

CODE PANEL QUESTIONS

1. 200 amp Main Breaker Meter Pedestal is located out by street which feeds a main breaker electrical panel just inside the home fifty feet away from the pedestal. How many ground rods are required and how many conductors are required for this application. What size are the conductors (all conductors aluminum). Ufer is installed in the foundation.

Answer:

I would consider the pedestal with the meter and the main to be a structure out by the street and this structure is where the service from the utility is being delivered to. Therefore, this structure and service would have to have a grounding electrode system complying with Part III of Article 250. If ground rods are the only electrode available and of choice, then there would have to be 2 installed unless the exception in 250.53(A)(2) were applied and one ground rod would suffice (not likely).

From this service pedestal to the home would be a feeder. That feeder would need 4 conductors, 250.32(B)(1) (I am assuming a normal 240/120 Volt 1-Phase, 3-Wire system). Two ungrounded, the neutral and an equipment grounding conductor. For 200 Amps the ungrounded would be 4/0 Al, the neutral would have to be a minimum 2 AWG per 250.24(C)(1) or larger based on calculations from 220.61. The equipment grounding conductor would be sized to 250.122 and would be 4 AWG Al or 6 AWG copper.

At the home the concrete encased electrode would require a 4 AWG copper grounding electrode conductor to the equipment grounding bar in the panel. There would not be any bonding jumper installed between the neutral and the equipment grounding bar in this panel – the neutral would have to be ungrounded from the point of bonding in the service pedestal all the way through the system per 250.24(A)(5).

There would not be any requirement for the concrete encased grounding electrode conductor to have any direct bonding to the ground rods at the service pedestal. These are separate structures and each would have its own grounding electrode or grounding electrode system independent of the other. The sole required connection between the two electrode systems is accomplished by the equipment grounding conductor installed with the feeder from the pedestal to the panel in the home.

2. Is the expansion foam that is used to seal air passages around NM cable identified or listed for use with the outer jacket of the NM cable?

Answer: No, if you look at the UL Mark on the great stuff, it says it is UL Classified for surface burning characteristics, flame spread and smoke developed index. It hasn't been evaluated for contact with NM cable or any other cable or conductor. The chemicals typically used in these foams when they are in their uncured form are not known to have compatibility issues with NM cables, however, during the curing process we have no idea what the chemical reaction during the curing process has on the cable jacket.

3. 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.]

Answer: The maintenance personnel don't have to be licensed but they need to be **qualified.**

Art 410--Luminaires

410.130(G) Requires a disconnecting means for fluorescent luminaires that utilize double-ended lamps and contain ballasts that can be serviced in place.

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.

Art 100 and NFPA 70E Definitions: **Qualified**

"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."

As stated in NFPA 70E (Standard for electrical safety in the workplace) A company shall 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.

And...Code of Iowa 103.22 states:

"Provisions of this chapter shall not require employees of industrial or commercial companies performing manufacturing, installation and repair work for such employer to hold licenses while acting within the scope of their employment."

So the substantiation is that even though the maintenance person may be unlicensed, that person will still need to be "qualified" per the definitions.

4. Can Table 310.15(B)(7) be used to size the conductors for a subpanel in a residence?
Code Ref: 310.15(B)(7) and dwelling unit definitions

Answer: Yes with conditions

This table is for dwelling units only with a feeder to a sub-panel that is the main power feeder to a dwelling unit. This code section defines the main power feeder as the feeder between the main disconnect and the panelboard that supplies power to the branch circuit or feeder loads that are part of this dwelling unit. Additional feeder panels such as a panel in a separate location in the house, garage or an out building would not apply. Feeder conductors for panels other than the main power feeder will need to be sized as per table 310.15(B)(16). An example of a main power feeder would be meter/disconnect or a feeder disconnect located outdoors that feeds a panel in a dwelling unit that contains all the branch circuits that supply the unit. This could be a structure that is a one, two or a multifamily dwelling unit. To be defined as a dwelling unit the unit will need to provide living facilities for one or more persons with permanent provisions for living, sleeping, cooking, and sanitation. A dorm, a motel room or assisted living unit with their own panel could use this code section only if they are a dwelling unit also.

5. A 200 amp main breaker meter pedestal is located out by the street which feeds a main breaker electrical panel just inside the home fifty feet away from the pedestal. How many ground rods are required and how many conductors are required for this application? What size are the conductors (all conductors are aluminum)? A UFER is installed in the house foundation.
Code Ref: _____ This is a repeat of question 1

6. Is a non-fused switch acceptable as a service disconnecting means?
Code Ref: 230.76 Manually or Power Operable.

Answer: The service disconnecting means for ungrounded service conductors shall consist of one of the following:

- (1) A manually operable switch or circuit breaker equipped with a handle or other suitable operating means
- (2) A power-operated switch or circuit breaker, provided the switch or circuit breaker can be opened by hand in the event of a power supply failure

230.77 Indicating.

Changed From 2008

- 230.77: Revised to clarify that “open” is “off” position and “closed” position is “on” position.

The service disconnecting means shall plainly indicate whether it is in the open (off) or closed (on) position.

230.79 Rating of Service Disconnecting Means.

The service disconnecting means shall have a rating not less than the calculated load to be carried, determined in accordance with Part III, IV, or V of Article 220, as applicable. In no case shall the rating be lower than specified in **230.79(A), (B), (C), or (D)**.

(A) One-Circuit Installations. For installations to supply only limited loads of a single branch circuit, the service disconnecting means shall have a rating of not less than 15 amperes.

(B) Two-Circuit Installations. For installations consisting of not more than two 2-wire branch circuits, the service disconnecting means shall have a rating of not less than 30 amperes.

(C) One-Family Dwellings. For a one-family dwelling, the service disconnecting means shall have a rating of not less than 100 amperes, 3-wire.

(D) All Others. For all other installations, the service disconnecting means shall have a rating of not less than 60 amperes.

7. Would ice cream/frozen yogurt or custard prep area without "cooking" equipment be considered a kitchen?
Code Ref: Art. 100—Definitions

Answer: Kitchen “An area with a sink and permanent provisions for food preparation and cooking”

Dictionary definition of Cooking....

1. to prepare (food) by the use of heat, as by boiling, baking, or roasting.
2. to subject (anything) to the application of heat.
3. the process of using heat to prepare foods for consumption

And...a permanent provision would be a range receptacle or a gas line for a stove.

There isn't any mention of a sink but I assume with ice cream/yogurt there probably is, and also a counter for the prep area....

As there is no permanent provision for cooking so I would say this is not a kitchen....

So **none** of the receptacles are required to be GFCI's. If there was a stove and a sink in the room then **ALL** the receptacles in the room will have to be GFCI

And.. (210.8(B)(5) says a GFCI is required for a receptacle within 6 ft of the sink regardless if it is a kitchen or not.

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?

Code Ref: 250.68(C), 250.58(C)

Answer: Yes

Code section 250.66 tells us to use table 250.66 to size the gec. This will require a 1/0 copper conductor to the water pipe. Code section 250.66(B) allows a gec conductor to the ufer to be a #4 copper and 250.66(A) allows a #6 copper to the ground rods. Code section 250.68(C) allows gec to be extended using the water pipe and the building steel. The water pipe needs to be the point that is less than 5 foot in the structure 250.68(C)(1) and can connect all electrodes that are part of the grounding electrode system.. The structural frame is allowed be used as a gec when the conditions of 250.68(2) (a), (b) and (c) are met. Connecting the structural metal frame to a concrete encased electrode or a ground ring, bonding the structural steel to ground rods or plates, or by other means to connect the metal frame to the earth. In 250.52(A)(2) the structural metal that is in contact with the earth 10 foot or more would be another approved means of establishing a connection to earth. Code section 250.54(C) that requires the gec to be continuous and allows 250.58(C) to be used and still be considered continuous. As long as each of the conductors to the grounding electrodes are sized for the largest conductor that will be supplying bonding to that electrode. The steel and the water pipe are used as a tap to connect and extend the grounding electrode system when all of the above conditions are met.

9. 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?

Answer: Either as long as it is accessible, see **250.24(A)(1) General**. The grounding electrode conductor connection shall be made at any accessible point from the load end of the service drop or service lateral to and including the terminal or bus to which the grounded service conductor is connected at the service disconnecting means.

10. Can you install metallic-sheathed cable (such as MC) in PVC conduit in a slab in a medical facility?

Answer: Yes, if the MC complies with Art 330.116

517.13 Grounding of Receptacles and Fixed Electrical Equipment in Patient Care Areas. See *related UL*

Wiring in patient care areas shall comply with **517.13(A)** and **(B)**.

(A) Wiring Methods. All branch circuits serving patient care areas shall be provided with an effective ground-fault current path by installation in a metal raceway system, or a cable having a metallic armor or sheath assembly. The metal raceway system, or metallic cable armor, or sheath assembly shall itself qualify as an equipment grounding conductor in accordance with **250.118**. See *related UL*

330.116 Sheath.

Metallic covering shall be one of the following types: smooth metallic sheath, corrugated metallic sheath, interlocking metal tape armor. The metallic sheath shall be continuous and close fitting. A nonmagnetic sheath or armor shall be used on single conductor Type MC. Supplemental protection of an outer covering of corrosion-resistant material shall be permitted and shall be required where such protection is needed. The sheath shall not be used as a current-carrying conductor.

11. 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?

Code Ref: Art 400—Flexible Cords and Cables

Answer: Since it sounds like the cord will be connected to a junction box on a stationary display shelf that doesn't require moving around, frequent interchange, or vibration it doesn't fall under any of the 400.7 "*Uses Permitted*".

400.8 "Uses Not Permitted" (1) states that flexible cords or cables shall not be used as a substitute for the fixed wiring of a structure.

So...I would say the SO cord couldn't be used, a permanent wiring method will need to be used.

12. 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?

Code Ref: NEC 300.5(B), UL Whitebook ZMVV and ZMWQ

Answer:

The inside of an above grade outside j-box is not a wet location. In the UL White book under WIRE CONNECTORS AND SOLDERING LUGS (ZMVV) covers splices that are listed for dry locations. Under related products in this category it directs you to the splices for wet locations under SEALED WIRE-CONNECTOR SYSTEMS (ZMWQ). Products that have this listing are splices that are listed for wet locations. In 300.5(B) in the NEC the wet locations are defined for enclosures and raceways installed in underground locations. This section requires any splices in these locations be "approved" for use in wet locations. A standard wire-nut would not be approved for a wet location. If the conduit system extends from an underground location to a j-box then the interior of that box is also a wet location and the splice will need to be approved for a wet location. A j-box that is outdoors and is not part of a conduit system that emerges from the ground would not be considered a wet location and a standard splice could be used. The box used in a wet location will required to be listed for the wet location (314.15).

- 13 Does a long run of PVC in the earth below the frost line need expansion fittings belowgrade or where exiting the earth?

Answer: NO. 352.44 Expansion Fittings. See related UL

Expansion fittings for PVC conduit shall be provided to compensate for thermal expansion and contraction where the length change, in accordance with **Table 352.44**, is expected to be 6 mm (¼ in.) or greater in a straight run between securely mounted items such as boxes, cabinets, elbows, or other conduit terminations.

SEE NEMA DOCUMENT # PRP-2009 Expansion Fittings for further information.

14. Do we have to have a **warning tape** in a ditch if the conductors are in conduit?

Answer: Yes, if they are service conductors and not encased in concrete.

300.5 Underground Installations.

(D) Protection from Damage. Direct-buried conductors and cables shall be protected from damage in accordance with **300.5(D)(1)** through **(D)(4)**.

(1) Emerging from Grade. Direct-buried conductors and cables emerging from grade and specified in columns 1 and 4 of **Table 300.5** shall be protected by enclosures or raceways extending from the minimum cover distance below grade required by **300.5(A)** to a point at least 2.5 m (8 ft) above finished grade. In no case shall the protection be required to exceed 450 mm (18 in.) below finished grade.

(2) Conductors Entering Buildings. Conductors entering a building shall be protected to the point of entrance.

(3) Service Conductors. Underground service conductors that are not encased in concrete and that are buried 450 mm (18 in.) or more below grade shall have their location identified by a warning ribbon that is placed in the trench at least 300 mm (12 in.) above the underground installation.

The warning ribbon required in **300.5(D)(3)** reduces the risk of an accident, an electrocution, or an arc-flash incident during excavation near underground service conductors that are not encased in concrete. This provision does not extend to feeders and branch circuits, because these circuits contain short-circuit and overload protection.

(4) Enclosure or Raceway Damage. Where the enclosure or raceway is subject to physical damage, the conductors shall be installed in rigid metal conduit, intermediate metal conduit, Schedule 80 PVC conduit, or equivalent. See *related UL*

15. Can panel boards be installed in “janitor closet” in a school?

Answer: 1st The definition of a close closet in **Art 100:**

“A non-habitable room or space intended primarily for storage of garments and apparel” so a janitor closet probably isn’t used primarily for clothes.

2nd Depending on how large the room is **110.26(A)(1)** “*working space around electrical equipment*” may be an issue. There needs to be sufficient height (6 ½ ft or height of the equipment), width (30 in min), depth (0-150 volts to ground needs to be **3 ft**)

3rd Also **240.24(D)** states that over-current devices shall not be located in the vicinity of easily ignitable materials such as a clothes closet.

So if sufficient space is available in that room and no ignitable materials are stored close to the panel (don't know how you can guarantee that one) then **yes, a panel could be installed there.**

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

Code Ref: 394.12(5) website for SEIDA

Answer: Where the knob and tube is installed in the hollow spaces of wall, ceilings and attics it is not allowed to be covered by any type of insulating material that envelops the conductor. The weatherization programs are installing the insulation in violation of this code section if the knob and tube wiring is not first removed.

SEIDA stands for the Southern Iowa Economic Development Association that consists of the counties of Appanoose, Davis, Jefferson, Keokuk, Mahaska, Van Buren and Wapello. They are a community action agency that is under the Iowa Department of Human Rights. They are not a government agency. There are a total of 18 community action agencies that cover all of Iowa's 99 counties. They are a private agency that receives funding from the combination of state, federal and local governments as well as private funding. They are governed by a 24 member board of directors. Complaints can be directed in writing to the program director.

I would say that a complaint to the program director or to the Iowa Department of Human Rights would make the agency and the state aware of the dangerous condition that the insulating of the knob and tube conductors may create. You may want to make the AHJ in the area aware of the situation and be included in the complaint. It's hard to tell what they would do with this information. Making them aware of the situation in a written complaint would make the complaint part of record should any problem arise from the violation.

17. On a single lot you have a 200 amp main breaker single phase meter pedestal located out by the front sidewalk of a zoned single family residential neighborhood. The 200 amp main breaker electrical panel is located on the basement foundation load bearing cement wall within 5 ft of the "point of entrance" of the wire penetration.

How many conductors are required?

What type of grounding is required both at the pedestal and the dwelling structure? You have plastic water line, CSST gas line, Satellite / telephone compatible, Ufer.

Answer: See my answer on question #1

18. Our local fire marshal tells me that a typical power strip is considered an extension cord to him, and he wants them removed. As you know most homes, offices, and I am sure the fire marshal's office has one under the desk for all the computer accessories. Some are built better than others, are they allowable by code for use all the time, or are they considered an extension cord, for temporary use?

Answer: Power strips are not extension cords, they are not for temporary use they can be used all year round and they are not addressed by the NEC other than NEC 110.3(B)..

They are listed under the product category Relocatable power taps, (XBYS) located on page 440 in the 2012 White Book. The guide information states They are intended for indoor use as relocatable multiple outlet extensions of a single branch circuit to supply laboratory equipment, home workshops, home movie lighting controls, musical instrumentation, and to provide outlet receptacles for computers, audio and video equipment, and other equipment.

Relocatable power taps are intended to be directly connected to a permanently installed branch circuit receptacle. Relocatable power taps are not intended to be series connected (daisy chained) to other relocatable power taps or to extension cords.

Relocatable power taps are not intended for use at construction sites and similar locations.

Relocatable power taps are not intended to be permanently secured to building structures, tables, work benches or similar structures, nor are they intended to be used as a substitute for fixed wiring. The cords of relocatable power taps are not intended to be routed through walls, windows, ceilings, floors or similar openings.

19. A 16ga extension cord with a triplex female receptacle end on the cord was found at a customer's house, with a running 1500 watt space heater plugged into the cord. My question is, those cords have been around for years, and most of the time, they are being over loaded. How are cords code compliant when they have three receptacles on them, and no built in over-current protection? And how can something like this be listed?

Code Ref: Art 400-- Flexible Cords and Cables

400.13—Overcurrent Protection: *Flexible cords and cables not smaller than 18 AWG shall be considered protected against overcurrent in accordance with 240.5*

240.5—Protection of Flexible Cords, Flexible Cables, and Fixture Wires: *Flexible cord including extension cords shall be protected against overcurrent by (A) or (B)*

(B)(3)--Extension Cord Sets: *Flexible cord used in listed extension cord sets shall be considered to be protected when applied within the extension cord listing requirements.*

From a tag on a 6-ft, 16 GA extension cord:

UL tag lists: 13A 125V 1625W

Product tag states:

- Look for the number of watts on appliances to be plugged into cord. See product or label markings for specific wattage.
- Do not plug more than the specified number of watts into this cord (1625W)
- And lots of information on how to use the cord set.

20. 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?

Code Ref: Iowa Administrative Code chapter 210, rule 110.18

When the detectors are installed in all the required areas then any additional detectors may be the single detector style. On April 1st of 2010 the Fire Marshall from the State of

Iowa required that all smoke detectors installed in a residence be dual rated. In a new installation they are required to be 120 volt with a battery backup. The sensing can be any 2 of the following: photoelectric, ionization, heat or carbon monoxide. The required locations for the detectors include the sleeping rooms, outside the sleeping room and on each level. Any additional detectors after the required detectors are installed can be the single detector style. A carbon monoxide detector is to be installed outside each sleeping area. The other answer is that the stores still sell the single detector style because people will buy them.

21. Can a flexible cord be used for the service conductors of a temporary panel?

Answer: **No**, see 590.4(A) which requires compliance with article 230.

22. 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?

Code Ref: 110.24

Answer: Available Fault Current. **(A) Field Marking.** 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 to withstand the environment involved.

Maybe, the label must be suitable to withstand the environment in which it is located in. It would become an AHJ call. So I would suggest you contact the AHJ and ask before inspection. You would also think that this is a workmanship issue also.

23. What is a horsepower rated plug or receptacle?

Code Ref: **Art 430.109(F)—Cord and Plug Connected Motors:** (Pg 331)

Answer: The HP rating of the plug or receptacle needs to match the nameplate of the motor HP.

Comparisons From a receptacle product guide sheet:

A 20A, 125volt receptacle is rated for 1 HP.

430.248 1 HP, 115 volt motor has a FLC of 16 amps

A 20A, 250volt receptacle is rated for 2 HP.

430.248 lists a 2 HP motor FLC of 12A.

So if a plug or receptacle is used for a motor circuit/disconnect then it has to have a sufficient HP rating to handle starting and full load currents of a motor.

24. In a residential application, can a #4 copper conductor be protected with a 100A breaker to a feeder panel?

Code Ref: This answer is the same as found in question #4.

25. 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?

Code Ref: 250.32

Answer: 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).

Grounding Electrode Conductor: “A conductor used to connect the system grounded conductor or the equipment to a grounding electrode or to a point on the grounding electrode system”

250.32(E) Grounding Electrode Conductor. The size of the grounding electrode conductor to the grounding electrode(s) shall not be smaller than given in 250.66, based on the largest ungrounded supply conductor. The installation shall comply with Part III of this article.

See 250.64 for Grounding Electrode Conductor Installation.

250.64(D)(3) Common Location. A grounding electrode conductor shall be connected to the grounded service conductor(s) in a wireway or other accessible enclosure on the supply side of the service disconnecting means. The connection shall be made with exothermic welding or a connector listed as grounding and bonding equipment. The grounding electrode conductor shall be sized in accordance with 250.66 based on the service-entrance conductor(s) at the common location where the connection is made.

250.64 Grounding Electrode Conductor Installation. Grounding electrode conductors at the service, at each building or structure where supplied by a feeder(s) or branch circuit(s), or at a separately derived system shall be installed as specified in 250.64(A) through (F).

While the question revolves around a “Feeder” 250.32(E) sends us to Part III for grounding electrode conductor installation requirements. Accordingly, 250.64 is in Part III and “(E)” identifies that connection point, which could either be the disconnect or the tap box.

26. A high pressure spray washer is 1 phase and less than 250 volts. Can this equipment be hard wired to a disconnect or a j-box? The cord and plug pressure washer at this rating needs to be gfci protected in the cord or receptacle as per 422.49. If direct wired is gfci protection required? In the UL White Book DMKK it seems to read a receptacle is required.

Answer: High pressure spray washers are Listed under the product category of the same name and product category code DMKK located on page 112 in the 2012 White Book.

Listed spray washers can be either hard wired or cord connected. If they are hard wired they must use a chapter 3 wiring method in the NEC and are not required to be GFI protected. If they are cord connected rated less than 250V single phase they must be provided from the factory with a cord and plug attached to the sprayer with a GFCI in the cord or the plug. The guide information on page 112 in the White Book says for DI sprayers they are not provided with a GFCI in the cord, but with a marking saying plug into a GFCI receptacle. That guide information needs to be updated, the standard now

requires all cord and plug connected 250V or less single phase sprayers to be provided with GFCI protection in the cord or plug consistent with NEC 422.49.

27. A receptacle in an aircraft hanger is gfci protected with a gfci breaker in the panel. This panel is in a separate room that is locked. Is this gfci protection considered readily accessible?

Code Ref: Art 210.8 GFCI Protection for Personnel: For both Dwelling and non-

Answer: Dwelling Units *“Shall be installed in a Readily accessible location”.*

240.24(A) *“Overcurrent devices shall be readily accessible.....”*

But the panel is in a locked room.....

110.26(F) *“rooms controlled by locks shall be considered accessible to qualified persons.....”*

So..I would say the GFCI location is ok.

28. A hydro-massage tub has faucets that are metallic. Some are single faucets and some use a metallic unit with both the hot and cold water. Do these faucets need to be bonded? How is this done if required?

Code Ref: 680.47

Answer: Yes

The code section 680.47 reads that all metal piping systems AND all grounded metal parts in contact with the circulating water shall be bonded. The word AND is meant to separate this sentence into 2 separate requirements. The metal piping is one and the metal parts is the other. There is a code change that will probably come out in the next code cycle that clarifies this to say metal piping supplying the hydro-tub. The metal “piping systems” is not defined whether it is meaning the supply pipe only, the metal manifold or the single faucets. With the word “metal piping system” as part of the requirement I would say that it would be all of these parts. A listed grounding pipe clamp could be used. How this is accomplished is different for the type of insulation that may be present. In some installations a lug may be better. The code does not address the how. This bond needs to connect all metal parts with a #8 solid copper conductor to connect the piping system to the pump and heater (if present) of the hydro-tub. If there are no metal parts to bond to in the heater or pump the bond wire will need to be installed to these locations for the future replacement of equipment that may require this bond.

29. 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?

Answer: I would say no. 300.7(B) states Raceways shall be provided with expansion fittings where necessary to compensate for thermal expansion and contraction.

The length of conduit is so small it would not be needed.

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

Code Ref: 516.4

Answer: Wiring and Equipment in Class I Locations. (A) Wiring and Equipment — Vapors. All electrical wiring and equipment within the Class I location (containing vapor only — not residues) defined in 516.3 shall comply with the applicable provisions of Article 501 or Article 505, as applicable.

While 516.3(B)(2) does specify interior of exhaust ducts as a Class I Div I location, in all likelihood, the actual connection/junction box will be located outside of the Class I Div I area as designated by 516.3 (area classification for spray applications). If the area in which the connection is made is designated a Class I Div II, then 501.10(B)(2)(3) permits LFMC to be used where flexibility is required.

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

Code Ref: Art 110.16—Arc-Flash Hazard Warning “in other than dwellings”

32. Why can't a conduit that sleeves NM conductors above a panel penetrate a finished ceiling?

Code Ref: [NFPA.org/about the codes](http://NFPA.org/about-the-codes) ROP 2008 and NEC 312.5 exceptions

Answer: The requirement is that the conduit sleeve can be no shorter than 18 inches and no longer than 10 feet and not penetrate a structural ceiling. It needs to extend directly above the enclosure, be bushed at the end and fastened at its outer end and at other points required by the wiring method.

The fastening and the bushing make common sense.

In the report on proposals it tells the story of why these requirements are what they are.

If there is an arc in the enclosure the arc debris would be allowed to exit the raceway if the raceway was installed down or sideways. Adequate closure of the conduit is dependent on the closing the end of the raceway. No fittings are designed or evaluated to close the opening around multiple cables. The lack of such a fitting presents the possibility that excess dust, debris, rodents, or other pests could enter the enclosure and create a potentially hazardous condition. Without this seal being visible the potential exist for the opening to allow these items to enter in a concealed installation. A fitting such as a romex connector is for 1 or 2 conductors only. The 18 inches is required to provide adequate containment of the cables. The 10 foot maximum is to prevent excess heat to build up. There was a proposal to have up to a 3 inch fitting that is installed in the back of the enclosure. This was rejected because an arc in the enclosure may not be contained by the enclosure.

33. A temporary panel has a receptacle for a construction office/job trailer. Does this receptacle need to be gfci protected?

Code Ref: I would say no, the receptacle is for the trailer not for use with equipment used in the see 590.6 This section shall apply only to temporary wiring installations used to supply temporary power to equipment used by personnel during construction, remodeling, maintenance, repair, or demolition of buildings, structures, equipment, or similar activities.

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

Answer: Contact the utility representative and ask. Many utilities have started to make those calculations available to meet 110.24.

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

Code Ref: Art 502.15 Sealing Class II, div 1 & 2 (Read the article for requirements)

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

Code Ref: 502.45

Receptacles in a class II division 1 must provide connection to the equipment grounding conductor of the flexible cord that is plugged into it and be listed for class II locations. The receptacle for a division II class II location is the same as the class I location except there is not a requirement that it is listed. The connection cannot be broken or made while live parts are exposed.

When purchasing a receptacle for a class II area there will be only the receptacle for the class II division I area available and this receptacle will be able to be used in a division II location.

A receptacle for a class I area will not necessarily be listed for a class II area and the listing will need to be checked.

The type of dust present will determine the listing required.

Group E for combustible metal dusts such as aluminum and magnesium.

Group F for carbon black, charcoal, coal or coke dusts

Group E combustible dusts such as flour, grain, wood, plastic, chemicals

The class II receptacle will be: dust ignition proof, listed for use between the temperatures of -13 and 104 degrees F, rotating the plug activates the plug or allows a switch to be turned on. The box for the receptacle will need to be dust tight and identified for the type of dust present when in a group E location.

37. A 30 amp 110 volt receptacle is installed outdoors at a residence. Does this receptacle need to be gfci protected?

Answer: No, Section 210.8 (A) only requires 15 and 20A, 125V receptacles in dwellings to be gfci protected.

38. A room in a residential basement has sheet rocked walls and ceiling and is used for storage with a work bench in the corner. The receptacles installed are only in the bench area. Do these receptacles need to be arc-fault or ground fault protected?

Answer: First you must define the room as one of the location 210.12(B) if it doesn't meet the requirements in 210.12(b) then I would say no. I would say if this a work/storage area that is defined in the code then

210.8 Ground-Fault Circuit-Interrupter Protection for Personnel.

Ground-fault circuit-interruption for personnel shall be provided as required in **210.8(A)** through **(C)**. The ground-fault circuit-interrupter shall be installed in a readily accessible location.

(A) Dwelling Units. All 125-volt, single-phase, 15- and 20-ampere receptacles installed in the locations specified in **210.8(A)(1)** through (8) shall have ground-fault circuit-interrupter protection for personnel.

(5) Unfinished basements — for purposes of this section, unfinished basements are defined as portions or areas of the basement not intended as habitable rooms and limited to storage areas, work areas, and the like

39. 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?

Code Ref: Art 348--Flexible Metal Conduit

Answer: 348.20(A) Minimum Size:

Minimum size you can use is ½ inch unless permitted in 348.20 (A)(1) thru (A)(5) for 3/8

(2) Can use in lengths not to exceed 6 ft for.....

So...NO to the 10 ft length!

110.3(B) *“Listed or labeled equipment shall be installed in accordance with any instructions included in the listing or labeling.”*

So... NO, can't use the NM connector

40. A transformer has the neutral bonded inside the transformer. Where is the gec connected? The panel or the transformer? Does this need to be a separate conductor to the grounding electrodes?

Code Ref: 250.30(A)(1), 250.30.(4) (1) and (2), 250.121

Answer: In the transformer. Yes a separate conductor is required.

Code section 250.30(A)(1) allows the bond to be located at any point of the separately derived system from the source (transformer) to the first system disconnecting means or overcurrent device. When the neutral is bonded in the transformer the gec will need to be installed to the transformer. Code section 250.30(4) says that the gec shall be the nearest of the following: metal water pipe, structural steel. When these electrodes are not present other electrodes found in 250.52(A) shall be used. In 250.121 there is a new code requirement that states that an equipment ground cannot share its use with a gec. The gec will need to be a separate conductor to the grounding electrode that is present. The neutral conductors in the panel will need to be isolated when the neutral is bonded in the transformer. If the neutral is bonded in the panel then the gec would need to be installed to the panel and the bonding jumper or screw in the panel will need to be installed.

41. Can a gec be installed in a feeder conduit? Can a gec be installed in a pvc conduit with the telephone and tv cables?

Code Ref: I don't know why you would have a grounding electrode conductor installed in either one of those conduits, but I don't see anything in the code that would prohibit it.

42. A receptacle is added in a residential bedroom in a new location on an existing circuit. Does this existing receptacle circuit now need to be arc-fault protected?

Answer: Yes. **210.12(B) Arc-Fault Circuit-Interrupter Protection.**

(B) Branch Circuit Extensions or Modifications — Dwelling Units. In any of the areas specified in **210.12(A)**, where branch-circuit wiring is modified, replaced, or extended, the branch circuit shall be protected by one of the following:

Changed From 2008

• 210.12(B): Added new requirement for AFCI protection where branch circuits are extended or modified.

(1) A listed combination-type AFCI located at the origin of the branch circuit See *related UL*

(2) A listed outlet branch-circuit type AFCI located at the first receptacle outlet of the existing branch circuit See *related UL*

43. Where can we get an arc-fault receptacle?

Answer: When I contacted a couple major suppliers of receptacles I didn't get a definite answer when AFCI receptacles might be available for purchase.

44. Can a gfci receptacle be installed in a 2 inch deep handi-box that has 2 mc single circuit cables that enter at the ends of the box?

Code Ref: Table 314.16, 314.16(B)(1), (B)(4) and (B)(5)

Answer: No No No No

A handi-box that is 1 7/8" deep has a volume of 10.3 square inches.

A handi box that is 2 1/8" deep has a volume of 13 square inches.

314.16(B)(1) says that each conductor that splices or terminates within the box is counted once. 314.16(B)(4) says that each device on a yoke is counted double for the conductor size used. 314.16(B)(5) says that the equipment ground is counted once based on the largest equipment ground in the box.

Using the calculations for 2-2 conductor #12 MC cable the following allowances are added up.

The conductors:	4 x 2.25 = 9.00
The eq. grounds	1 x 2.25 = 2.25
The device	2 x 2.25 = 4.50
Total	15.75

Using the calculation for 2-2 conductor #14MC cables the following allowances are added up

The conductors	4 x 2.00 = 8.00
The eq. grounds	1 x 2.00 = 2.00
The device	2 x 2.00 = 4.00
Total	14.00

Neither box has the volume for the 2 MC cables that are #12 or #14 and a receptacle.

45. Can romex connectors be used to terminate a mc cable? What are those red things that come with the mc cable used for?

Answer: No, Romex connectors are Listed under the product category Non metallic Sheathed Cable Connectors (PXJV) located on page 303 in the 2012 . MC cable connectors are Listed under the product category Metal Clad Cable Connectors, Type MC (PJOX) located on page 291 in the 2012 UL White Book.

The red things that come with MC cable are used as bushing for the cable if the local AHJ requires it. The red insulation bushings are not required for MC cable per Article 330 in the NEC. However, they are required for Type AC armored cable per NEC 320.40 which requires that : in addition, an insulating bushing or its equivalent protection shall be provided between the conductors and the armor.

Many manufacturers just include the bushings with the rolls of MC just in case someone requires it.

46. 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?

Answer: NO. Installing this ground rod would be considered an auxiliary ground rod and not have to comply with Art 250.56.

Where most authorities request a rod be installed is due to – possibly the design engineer may have included it into the plans that were submitted to plan review department.

250.54 Auxiliary Grounding Electrodes

One or more grounding electrodes shall be permitted to be connected to the equipment grounding conductors specified in **250.118** and shall not be required to comply with the electrode bonding requirements of **250.50** or **250.53(C)** or the resistance requirements of **250.56**, but the earth shall not be used as an effective ground-fault current path as specified in **250.4(A)(5)** and **250.4(B)(4)**.

47. 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?
Code Ref: Art 406.4(D)(4)Replacements AFCI Protection

Answer: Nothing listed in the code book, only about replacing receptacles on a 2-wire system with another 2 prong receptacle or a GFCI or a GFCI breaker.

Look for more info on this in the 2014 code cycle, AFCI receptacle requirements becomes effective January 1, 2014

- 48 . Are cords (S or SJ) allowed for temporary equipment connections in Hazardous Locations (Class 1, Div. 1 or 2)? [Thinking in terms of power outages]
Code Ref: 590.2(A), 590.2(B), 501.14o(B)(1) table 400.4

Answer:No In temporary locations 590.2(A) state that all other requirements for permanent wiring, unless modified, shall apply to the permanent wiring method. 590.2(B) says that temporary wiring shall be acceptable only if approved based on the conditions of use and any special requirements of the temporary installation. A classification of the hazardous location must be determined where the temporary is being used. 501.140(A)(5) allows a flexible cord for use with temporary portable assemblies.

501.140(B)(5) requires that when a flexible cord is used that it needs to be listed as “extra-hard usage”.

Table 400.4 for flexible cords lists a S cord as a “hard service cord” and a SJ cord as a “junior hard service cord”. Neither of these cords are “extra-hard usage” and cannot be used in temporary or permanent installations.

49. 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?

Code Ref:_____

Answer: No. 250.24 Grounding Service-Supplied Alternating-Current Systems.

(A) System Grounding Connections. A premises wiring system supplied by a grounded ac service shall have a grounding electrode conductor connected to the grounded service conductor, at each service, in accordance with **250.24(A)(1)** through **(A)(5)**.

(C) Grounded Conductor Brought to Service Equipment. Where an ac system operating at less than 1000 volts is grounded at any point, the grounded conductor(s) shall be routed with the ungrounded conductors to each service disconnecting means and shall be connected to each disconnecting means grounded conductor(s) terminal or bus. A main bonding jumper shall connect the grounded conductor(s) to each service disconnecting means enclosure. The grounded conductor(s) shall be installed in accordance with **250.24(C)(1)** through **(C)(4)**.

50. 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?

Answer: The answer is, it’s up to the AHJ who is familiar with the soil conditions in the area and what is sufficient as supplementary protection.

For RMC, NEC 344.10(B)(1) states (1) Galvanized Steel, Stainless Steel, and Red Brass RMC, Elbows, Couplings, and Fittings. Galvanized steel, stainless steel, and red brass RMC elbows, couplings, and fittings shall be permitted to be installed in concrete, in direct contact with the earth, or in areas subject to severe corrosive influences where protected by corrosion protection and judged suitable for the condition.

UL Lists RMC under the category Rigid Ferrous Metallic Conduit (DYIX) located on page 121 in the 2012 UL White Book. The Guide Information for DYIX states: Corrosion Protection and Coatings Galvanized rigid steel conduit installed in concrete does not require supplementary corrosion protection. Galvanized rigid steel conduit installed in contact with soil does not generally require supplementary corrosion protection. In the absence of specific local experience, soils producing severe corrosive effects are generally characterized by low resistivity (less than 2000 ohm-centimeters).

Wherever ferrous metal conduit runs directly from concrete encasement to soil burial, severe corrosive effects are likely to occur on the metal in contact with the soil.

Conduit that is provided with a metallic or nonmetallic coating, or a combination of both, has been investigated for resistance to atmospheric corrosion.

Rigid metal conduit with or without a nonmetallic coating has not been investigated for severely corrosive conditions.

Steel EMT is covered under Article 358 in the NEC and NEC 358.10(B) states that B) Corrosion Protection. Ferrous or nonferrous EMT, elbows, couplings, and fittings shall be permitted to be installed in concrete, in direct contact with the earth, or in areas subject to severe corrosive influences where protected by corrosion protection and approved as suitable for the condition. UL Lists EMT under the product category Electrical Metallic Tubing (FJMX) located on page 147 in the 2012 UL White Book which states:

Galvanized steel electrical metallic tubing installed in concrete on grade or above generally requires no supplementary corrosion protection. Galvanized steel electrical metallic tubing in concrete slab below grade level may require supplementary corrosion protection.

In general, galvanized steel electrical metallic tubing in contact with soil requires supplementary corrosion protection. Where galvanized steel electrical metallic tubing without supplementary corrosion protection extends directly from concrete encasement to soil burial, severe corrosive effects are likely to occur on the metal in contact with the soil.

Galvanized steel electrical metallic tubing that is provided with a metallic or nonmetallic coating, or a combination of both, has been investigated for resistance to atmospheric corrosion.

Galvanized steel electrical metallic tubing with or without a nonmetallic coating has not been investigated for severely corrosive conditions.

Aluminum electrical metallic tubing used in concrete or in contact with soil requires supplementary corrosion protection.

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

Code Ref: Art 250.92 Services

**Answer: 250.92(B) Method of bonding at the Service
250.96(A) Bonding of Other Enclosures**

Sizing the *Supply Side Bonding Jumper* that connects to the bonding bushing on service equipment is based on the ungrounded conductors of the service:

Size according to table 250.66

Sizing the *Equipment Bonding Jumpers* on the load side of an overcurrent device:

Size Based on the overcurrent device and Table 250.122

52. Is a neutral conductor to be installed in all 3 and 4 way switches?
Code Ref: 404.2(C)

Answer: Yes The requirement in 404.2(C) does not define the type of switch. Any switch that controls a lighting load is required to have the neutral present. The lighting load would be any load that will be used for lighting. This could include the receptacles if they are used as the lighting for the area or the control circuit that switches relays for a lighting contactor. The only exceptions are for raceways and where there is access to the framing cavity from the top or bottom or through a wall, floor, or ceiling that is unfinished on one side. The requirement is for a grounded general purpose branch circuit. Low voltage switching would not have the neutral requirement.

53. When wiring a hot tub in a residential application, I run a 6/3 nm from load center to hot tub disconnect, then from the disconnect, using liquid tight flexible conduit, or pvc conduit, go to the hot tub. Wiring in the seal tight/pvc would be #6 THHN with a #10 green for equipment ground. Is the 6/3 NM allowable for this installation because it has a bare equipment grounding conductor?
Code Ref: Assuming that the disconnect is on the wall of the house and the connection to the disconnect was through the back of the disconnect so that the NM was never in a wet location, I would say it is ok, per 680.42(C) unless there is a light in the hot tub, then you have to comply with 680.23 which requires an insulated equipment Ground.

Code Panel

Tom Lichtenstein—UL—Quest. 1, 5, 9, 13, 17, 21, 25, 29, 33, 37, 41, 45, 49, 53

Don Iverson—NEMA—Quest. 2, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42, 46, 50

Scott Abbott—NW Comm. College—3, 7, 11, 15, 19, 23, 27, 31, 35, 39, 43, 47, 51

Pat Hansen—St. of Iowa Supervisor—Quest. 4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44, 48, 52

EXTRA QUESTIONS

(Dwight Kramer)

1. 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?

The listing for the outlet branch circuit type AFCI (AWBZ) is found on page 66 of the 2011 issue of the UL White Book. Here it states that the device will protect series arcing, with or without ground, in both the line and load sides of the device so it appears to be able to operate on an ungrounded circuit. However, to comply with 210.12(B)(2) this device must be installed in the first receptacle of the existing circuit which, based on the question, would be a non-grounding receptacle. The

replacement of a non-grounding type receptacle must follow one of the three options given in 406.4(D)(2), none of which include the outlet branch circuit AFCI.

2. Article 250.121, a new section, appears to require additional requirements for section 250.32. If a building is supplied by a feeder, a grounding electrode system shall be installed at that building in accordance with Part III of Article 250. Does that mean that all grounding electrodes at each building shall be bonded together

Yes. 250.64(F)

Is the size of the conductor based on service or feeder conductors?

The size fo the grounding electrode conductor is based on the size of the service or feeder conductor. 250.66

3. Given: Feed for a detached accessory building for residential dwelling. 225.39 states that for more than 2 circuits your disconnect rating must be 60A or more. Does the disconnect need to be fed by a 60A or more from the dwelling or is it based on the load of the detached building?

Both. 225.39 requires the feeder or branch circuit disconnecting means to be not less than the calculated load of the detached building but also no lower than 60A if for more than 2 circuits. 225.39(D)

4. The electric or gas range has a 120-volt convenience outlet up by the cook top. It is right by the sink. Is this outlet required to be GFCI protected?

No. GFCI protection of receptacles within 6' of a sink is only required in areas other than kitchens. 210.8(A)(97)

If so, how?

If it's not within 6-feet of the sink but still in the kitchen, is it still required to be GFCI protected?

No. Only receptacles intended to serve the countertop must be GFCI protected. 210.8(A)(6) I have walked through the appliance section of two major retailers and none of the electric or gas ranges had a factory installed receptacle in them.