containing two or more current-carrying conductors are bundled together and pass through wood framing that is to be fire or draft stopped using thermal insulation or sealing foam, the allowable ampacity of each conductor shall be adjusted in accordance with Table 310.15(B)(2)(a).

Number of Current-Carrying Conductors	Percent of Values in Tables 310.16 through 310.19 as Adjusted for Ambient Temperature if Necessary
4-6	80 %
7-9	70%
10-20	50%
21-30	45%
31-40	40%
41 and above	35%

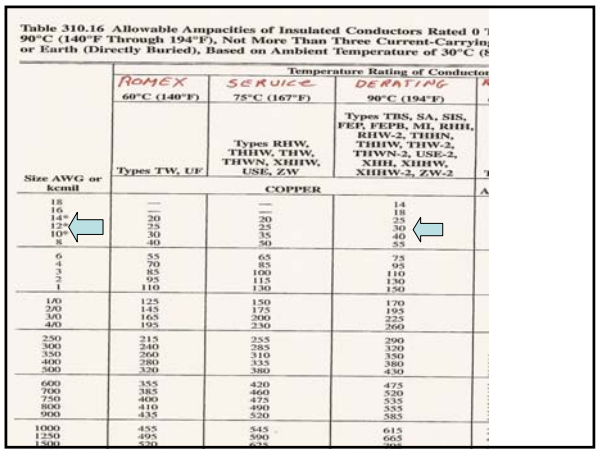


Table 310.16 Allowable Ampacities of Insulated Conductors Rated 0 T 90°C (140°F Through 194°F), Not More Than Three Current-Carryin or Earth (Directly Buried), Based on Ambient Temperature of 30°C (8

Size AWG or kcmil	Temperature Rating of Conductor		
	ROMEX 60°C (140°F)	SERVICE 75°C (167°F)	DERATING 90°C (194°F)
	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, USE, ZW	Types TBS, SA, SIS, FEP, FEPB, MI, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE-2, XHH, XHHW, XHHW-2, ZW-2
	COPPER		
18	—	—	14
16	—	—	18
14*	20	20	25
12*	25	25	30
10*	30	35	40
8	40	50	55
6	55	65	75
4	70	85	95
3	85	100	110
2	95	115	130
1	110	130	150
1/0	125	150	170
2/0	145	175	195
3/0	165	200	225
4/0	195	230	260
250	215	255	290
300	240	285	320
350	260	310	350
400	280	335	380
500	320	380	430
600	355	420	475
700	385	460	520
750	400	475	535
800	410	490	555
900	435	520	585
1000	455	545	615
1250	495	590	665
1500	520	625	705

Question

- We have nine two wire #14 Romex cables through a hole and the hole will be filled with thermal caulking, what size breaker will be allowed?

Answer

- We have nine two wire #12 Romex cables through a hole and the hole will be filled with thermal caulking, what size breaker will be allowed?

30 amps X 70% = 21.00 amps = 20 amp breaker

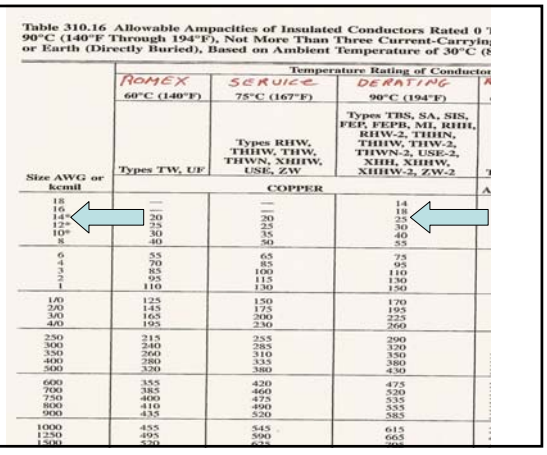


Table 310.16 Allowable Ampacities of Insulated Conductors Rated 0 T 90°C (140°F Through 194°F), Not More Than Three Current-Carryin or Earth (Directly Buried), Based on Ambient Temperature of 30°C (8

Size AWG or kcmil	Temperature Rating of Conductor		
	ROMEX 60°C (140°F)	SERVICE 75°C (167°F)	DERATING 90°C (194°F)
	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, USE, ZW	Types TBS, SA, SIS, FEP, FEPB, MI, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE-2, XHH, XHHW, XHHW-2, ZW-2
	COPPER		
18	—	—	14
16	—	—	18
14*	20	20	25
12*	25	25	30
10*	30	35	40
8	40	50	55
6	55	65	75
4	70	85	95
3	85	100	110
2	95	115	130
1	110	130	150
1/0	125	150	170
2/0	145	175	195
3/0	165	200	225
4/0	195	230	260
250	215	255	290
300	240	285	320
350	260	310	350
400	280	335	380
500	320	380	430
600	355	420	475
700	385	460	520
750	400	475	535
800	410	490	555
900	435	520	585
1000	455	545	615
1250	495	590	665
1500	520	625	705

Answer

- We have nine two wire #14 Romex cables through a hole and the hole will be filled with ASTM 136 thermal caulking, what size breaker will be allowed?

25 amps X 70% = 17.50 amps = 15 amp breaker

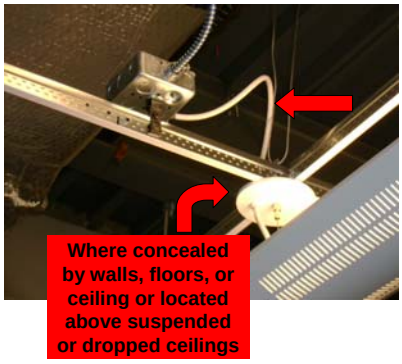
400.8 Uses Not Permitted

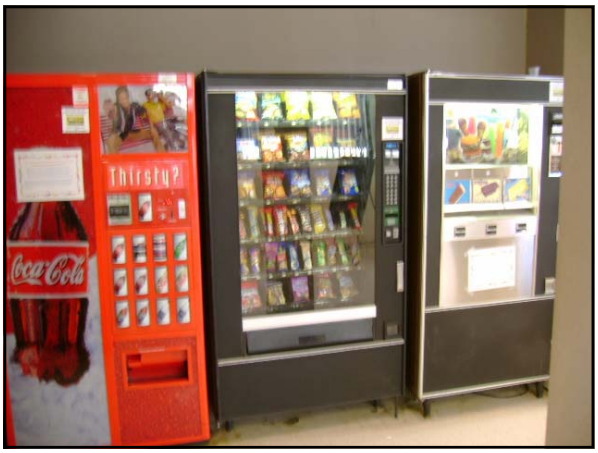
1. As a substitute for fixed wiring of a structure
2. Where run through holes in walls, structural ceilings, suspended ceilings, dropped ceilings, or floors.
3. Where run through doorways, windows, or similar openings
4. Where attached to building surfaces
5. Where concealed by walls, floors, or ceiling or located above suspended or dropped ceilings
6. Where installed in raceways, except as otherwise permitted in this *Code*
7. Where subject to physical damage

Article 400
Flexible Cords and Cables

- 400.8 Uses Not Permitted

  Unless specifically permitted in 400.7, flexible cords and cables shall not be used for the following:

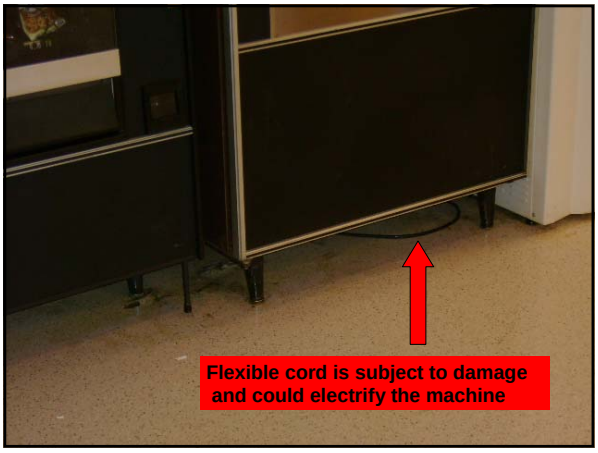




NEC 422.51
Cord and Plug Connected Vending Machines

- Cord and plug connected vending machines manufactured or re-manufactured on or after January 1, 2005, shall include a ground-fault circuit-interrupter as an integral part of the attachment plug or located in the power supply cord within 12 inches of the attachment plug. Cord and plug connected vending machines not incorporating integral GFCI protection shall be connected to a GFCI **protected outlet**.

NOTE: GFCI receptacle outlets are required by installation instructions to be tested monthly. If the GFCI receptacle outlet is behind the vending machine then a GFCI breaker is required.

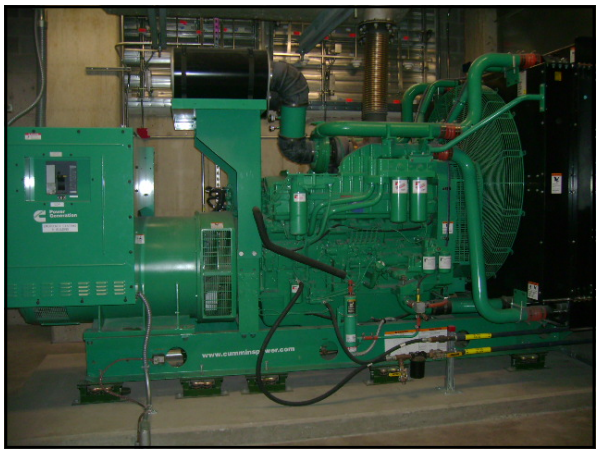


[redacted]

G148
GENERATOR
ROOM

G148
GENERATOR
ROOM

EMERGENCY
GENERATOR STOP
PULL TO RESET
PUSH BUTTON



EMERGENCY
GENERATOR STOP
BREAK GLASS TO RELEASE BUTTON
MODEL SERIES ST120SLGEN

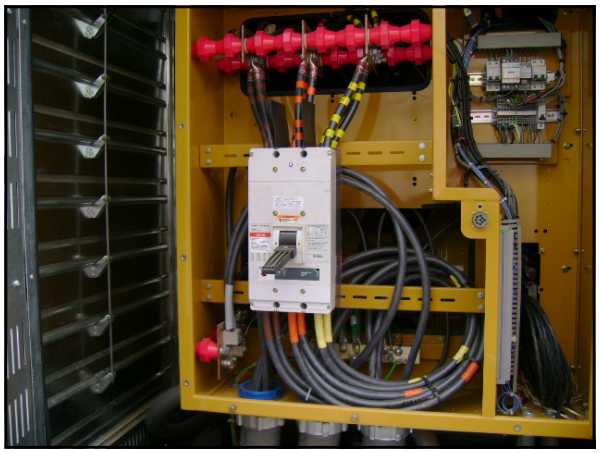
GENERAC

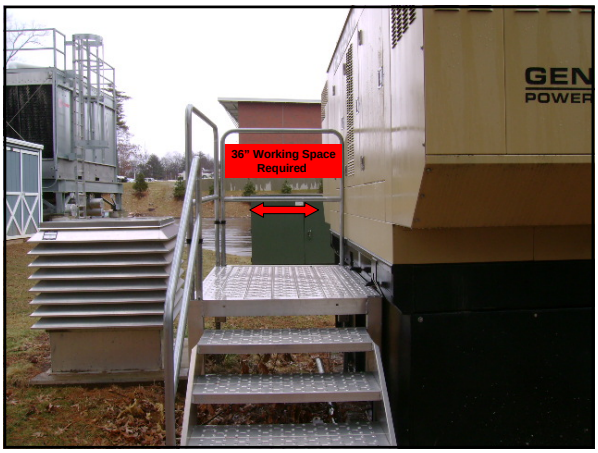
NFPA 110
Emergency and Standby Power Systems

5.6.5.6* All Level 1 and Level 2 installations shall have a remote manual stop station of a type similar to a break-glass station located outside the room housing the prime mover, where so installed, or elsewhere on the premises where the prime mover is located outside the building.

NFPA 110
Emergency and Standby Power Systems

A.5.6.5.6 For Level 1 and Level 2 systems located outdoors, the manual shutdown should be located external to the weatherproof enclosure and should be appropriately identified.





NEC 240.24
Location in or on Premises

(A) Accessibility – Overcurrent devices shall be readily accessible and shall be installed so that the center of the grip of the operating handle of the switch or circuit breaker, when in its highest position, is not more than 6 feet 7 inches above the floor or working platform unless one of the following applies:

(1) For busways

(2) For supplementary overcurrent protection, as described in 240.10

(3) For overcurrent, as described in 225.40 and 230.92

(4) For overcurrent devices adjacent to utilization equipment that they supply, access shall be permitted to be by portable means.

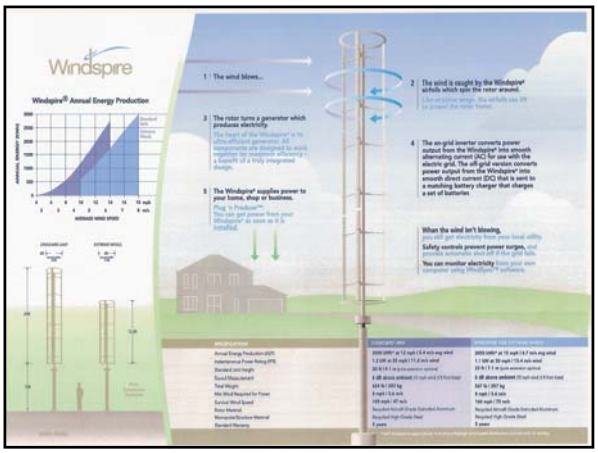
NEC 404.8
Accessibility and Grouping

(A) Location – all switches and circuit breakers used as switches shall be located so that they may be operated from a readily accessible place. They shall be installed such that the center of the grip of the operating handle of the switch or circuit breaker, when in its highest position, is not more than 6 feet 7 inches above the floor or working platform.

Exception No. 1: On busway installations, fused switches and circuit breakers shall be permitted to be located at the same level as the busway. Suitable means shall be provided to operate the handle of the device from the floor.

Exception No. 2: Switches and circuit breakers installed adjacent to motors, appliances, or other equipment that they supply shall be permitted to be located higher than 6` 7" and to be accessible by portable means

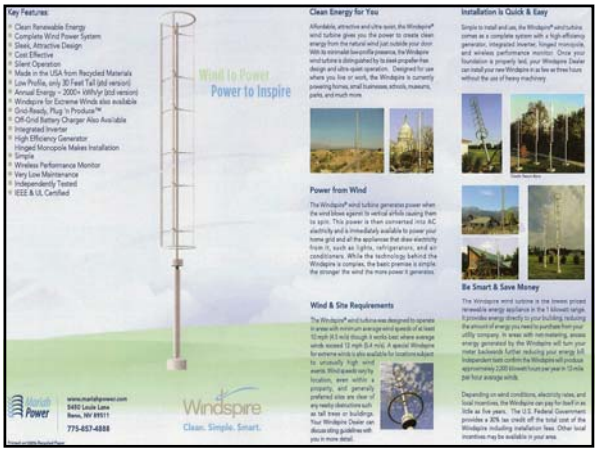
Exception No. 3: Hookstick operable isolating switches shall be permitted at greater heights.

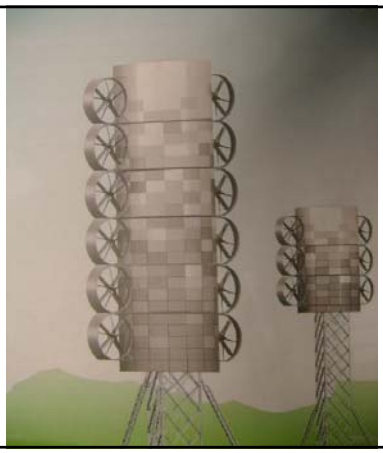


NEC Article 705
Interconnected Electric Power Production Sources

Wind Power

- **705.1 Scope** – This article covers installation of one or more electric power production sources operating in parallel with a primary source(s) of electricity.
- **705.2 Definition**
  Interactive System – An electric power production system that is operating in parallel with and capable of delivering energy to an electric primary source supply system.
- **705.10 Directory** – A **permanent plaque or directory**, denoting all electrical power sources on or in the premises, shall be installed at each service equipment location and at locations of all electric power production sources capable of being interconnected.





NEC 690.56
Solar Photovoltaic Systems

- (A) Facilities with Stand-Alone Systems –
  Any structure or building with a photovoltaic power system that is not connected to a utility service source and is a stand-alone system shall have a **permanent plaque or directory** installed on the exterior of the building or structure at a readily visible location acceptable to the authority having jurisdiction. The **plaque or directory** shall indicate the location of system disconnecting means and that the structure contains a stand-alone electrical power system.

NEC 690.56
Solar Photovoltaic Systems

- (B) Facilities with Utility Services and PV Systems –
  Buildings or structures with both utility service and a photovoltaic system shall have a **permanent plaque or directory** providing the location of the service disconnecting means and the photovoltaic system disconnecting means, if not located at the same location.

NEC Section 692.65(B)(4)
Fuel Cell Systems

- Equipment containing overcurrent devices in circuits supplying power to a busbar or conductor shall be marked to indicate the presence of all sources.

Signs
2005 Amendments

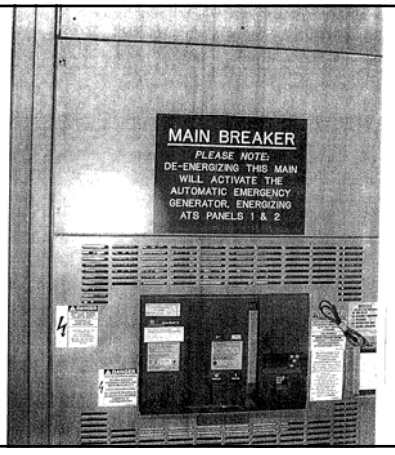
- Emergency Sources – A sign shall be placed at the service entrance equipment, at the meter location, and on any equipment up to the service entrance equipment indicating **type and location** of on-site emergency power sources.
  NOTE: This includes manual as well as automatic transfer switches

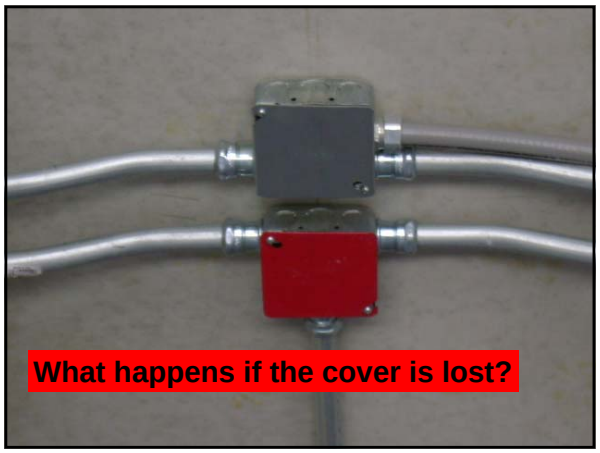
  This applies to NEC Articles:

- 700 Emergency Systems –
  Section 700.8(A) Emergency Sources
- 701 Legally Required Standby Systems -
  Section 701.9 (A) Mandated Standby
- 702 Optional Standby Systems –
  Section 702.8(A) Standby

NEC 700.9
Wiring, Emergency System

- **(A) Identification** – All **boxes** and enclosures (including transfer switches, generators, and power panels) for emergency circuits **shall be permanently marked so they will be readily identified** as a component of an emergency circuit or system.





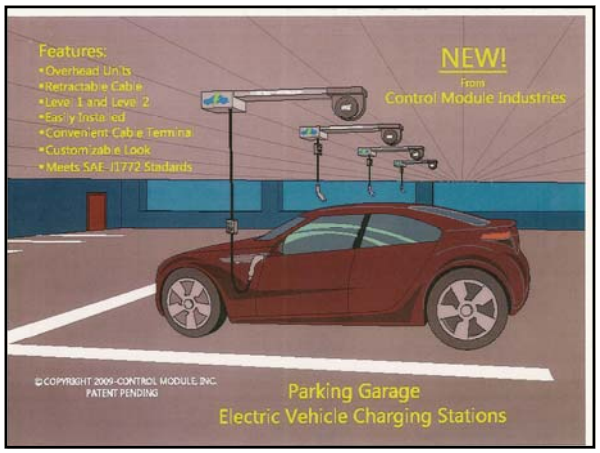
Electric Vehicle Charging Product Overview

- Location Focus:
  - Indoor & Outdoor 30A-70A
  - Parking Lots and Garages
  - Work place
- Types
  - Curbside Overhead Retractable Cable
  - Parking Garage Overhead
  - Weather Proof
  - J1772 Plug Standard Compliant
- Easy to install
- Adaptable
  - trucks
  - busses
  - cars
- Simple to use
- Safe, controlled power
- Communicates with the Grid

Article 625
Electric Vehicle Charging System

- 625.1 Scope – The provisions of this article cover the electrical conductors and equipment external to an electric vehicle that connect an electric vehicle to a supply of electricity by conductive or inductive means, and the installation of equipment and devices related to electric vehicle charging.

Level 1 and Level II Work Locations



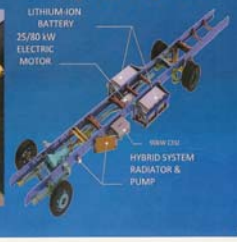
DTE Electric Bus Requirements

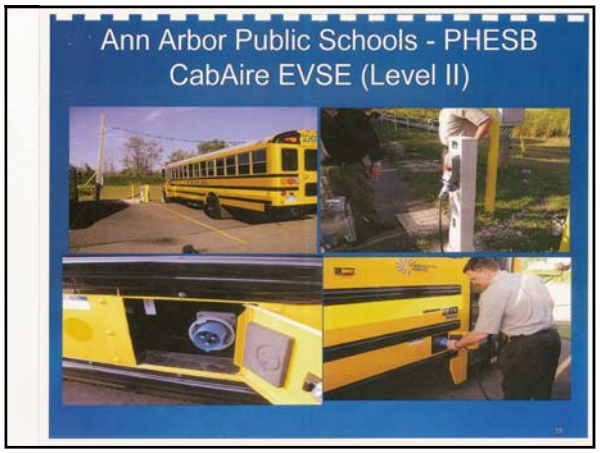
- Electric Charging for Ann Arbor School District
- Level 2
  - One outlet
  - 240V@30 Amps
  - On-off switch
  - Optional watt-meter
  - Removable cord
- Bus battery 100A "R" 35.8 Kw hour battery

IC Bus – School Bus Overview

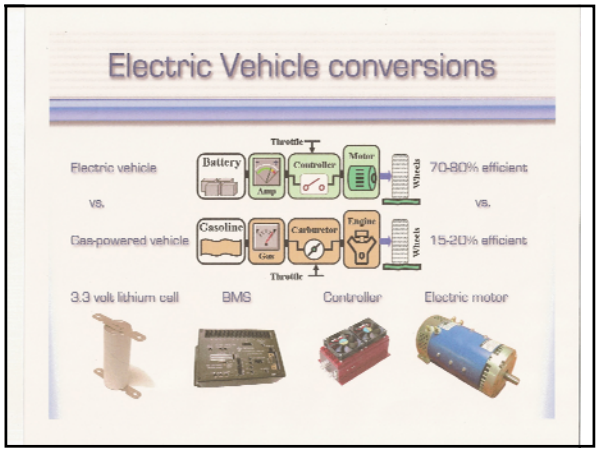
IC Bus
Charge Depleting
School Bus

Enova Systems
Charge Depleting
Hybrid System




Ann Arbor Public Schools - PHESB
CabAire EVSE (Level II)

We offer 3 basic types of conversions:


Electric Vehicle conversions
Electric vehicle
Battery
Amp
Controller
Motor
Wheels
70-80% efficient
vs.
Gas-powered vehicle
Gasoline
Gage
Carburetor
Engine
Wheels
15-20% efficient
Throttle
3.3 volt lithium cell
BMS
Controller
Electric motor

THE
END

QUESTIONS

?

STAY SAFE