National Electrical Code Forum

Your Questions Answered

Code Panel #1

Meet Your Distinguished Experts

Moderator: Don Offerdahl - Bismarck, ND

Tim McClintock – Shreve, OH
NFPA, Regional Electrical Code Specialist

Mike Johnston – Bethesda, MD
NECA, CMP – 5 , Chair NEC Correlating Committee

David Kendall – Memphis, TN
Thomas & Betts, CMP-8

Richard Loyd - Sun Lakes AZ
Steel Tube Institute, CMPs- 5 & 8

Alan Manche - Lexington, KY
Schneider Electric, CMP- 10

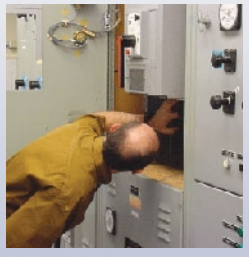
Chuck Mello – Vancouver, WA
Underwriters Laboratories, Inc. - CMP-5

Don Iverson – Lansing, MI
NEMA

Dave Williams - Lansing, MI
Delta Township, CMP- 5

Industrial Establishments

1. Why are exceptions made for industrial establishments with regard to wiring practices and safety concerns in the NEC when most places (jurisdictions) do not require the licensing of the industrial electricians or maintenance personnel? [Example: 410.130(G)(1) Exception No. 4.]



Industrial Establishments

Reference: NEC® Article 100 – Qualified Person

Answer: Exceptions for industrial establishments included in the NEC® take into consideration they are generally staffed by qualified persons and/or have engineering personnel on staff to supervise installations. While maintenance personnel aren't required to be licensed, they do need to be qualified.

- A Qualified Person is "One who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved." NFPA 70E, Standard for Electrical Safety in the Workplace, requires a company to have a safety plan with training in place. From this safety training it will be determined who is considered to be qualified per the definition.

Industrial Establishments

Reference: NEC® Article 100 – Qualified Person &
410.130(G)(1) Exception #4

- 410.130(G)(1) Exception #4 states: A disconnecting means shall not be required in industrial establishments with restricted public access where conditions of maintenance and supervision ensure that only qualified persons service the installation by written procedures.

Insulating Restrictions

2. Since the code prohibits insulating over K & T wiring, how do you deal with SEIDA and other weatherization projects that do so?

   Reference: NEC 394.12(5) indicates K&T is not permitted in walls, ceilings, and attics where such spaces are insulated by loose, rolled, or foamed-in place insulating material that envelops the conductors.

   Answer: It is difficult to enforce the NEC when permits and inspections may not even be required. When there is a known violation of this NEC rule, corrective action should be taken by the inspector a Code violation notice to the property owner.

Paint Booth/LFMC

3. A paint booth has an exhaust fan that is rated for this application. Can LFMC be used to feed this fan?

Reference:

Article 516: Spray Application, Dipping, and Coating Process

516.3(B) Classification of Locations

501.10 Wiring Methods

Answer: Article 516 addresses "Spray Application, Dipping, and Coating Processes". 516.3(B) tells us that the interior of spray booths and rooms and other areas shall be considered a Class I, Division 1, or a Class II, Zone 1, or Class II, Division 1 location. If the LFMC used for the electrical connection of a fan is located in the Class I, Division 1 area or any of the Class I, Division 1 areas defined in 516.3(B) or (C) then the answer is NO based on 501.10(A). If the area where the LFMC is use is determined to be a Class I, Division 2 or a Class II, Division 1 area then LFMC can be used per 501.10(B)(2)(3) and 502.10(A)(2)(2). If the LFMC location is external and is not located in a Classified Location as described in 516.3(C)(4) and illustrated in Figure 516.3(C)(4) , then of course it can be used.

•Termination of Grounding Electrode Conductor

4. What is the proper termination point for the grounding electrode conductor on a residential service? Is it the meter base or first point of disconnect in the service?

- NEC 250.24(A)(1)
- Ans. Any accessible point from the load end of the service drop or lateral to and including the terminal or bus where the grounded service conductor is connected at the service disconnect.

Feeder Conductor Sizing / Dwelling Subpanel

5. Can Table 310.15(B)(7) be used to size the conductors for a subpanel in a residence?

Reference: NEC 310.15(B)(7)

Answer:

The answer to the question depends on the function of the "Subpanel." In general the answer is No. The NEC is clear that these feeder conductors must carry "all loads that are part or associated with the dwelling unit." If the "subpanel" is fed from a service disconnect and complies the noted requirement, then it is permitted to be sized in accordance with the referenced table above.

Wet Locations Terminations

6. Is a standard wire-nut approved for a wet location as in an outside j-box?

Is there a listed wet location wire-nut other than the ones approved for direct burial or in below grade j-boxes?

Reference: UL White Book, category codes ZMVV and ZMWQ

Wet Locations Terminations

6. Answer:

The interior of an outdoor rated junction box installed above grade is considered a dry location. By virtue of the listing as suitable for outdoor use, the inside is not to accumulate water or moisture so that it would deteriorate the devices or products inside the enclosure or box. Therefore the standard wire nut listed under the category code ZMVV would be acceptable.

Where the connection is made below grade, either direct burial or in a below grade junction box, where water is expected to accumulate, then the sealed type wiring connector listed under category code ZMWQ is required.

Dual Sensor Smoke Alarms

Question # 7

Dual sensor smoke detectors have been required for a couple of years. A lot of wholesalers and retailers are still selling the old style smoke detectors. If they are still selling the old style, that means a lot of people are still buying them. Where are the old style smoke detectors allowed to be used?

Answer #7

In several states they have technology requirements of technology specific for smoke detection. Several that come to mind are Iowa, Vermont, Massachusetts and three jurisdictions in California. However, there is no national consensus standard (NFPA 72, NFPA 101, NFPA 5000 or the International Residential Code) requiring a smoke detection device to employ both ionization and photoelectric technology in a single unit (dual sensor) or by means of two separate units. Numerous technical reports and studies have demonstrated that single technology smoke detection devices provide the required save available egress time for occupants and therefore can be installed throughout the dwelling unit.

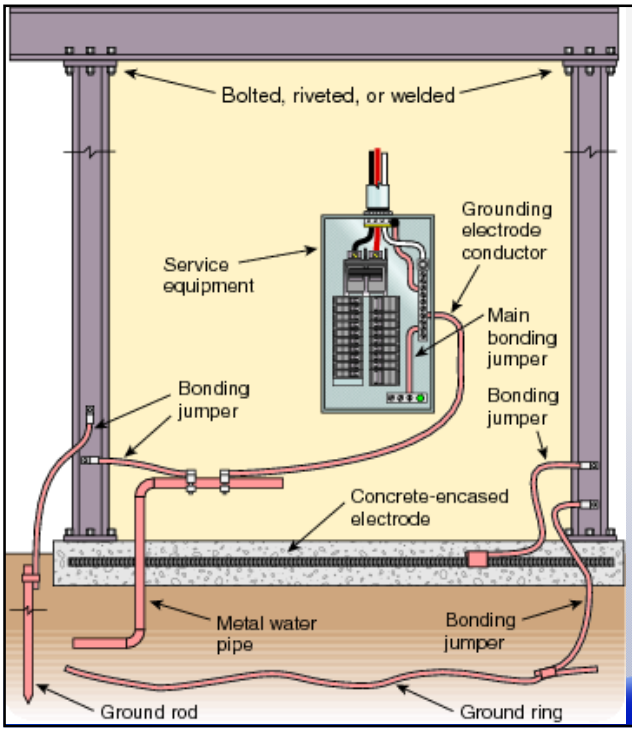
(8) Grounding Electrode Conductor Installation

8. My grounding electrode system consists of a water pipe, a UFER, and a ground rod. My service conductors are 500kcmil copper. Can I run a 1/0 CU grounding electrode conductor to the water pipe, then a #4 cu conductor from the water pipe to the UFER, then a #6 cu from the UFER to the ground rod?

(8) Grounding Electrode Conductor Installation

- Reference:
- 250.64(F) Installation to Electrode(s). Grounding electrode conductor(s) and bonding jumpers interconnecting grounding electrodes shall be installed in accordance with (1), (2), or (3). The grounding electrode conductor shall be sized for the largest grounding electrode conductor required among all the electrodes connected to it.
- (1) The grounding electrode conductor shall be permitted to be run to any convenient grounding electrode available in the grounding electrode system where the other electrode(s), if any, is connected by bonding jumpers that are installed in accordance with 250.53(C).

David Williams, CMP-5



David Williams, CMP-5

SE Cable installation Requirements

9. Is it permissible to install aluminum SER cable in an underground PVC raceway between a house and a garage?

Reference: NEC® 338.12(A)(2)

Answer: No

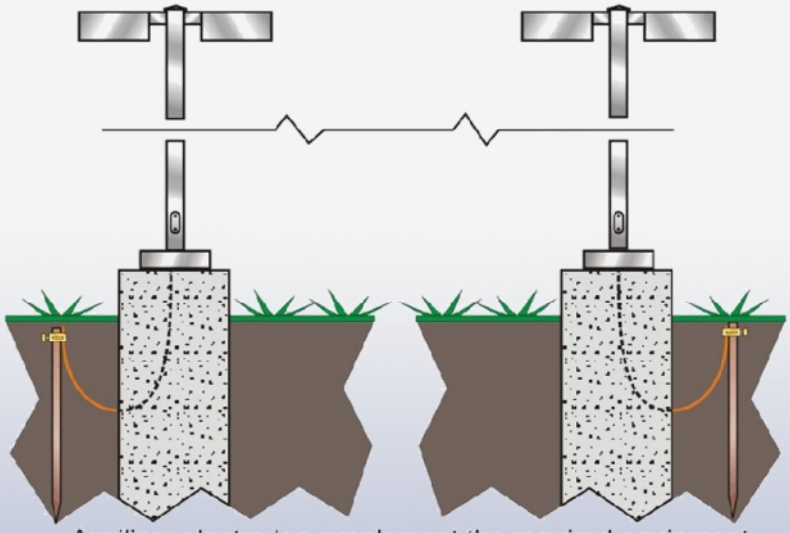
- Per Section 338.12(A)(2), SE cable is not permitted underground with or without a raceway. Keep in mind that SEU and SER are industry terms and are not identified in the NEC®. The NEC® would consider both cable types as SE cable.
- Also look at UL Product Category TYLZ; Type SE — Indicates cable for aboveground installation.

Auxiliary Grounding Electrodes

10. Engineers often ask for a ground rod at parking lot lights. Should the wire from the ground rod be connected to the equipment ground from the lighting circuit?

Reference: NEC 250.54 Indicates that one or more grounding electrodes shall be permitted to be connected to the equipment grounding conductors specified in 250.118.

Answer: Yes. The auxiliary grounding electrode should be connected to the conductive equipment (light pole) to which the required equipment grounding conductor is connected.



Auxiliary electrodes supplement the required equipment grounding conductor of the circuit supplying equipment.

Drawing Courtesy of NECA and NJATC

3/8 Flex

11. A HVAC contractor installed a 10 foot piece of 3/8 flex from the geo unit to a couple of circulating pumps. Is this allowed? Can a Romex connector be used to terminate the 3/8 flex?

Reference:

348.20 Size (Flexible Metal Conduit)

356.20 Size (Liquidtight Flexible Nonmetallic Conduit)

Answer: Both section 348.20 for FMC and 356.20 for LFNC tells us that these conduits in 3/8" Trade Size are permitted to be used for "utilization equipment". However, both conduits are limited to lengths not exceeding 6 ft per 348.20(A)(2) and 356.20(A)(1).

Only fittings listed for FMC or LFNC shall be used. Romex connectors are unacceptable for use with FMC or LFNC

Expansion

- 12. A rigid metallic service conduit is installed outdoors from the meter socket down into a cement slab under the socket. Is an expansion fitting required for this conduit installation?
- NEC 300.7(B)
- Depends on temperature change and length, with a 100 degree Temperature change EMT will expand about ¾ inch per 100 feet. Not for example if this is 5 feet long then it will expand 4 hundreds of an inch or 1 millimeter

Available Fault Current Marking

13. Can a marking pen be used to "legibly mark" the available fault current on a service disconnect? What if the marking is inside the door of an outdoor disconnect?

Reference: NEC 110.24

Answer:

The requirement in NEC 110.24 states the equipment "shall be legibly marked in the field…. and shall be of sufficient durability to withstand the environment."

A permanent marker may comply with this requirement depending upon the environment. A marking inside the door of an outside disconnect likely extends the life of the marking as it is not exposed to the sun and other environmental impacts aspects (dust, dirt, rain,…).

Class II Area Conduit Seals

14. How do you seal the conduits that leave a class II area?

Reference: NEC 502.15

Answer: The options are found in 502.15 of the NEC. These options include using a standard raceway seal as you would for a Class I area. Arrangement of enclosures can be used as long as the enclosure that needs to be dust-ignition proof is above or horizontal, with specified distances of raceway, to mitigate the transmission of dust. Lastly, as sealing material such as sealing putty (duct seal) can be installed in the raceway to prevent the transmission of dust into the enclosure.

Class II Area Conduit Seals

502.15 Sealing, Class II, Divisions 1 and 2. Where a raceway provides communication between an enclosure that is required to be dust-ignitionproof and one that is not, suitable means shall be provided to prevent the entrance of dust into the dust-ignitionproof enclosure through the raceway. One of the following means shall be permitted:

(1) A permanent and effective seal

(2) A horizontal raceway not less than 3.05 m (10 ft) long

(3) A vertical raceway not less than 1.5 m (5 ft) long and extending downward from the dust-ignitionproof enclosure

(4) A raceway installed in a manner equivalent to (2) or (3) that extends only horizontally and downward from the dust-ignition proof enclosures

Where a raceway provides communication between an enclosure that is required to be dust-ignitionproof and an enclosure in an unclassified location, seals shall not be required.

Sealing fittings shall be accessible.

Seals shall not be required to be explosionproof.

Switches in Shower/Tub Enclosures

Question # 15

How Close to a bathtub/shower compartment can a switch be located?

Switches in Shower/Tub Enclosures

Question # 15

- 404.4 Damp or Wet Locations. A surface-mounted switch or circuit breaker in a damp or wet location shall be enclosed in a weatherproof enclosure or cabinet that shall comply with 312.2. A flush-mounted switch or circuit breaker in a damp or wet location shall be equipped with a weatherproof cover. Switches shall not be installed within wet locations in tub or shower spaces unless installed as part of a listed tub or shower assembly.

(16)Grounding Electrode Conductor Terminations

16. A separate structure is fed with an underground feeder with an equipment ground. Outside the structure there is a tap box, the tap over-current protection next to the tap box and a panel inside the structure. Which of these 3 points does the grounding electrode conductor terminate?

- Reference:
- 250.32(D) Disconnecting Means Located in Separate Building or Structure on the Same Premises.
- (3) The connection between the equipment grounding conductor and the grounding electrode at a separate building or structure shall be made in a junction box, panelboard, or similar enclosure located immediately inside or outside the separate building or structure.

David Williams, CMP-5

(16) Grounding Electrode Conductor Terminations

Answer:

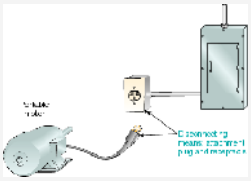
The requirements for the location of the connection of the grounding electrode conductor for a disconnect at a separate structure is covered in Section 250.32(D) and specifically sub-section 3. In this application, it can be connected either at the tap box, or the tap over-current protection device. If there was not a overcurrent device outside than it could be connected to the panel inside the structure.

David Williams, CMP-5

HP Ratings – Attachment Plugs & Receptacles

17. What is a horsepower rated plug or receptacle?

Reference: NEC® 430.109(F); 110.3(B)



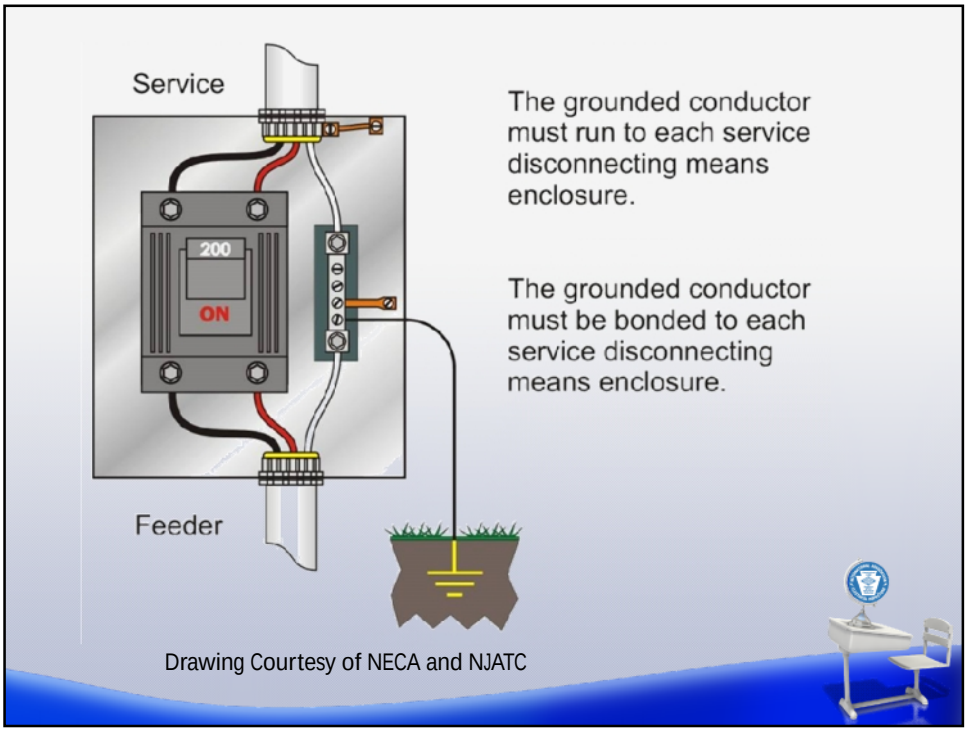
- Answer: Horsepower is the unit of measurement for power and is used to define the rated output power of a motor, whereas the watt is used to define its corresponding input power.
- For cord-and-plug-connected motors, 430.109(F) applies. This section allows a cord-and-plug-connected motor with a horsepower-rated attachment plug and receptacle that are not less than the horsepower rating of the motor to serve as the disconnecting means. Horsepower ratings for receptacles and attachment caps (plugs) are listed in the U.L. White Book (corresponds w/Table 430.148):
- RECEPTACLES FOR PLUGS AND ATTACHMENT PLUGS (RTRT)

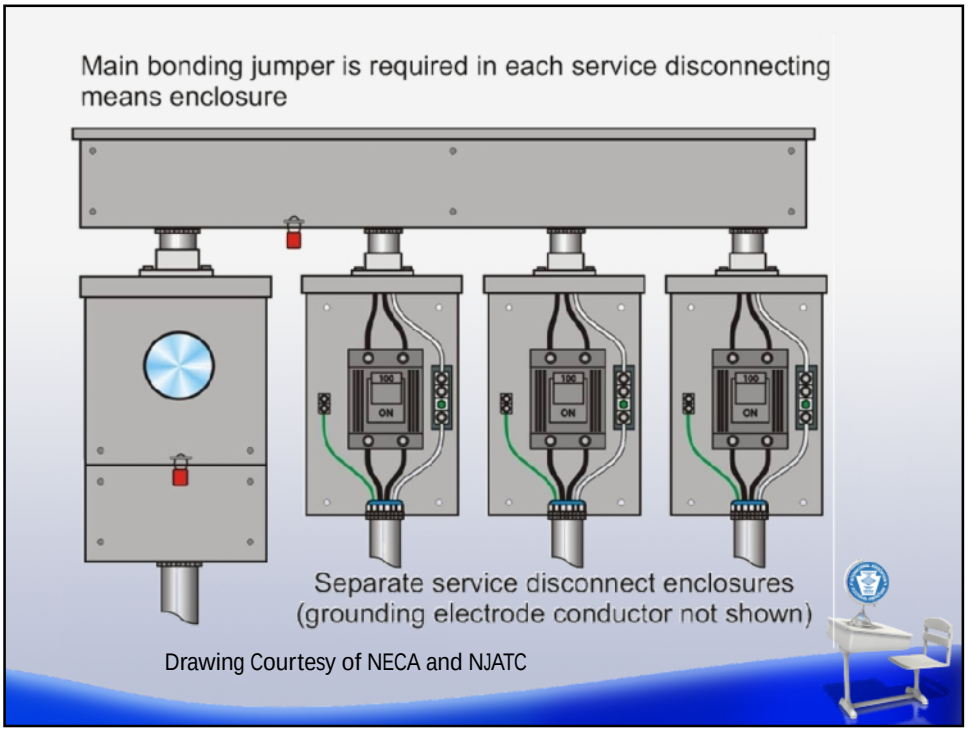
Grounded Conductor Brought to Service

18. A 480/277volt 3 phase service was installed without the grounded conductor being brought to the first disconnecting means, can a bonding bushing and a properly sized equipment bonding jumper at both the transformer and the disconnecting means be used instead?

Reference: NEC 250.24(C) indicates that the grounded conductor must be brought to the service disconnect and bonded to the disconnect enclosure, usually by a main bonding jumper.

Answer: Yes. The grounded conductor (usually a neutral) is required to be installed in this fashion. The grounded conductor is also one of the bonding methods permitted for services as provided in 250.92(B)(1).


Service
200
ON
Feeder
The grounded conductor must run to each service disconnecting means enclosure.
The grounded conductor must be bonded to each service disconnecting means enclosure.
Drawing Courtesy of NECA and NJATC


Main bonding jumper is required in each service disconnecting means enclosure
Separate service disconnect enclosures (grounding electrode conductor not shown)
Drawing Courtesy of NECA and NJATC

Extra Corrosion Protection

19. What can be used as extra corrosion protection for steel conduits buried in the earth or concrete? Does the galvanization on some conduits meet the requirements?

Reference: 342.10(B), 344.10(B)(1) and 358.10(B) Uses Permitted
UL Guide Card DYIX

Answer: Underwriters Laboratories' Electrical Construction Equipment Directory contains information relating to limitations or special conditions applying to products listed by UL. The Directory states that Galvanized Rigid Steel Conduit and IMC do not generally require supplementary corrosion protection when installed in soil unless: 1. Soil resistivity is less than 2000 ohm-centimeters. 2. Local experience has confirmed that the soil is extremely corrosive.

When these conduits need addition protection due to severe corrosive influences in the soil (a non-issue when encased in concrete) there are several products on the market such as PVC Coated Steel Conduits, paint or tape.

When the conduit is in contact with both concrete and soil it is recommended that the conduit is protected by a supplementary protection 4" on each side from the entry point.

Listed Fittings

- 20. Is it permissible to install locknuts taken from an EMT connector on Rigid Metal Conduit?
- NEC Article 314, 3XX.6, 300.12 & 13, 110.3(A) & (B)
- Ans. No, A connector fitting includes the locknut which it has been tested with and should be used only with that fitting.

Maximum Available Fault Current Value

21. How do we get the utilities to provide the information we need to calculate the fault currents as required in 110.24?

Reference: NEC 110.24, Utility Handbooks, Utility

Answer: The serving utility must provide this information so that appropriately sized electrical equipment can be installed. They provide such information in a number of ways:

a) Utility Handbook provides the "Max" fault current on the load terminals for their transformer stock that can be installed to serve that facility.

b) Utility may provide exact information for a particular installation

Once the value is established at the load terminals of the transformer, a calculation can be made based on the conductor length and configuration from the serving transformer to the electrical equipment.

Class II Area Receptacles

22. What kind of receptacles can be installed in Class II division 1 and division 2 areas?

Reference: NEC 502.145 and UL White book Category Codes RTRT and RRAT

Answer: For Class II Div. 1 areas the receptacles have to be identified for that classified area. One means of identification is listing. The UL listing category code is RRAT.

For Class II Div. 2 areas standard receptacles can be used as long as the connection and disconnection of the cord cap does not allow exposed live parts.

Service Bonding Requirements

Question # 23

What are the bonding requirements for service raceways and enclosures containing service conductors?

Answer: 250.92(A)

Service Bonding Requirements
Question # 23

- 250.92 Services.
- (A) Bonding of Equipment for Services. The normally non–current-carrying metal parts of equipment indicated in 250.92(A)(1) and (A)(2) shall be bonded together.
- (1) The service raceways, cable trays, cablebus framework, auxiliary gutters, or service cable armor or sheath except
- as permitted in 250.84 (250.84 Underground Service Cable or Raceway)
- (2) All service enclosures containing service conductors, including meter fittings, boxes, or the like, interposed in the service raceway or armor
-

Service Bonding Requirements
Question #23

(B) Method of Bonding at the Service. Electrical continuity at service equipment, service raceways, and service conductor enclosures shall be ensured by one of the following methods:

(1) Bonding equipment to the grounded service conductor in a manner provided in 250.8

(2) Connections utilizing threaded couplings or threaded bosses on enclosures where made up wrenchtight

(3) Threadless couplings and connectors where made up tight for metal raceways and metal-clad cables

(4) Other listed devices, such as bonding-type locknuts, bushings, or bushings with bonding jumpers

Bonding jumpers meeting the other requirements of this article shall be used around concentric or eccentric knockouts that are punched or otherwise formed so as to impair the electrical connection to ground. Standard locknuts or bushings shall not be the sole means for the bonding required by this section.

Service Bonding Requirements
Question #23

250.8 Connection of Grounding and Bonding Equipment.

(A) Permitted Methods. Grounding conductors and bonding jumpers shall be connected by one of the following means:

(1) Listed pressure connectors

(2) Terminal bars

(3) Pressure connectors listed as grounding and bonding equipment

(4) Exothermic welding process

(5) Machine screw-type fasteners that engage not less than two threads or are secured with a nut

(6) Thread-forming machine screws that engage not less than two threads in the enclosure

(7) Connections that are part of a listed assembly

(8) Other listed means

(24) Equipment Grounding Conductor Sizing

24. What is the sizing ruling for an equipment grounding conductor in a raceway that contains multiple circuits?

- Reference: 250.122(C) Multiple Circuits. Where a single equipment grounding conductor is run with multiple circuits in the same raceway, cable, or cable tray, it shall be sized for the largest overcurrent device protecting conductors in the raceway, cable, or cable tray.

Answer: The requirement for sizing a single equipment grounding conductor in a raceway that contains multiple circuits is located in 250.122(C). A single equipment grounding conductor is sized based on the largest overcurrent device protecting the conductors in that raceway.

Pool Perimeter Bonding Requirements

25. Where is the distance the equipotential bond wire is required to be installed, measured from the edge of a concrete pool, without a deck?

Reference: NEC® 680.26(B)(2)

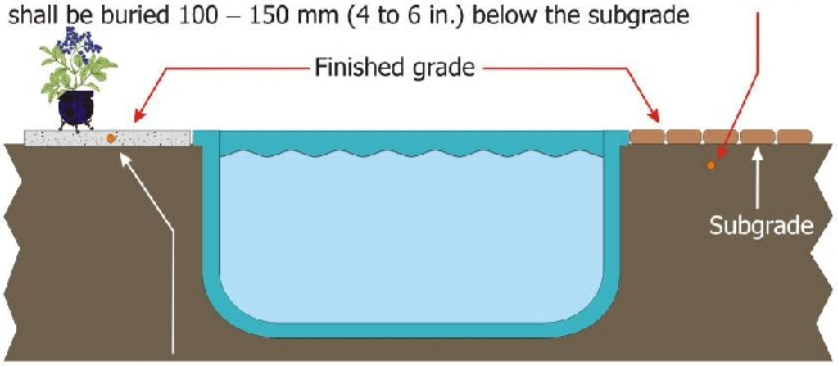
Answer:

- The perimeter surface shall extend for 1 m (3 ft) horizontally beyond the inside walls of the pool and shall include unpaved surfaces, as well as poured concrete surfaces and other types of paving.
- Bonding to perimeter surfaces shall be provided as specified in 680.26(B)(2)(a) or (2)(b):
- (a) Structural Reinforcing Steel.
- (b) Alternate Means.
  - (1) At least one minimum 8 AWG bare solid copper conductor shall be provided.
  - (4) The required conductor shall be 450 mm to 600 mm (18 in. to 24 in.) from the inside walls of the pool.

Alternate Means for Perimeter Surfaces

Where structural reinforcing steel is not available or encapsulated, at least one 8 AWG solid copper conductor secured within or under the perimeter surface and installed 450 – 600 mm (18 to 24 in.) measured horizontally from the inside walls of the pool

Where installed beneath the final grade material, the bonding conductor shall be buried 100 – 150 mm (4 to 6 in.) below the subgrade



A single 8 AWG solid copper conductor or structural reinforcing steel (rebar or wire mesh) in the concrete is permitted as the bonding grid

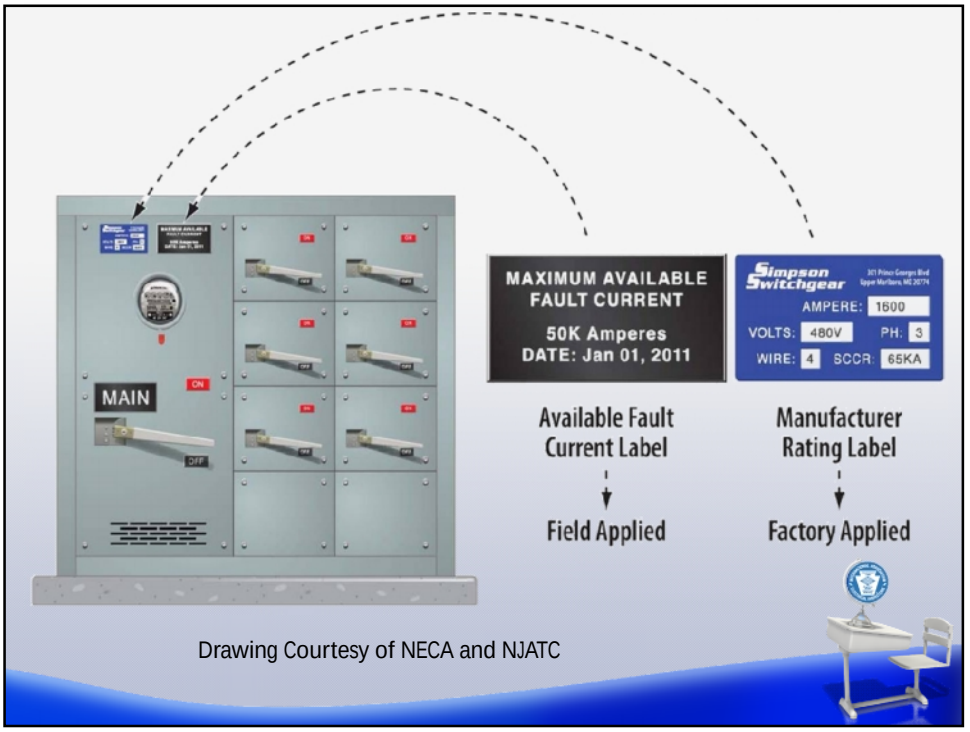
680.26(B)(2)(b)

Available Fault Current Marking at Service

26. What are the field marking requirements for available fault current at electrical service equipment?

Reference: NEC 110.24(A) and (B)

Answer: This section indicates that the service equipment in other than dwelling units shall be legibly marked in the field with the maximum available fault current. The field marking(s) shall include the date the fault current calculation was performed and be of sufficient durability. This value is typically published by the serving utility and is part of the requirements for electric service, often online. This value is needed for design and installing equipment within its fault current rating.



Drawing Courtesy of NECA and NJATC

FMC and LFMC as an EGC

27. Are flexible metal conduit and liquid tight flexible metal conduit allowed to serve as an equipment grounding conductors by the NEC?

Reference: 250.118(5) and (6)

Answer: Flexible Metal Conduit (FMC) is permitted to an Equipment Grounding Conductor when the conditions of 250.118(5) are met. Liquidtight Flexible Metal Conduit (LFMC) is permitted to an Equipment Grounding Conductor when the conditions of 250.118(6) are met.

Solar Installation

28. In a solar photovoltaic installation, can the EMT raceway system between the modules and the inverter be recognized as the equipment grounding conductor or is it necessary to install an equipment grounding conductor in the raceway?

- NEC 690.45
- Ans. No, 690.45(A) only references Table 250.122 for sizing therefore 250.118 does not seem to be permitted.

Outlet AFCI on 2-Wire Branch Circuit

29. Can a listed outlet branch-circuit type AFCI be installed on a 2-wire branch circuit to comply with 210.12(B)(2) without installing an equipment grounding conductor?

Reference: NEC 210.12(B), NEC 406.4(D)

Answer:

Since none exist on the market, it is not clear if a Listed outlet branch-circuit type AFCI would require an equipment grounding conductor to operate in accordance with its Listing.

NEC 210.12(B) addresses modifications to the branch circuit. NEC 406.4(D) addresses replacement receptacles. Assuming such outlet AFCIs would be the grounding type, NEC 406.4(D)(2)(c) would drive the need to provide Listed GFCI protection as integral or ahead of the outlet AFCI.

Bonding Bushings

30. Describe and discuss when bond bushings are to be used.

References: 250.92, 260.64(E), 250.100, 500.5

Answer:

Bonding bushings are one option where raceway bonding is required. The purpose of the bonding is to ensure the electrical continuity of the race to enclosure, other raceway, or wiring method to limit voltage differential and to facilitate carrying ground fault current. This includes service raceways per 250.92, raceways containing grounding electrode conductors that are not continuous from the equipment to the grounding electrode 250.64(E), and certain hazardous location areas 250.100 and 500.5.

Service Requirements

Question #31

What are the rules for the location of the service disconnect?

Answer: 230.70(A) Location. The service disconnecting means shall be installed in accordance with 230.70(A)(1), (A)(2), and (A)(3).

(1) Readily Accessible Location

(2) Bathrooms

(3) Remote Control

(32) Equipment Grounding Conductors

32. Is it permitted to use the same EGC (equipment grounding conductor) for two separate systems with two different voltages, such as a 277/480 and a 120/240 volt system?

Reference: 250.122(C) Multiple Circuits. Where a single equipment grounding conductor is run with multiple circuits in the same raceway, cable, or cable tray, it shall be sized for the largest overcurrent device protecting conductors in the raceway, cable, or cable tray.

- Answer: There is not a requirement for having a separate equipment grounding conductor where you have circuits in the raceway that originate from different systems with two different voltages. The requirements of Section 250.122(C) would apply.

Garbage Disposal Requirements

33. A 15-ampere, 120-volt duplex rated receptacle is installed to supply a 1/3 HP, 120-volt disposal from a 20-ampere rated circuit. A CO/ALR 120-volt, 15-ampere, general-use rated snap switch is installed to control the disposal's operation. Does this installation meet NEC requirements?

Reference: NEC® Table 210.21(B), 404.14(A)(3) 422.16(B)(1), 422.31(C), 422.33(A), & 430.109(C)(2)

Answer: Yes

Garbage Disposal Requirements

Reference: NEC® Table 210.21(B), 404.14(A)(3) 422.16(B)(1), 422.31(C), 422.33(A), & 430.109(C)(2)

- Table 210.21(B) permits 15 amp duplex on 20 amp circuit
- 422.16(B)(1) permits cord-and-plug-connection
- 404.14(A)(3) Motor loads not exceeding 80 percent of the ampere rating of the switch at its rated voltage
- 422.31(C) Motor-Operated Appliances Rated over 1/8 Horsepower. ... The disconnecting means shall comply with 430.109 and 430.110.
- 430.109(C)(2) permits general-use snap switch

Outdoor Generator Electrode Requirements

34. Is it required to bond an outside generator grounding electrode system (it is a separately derived system) to the building grounding electrode system? If it is not a separately derived system, is it required to have a grounding electrode system since it's a separate structure?

References: Article 100, 250.54, 250.30(A)(4)

Answer: A structure is defined as "That which is built or constructed." A generator is equipment that is installed typically on a concrete pad. In my opinion, an electrode is not necessary for this equipment. If an electrode is installed as an option, it is required to be in accordance with 250.54 which covers auxiliary electrodes. If the generator is a separately derived system, the electrode(s) required are provided in 250.30(A)(4).

Equipment installed on concrete pad covered by NEC Article 445

Photo Courtesy of NECA and NJATC

SO Cord

35. Can SO cord be dropped from a bar joist to a display shelf (end cap) and hard-wired to a junction box on that display unit or does it have to be installed in conduit?

Reference: 400.8 (1)

Answer: SO Cord is a Hard Service Cord found in Table 400.4 Use: Pendant or portable.

No, 400.8(1) does not allow cords to be used as a substitute for fixed wiring. So even if the SO Cord was able to be installed in conduit it would not be permitted.

Suitable for Wet Locations

36. What fittings are approved to be used on the exterior of a building, weather proof or rain tight?

- NEC 314. 15, 358.10
- All fittings must be listed for use in wet locations. However, 358.10 only requires EMT fittings to be approved for the use and RMC and IMC Couplings are not fittings, they are listed as an integral part of the conduit.

Equipment Grounding Conductor Size

37. We increased the size of the circuit conductors on a pumping station to compensate for the voltage drop. We increased in size from a #6 AWG copper to a 1/0 copper conductor. What if anything needs to be done with the equipment grounding conductor when the circuit conductors are increased?

Reference: NEC 250.122(B)

Answer:

NEC 250.122(B) – The "equipment grounding conductors, where installed, shall be increased in size proportionally according to circular mil area of the ungrounded conductors."

Hubs Listed for Bonding

38. Are rain-tight hubs listed for bonding purposes on the line side of a service?

Hubs Listed for Bonding

38. Reference: 250.92(B), UL White Book Category Code DWTT

Answer:

Yes, hubs are one of the devices listed for bonding and are identified in this code reference as suitable for use for a service raceway.

NEC 250.92(B)(2) Connections utilizing threaded couplings or threaded hubs on enclosures if made up wrenchtight.

DWTT statement - Hubs intended for use with conduit that serves as a service mast in accordance with the NEC are marked on the fitting or carton to indicate suitability for use with service entrance equipment.

Conduit Fittings.

Small Appliance Circuits

Question #39

Can I install a dishwasher and a garbage disposal together on a single phase/120volt 20amp small appliance circuit per 422.16(B)?

Answer: It can be done if proper circuit ampacity is provided for and the system branch circuit is designed as indicated.

Small Appliance Circuits
Question # 39

- 110.3(B) Installation and Use. Listed or labeled equipment shall be installed and used in accordance with any instructions included in the listing or labeling. “Thus if the manufacturer specifies a separate circuit for a dishwasher or garbage disposal, then the response should be yes.
- If a separate circuit is not indicated, then you must review 210.19(A)(1).
- (1) General. Branch-circuit conductors shall have an ampacity not less than the maximum load to be served. Where a branch circuit supplies continuous loads or any combination of continuous and noncontinuous loads, the minimum branch-circuit conductor size, before the application of any adjustment or correction factors, shall have an allowable ampacity not less than the noncontinuous load plus 125 percent of the continuous load.

Small Appliance Circuits
Question #39

- I would not consider a dishwasher or garbage disposal to be a continuous load. Next, we need to consider Section 210.23(A) 15- and 20-Ampere Branch Circuits. "A 15- or 20-ampere branch circuit shall be permitted to supply lighting units or other utilization equipment, or a combination of both, and shall comply with 210.23(A)(1) and (A)(2)." Subsection (A)(1) states, "The rating of any one cord-and-plug-connected utilization equipment shall not exceed 80 percent of the branch-circuit ampere rating."
- (A)(2)States "The total rating of utilization equipment fastened in place, other than luminaires (lighting fixtures), shall not exceed 50 percent of the branch-circuit ampere rating where lighting units, cord-and-plug-connected utilization equipment not fastened in place, or both, are also supplied."

(40) Concrete Encased Electrode/Supplemental

40. Is a supplemental grounding electrode required for a concrete-encased electrode? My inspector says I have to drive a ground rod. The water piping system serving the building is plastic.

Reference: 250.53 Grounding Electrode System Installation. (A)(2) Supplemental Electrode Required. A single rod, pipe, or plate electrode shall be supplemented by an additional electrode of a type specified in 250.52(A)(2) through (A)(8).

- Answer: A supplemental grounding electrode is required as referenced in Section 250.53(A)(2) for rod, pipe or plate electrodes. The code does not require a concrete-encased electrode to be supplemented.

David Williams, CMP-5

Arc-flash Warning Label Requirements

41. When does an arc-flash warning label need to be installed?

Reference: NEC® 110.16

Answer: Electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers, that are in other than dwelling units, and are likely to require examination, adjustment, servicing, or maintenance while energized shall be field marked to warn qualified persons of potential electric arc flash hazards.

Grounding Electrodes for PV Systems

42. Where a photovoltaic system serves both dc and ac circuits with no direct connection between the dc grounded conductor and the ac grounded conductor, would each system be required to have separate grounding electrode systems and to what all would be these systems be required to be bonded?

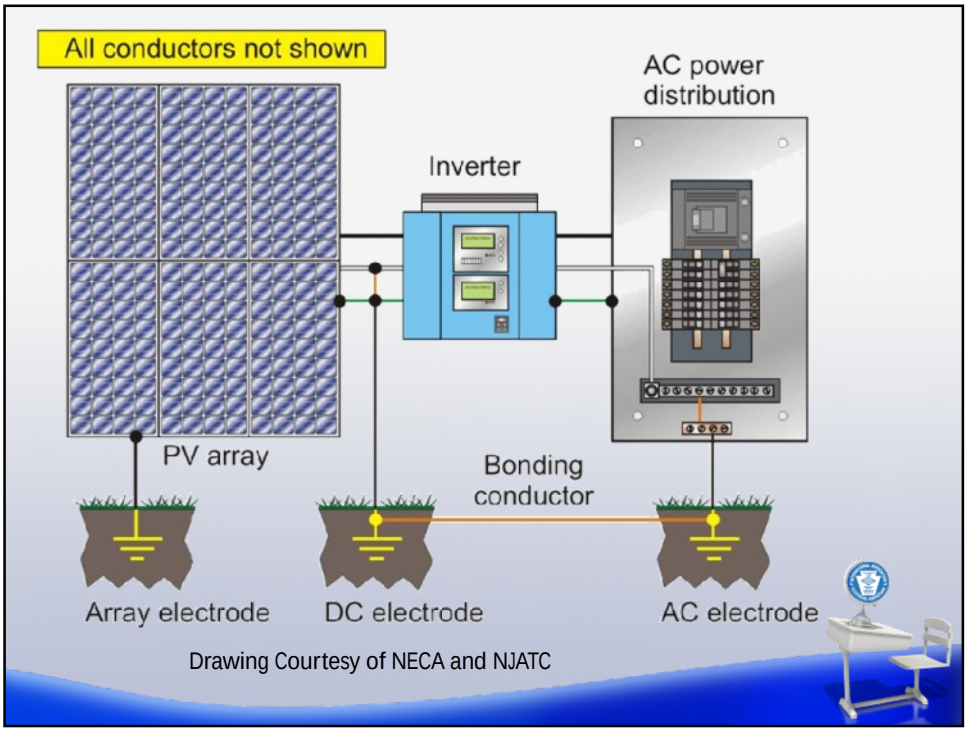
Reference: 690.47(C)(1),(2), or (3)

Answer: One of the methods in (1), (2), or (3) is required.

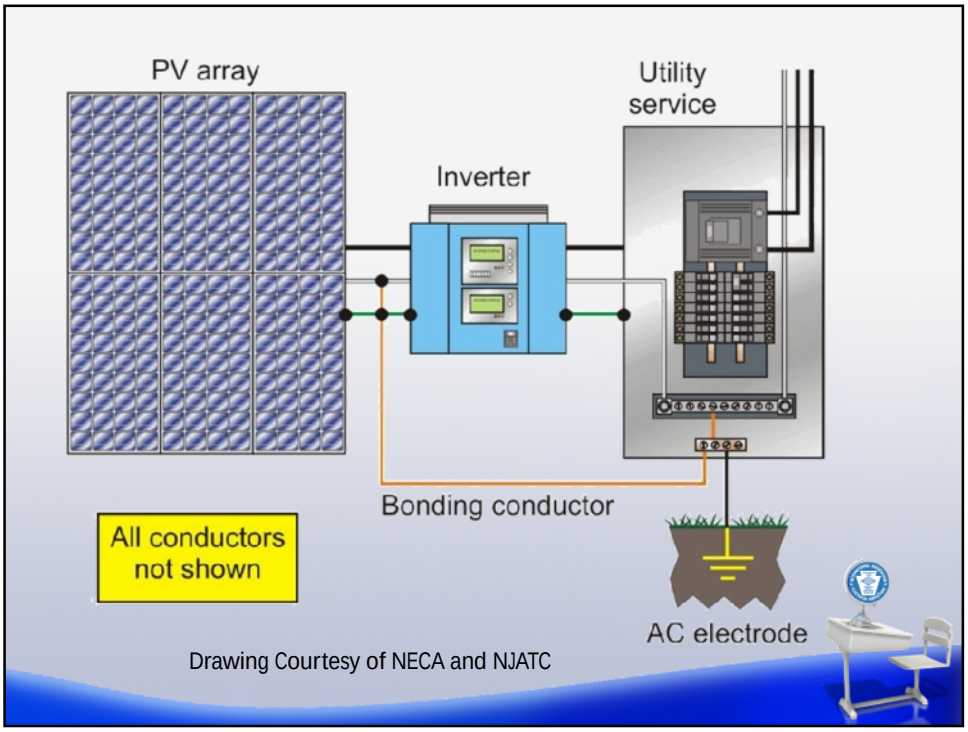
(1) Separate Direct-Current Grounding Electrode System Bonded to the Alternating-Current Grounding Electrode System.

(2) Common Direct-Current and Alternating-Current Grounding Electrode.

(3) Combined Direct-Current Grounding Electrode Conductor and Alternating-Current Equipment Grounding Conductor.



Drawing Courtesy of NECA and NJATC



LFMC in an Environmental Air Return

43. I have installed liquidtight metal flexible conduit to several RTU's (rooftop units). The space above the ceiling is used for environmental air return. The inspector has asked me to replace it. Can't it be used in this application?

Reference: 300.22(C)(1)

Answer: 300.22(C)(1) list the permitted wiring methods that are allowed to be used in a ceiling used for environmental air. Liquidtight Metal Flexible Conduit (LFMC) is not listed. LFMC was removed as an acceptable wiring method for the 2002 NEC. Prior to the 2002 NEC LFMC was permitted to be used in lengths not exceeding 6 feet.

Supply Side Bonding Jumper

44. What is the minimum size for an equipment bonding jumper on the supply side of a service with 5-parallel 500 kcmil copper conductors?

- NEC 250.30(A)(2)
- Not larger than the ungrounded conductors or nonflexible conduit or tubing. If a wire it is based on the size of the ungrounded conductors per 250.102(C).
- 5 X 500 X 12.5% = 312.4 therefore 350 kcmil

Transfer Switch / Service Disconnect

45. Can a transfer switch for a standby power system be located between the meter and an existing panelboard? Does the grounding electrode conductor and the main bonding jumper need to be relocated from the existing panelboard to the transfer switch?

Reference: NEC 230.82, NEC 230.91, NEC 250.24

Answer: 1) Yes, 2) Yes

Assume the transfer switch is a double-throw switch, no overcurrent protection. The Double-throw becomes the service disconnect. The main breaker in the panelboard becomes the service overcurrent device (NEC 230.91) that must be located adjacent to the switch. (Switch outside, panel inside is not adjacent)

The switch and panelboard still fall within the definition of service equipment. However, NEC 250.24(B) requires the Main Bonding Jumper to be located in the service disconnect enclosure. (Very explicit to say service disconnect and not service equipment)

Busbar Taps for PV Back feeding

46. We are back feeding from a PV inverter to the MDP. There is no room for breakers, so can we drill and attach to the bus bar if we have overcurrent protection ahead of the connection?

Reference: UL White Book page 43, Field Modifications

Busbar Taps for PV Back feeding

Answer: Possibly. This is a modification to the listed panelboard or switchboard. The panelboard manufacturer may have an accessory kit listed for installation where the backfed PV conductors from the inverter can be terminated. If no such accessory kit exists the panelboard would have to have the capacity and sufficient bus material considering what was drilled out to still maintain ampacity and temperatures. Most panelboards would not necessary meet this criteria. Switchboards being generally larger in ampacity may have more opportunity to have the modification completed. In all cases, other than the listed accessory kit, any modification would require a Field Evaluation by a qualified testing laboratory, which should be the one that listed the equipment, to verify that the modifications still have a compliant construction to UL 891.

Grounding Small Wind Turbines

Question # 47

What type of a grounding electrode system is required for the inverter of a small wind turbine?

Grounding of Small Wind Turbines

Question # 47

- Wind generator and tower are their own separate structure, consider 250.32 for feeders or branch circuits and separate structures as another possible requirement that a grounding electrode system meeting Part III of the Article 250 would apply.
- Also 250.30(C) could be applied where the separately derived system installed outside of the building requires a grounding electrode and grounding electrode conductor to be installed.

(48) Grounding Electrode/Separate Building

48. A small maintenance building was built on a concrete foundation 500' away from the main building. The building has a 150 amp service fed underground from the main building. This feeder contains a grounded conductor and an equipment grounding conductor. Is it required to connect this subpanel to the rebar in the footing?

(48) Grounding Electrode/Separate Building

Reference:

- 250.32 Buildings or Structures Supplied by a Feeder(s) or Branch Circuit(s).
- (A) Grounding Electrode. Building(s) or structure(s) supplied by feeder(s) or branch circuit(s) shall have a grounding electrode or grounding electrode system installed in accordance with Part III of Article 250. The grounding electrode conductor(s) shall be connected in accordance with 250.32(B) or (C). Where there is no existing grounding electrode, the grounding electrode(s) required in 250.50 shall be installed.

(48) Grounding Electrode/Separate Building

- Reference: 250.50 Grounding Electrode System.
- All grounding electrodes as described in 250.52(A)(1) through (A)(7) that are present at each building or structure served shall be bonded together to form the grounding electrode system. Where none of these grounding electrodes exist, one or more of the grounding electrodes specified in 250.52(A)(4) through
- (A)(8) shall be installed and used.
  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.

David Williams, CMP-5

(48) Grounding Electrode/Separate Building

- Answer:
- The feeder terminating at the second building is required to establish a grounding electrode system Per Section 250.32. Section 250.50 references that when a grounding electrode as defined in 250.52, is present at a building or structure it must be connected as a part of the grounding electrode system. There is an exception in 250.50 that does not require you to connect to a concrete encased electrode in an existing building.

David Williams, CMP-5