

INTERNATIONAL ASSOCIATION OF ELECTRICAL INSPECTORS

IOWA CHAPTER SPRING 2009 EDUCATIONAL MEETING

CODE PANEL QUESTIONS

Rick Chambers.....1, 5, 9, 13, 17, 21, 25
Tom Lichtenstein.....2, 6, 10, 14, 18, 22, 26
Mel Sanders.....3, 7, 11, 15, 19, 23, 27
Dwight Kramer.....4, 8, 12, 16, 20, 24, 28

1. Do I need to bond a cyclone fence around a 12 KV substation for the plant? The secondary of the transformer is 480 V.

Yes. Although this is not addressed in the NEC, it is covered by the National Electrical Safety Code (NESC). Section 11, rule 110A1, (page 32) states: "Metal fences, when used to enclose electric supply stations having energized electric conductors or equipment . . . shall be grounded in accordance with Section 9."

Rule 92E (page 19 in this section) gives a reference to IEEE Standard 80-2000 [B32] for guidance as well as listing details for grounding the fence, gate, posts, etc. Rules 93C6 and 93C5 (page 21) give details on the type and size of grounding conductors required and the type of connections permitted.

2. Where can I find information on bus drop cord?

Look in the 2008 UL White Book under the product category Bus Drop Cable (ZIMX), located on page 383 of the White Book. The Guide Information for ZIMX states "This category covers multiple-conductor bus drop cable as described in Sec. 368.56(B) of ANSI/NFPA 70, "National Electrical Code" (NEC), and intended for use in accordance with Article 368 and other applicable parts of the NEC. The cable consists of three or four Type TW, THW, THHN and THWN, or XHHW, RHW and RHH conductors cabled together with a grounding conductor with an overall jacket. The cable is rated 600 V, 60, 75, 90 or 105°C."

In addition, you can find information on the use of bus drop cable under the category Power Cable Assemblies (QPPL) on page 276 in the White Book.

3. What are the minimum size service entrance conductors which can be used for a temporary service?

Temporary service = temporary occupancy addressed in Article 590. 590.2(A) advises that services are as required in Article 230. 230.42(A)(1) is based upon calculation per Article 220. 230.42(B) refers to 230.79(A) through (D), with the selected disconnect rating used to determine minimum size wire, which cannot be less than the selected disconnect ampere rating. 230.79(D) states minimum rating is 60 Amperes, and 110.14(C) (1) criteria requires 60°C terminals to have 4 AWG copper or 3 AWG aluminum and 75°C terminals to have 6 AWG copper or 4 AWG aluminum using T310.16..

4. What would be the percentage of new construction AHJ's are seeing the concrete encased electrodes being installed?

In the 2005 NEC, the wording in 250.50 was changed from "if available on the premises at each building or structure served" to "that are present at each building or structure served". Therefore, since the adoption of the 2005 NEC, any new building or structure that contain a foundation or footings must make use of the concrete encased electrode. This electrode shall consist of at least 20 feet of 1/2" rebar or 20 feet of bare copper conductor not smaller than #4 AWG.

Since the Iowa Electrical Examining Board has adopted the 2008 NEC statewide, all new structures shall contain this electrode.

5. What type of protection is allowable for interior and energized panels during the rough-in to finish stages of the project?

Section 110.11 of the 2008 NEC requires equipment to be protected against damage from the weather during construction. What type of protection is allowed would depend on the individual AHJ. In my experience, however, most will require the roof to be on the building and the building nearly or completely enclosed before releasing the service. To protect panels during the remaining stages of construction, there is a new product available called TempCovers™ from Grace Engineering Products.

6. What method and where, are inspectors seeing the grounding of the CSST gas piping?

Check the manufacturer's installation instructions with the CSST. CSST is not UL Listed. Some manufacturers recommend using a Listed pipe clamp for use on the hex nut. Up until recently, there were no clamps that were evaluated for this use. I believe a manufacturer recently received Listing or is very close to receiving Listing of a clamp to ground the hex nuts of these systems.

7. Bending radius of NM cable...Does it matter which way it is bent? Flat or on side?

No and No. 334.24 states bending radius than 5 times cable diameter. Because NM is oval, the greater dimension of the oval is taken as the diameter based upon Chapter 9 Table 1 Note 9 In addition you must ensure the outer jacket is not damaged, wrinkled or otherwise distorted, because that is an inherent part of the overall cable assemble per 334.116.

8. Continuous load of 50A: how do you size conductors and over current protection?

The general rule in 210.19 (Branch Circuits) and 215.2 (Feeders) is that the minimum conductor size shall be 125% of the continuous load prior to the application of any adjustment or correction factors. So in this example, the conductor shall have the minimum ampacity of 62.5 amps. Because 110.14(C)(1)(a) requires the 60° column of T310.16 to be used, the conductor would be #4CU or #3AL. 240.4(B) permits the next higher standard overcurrent device above the conductor ampacity to be used. From the list of standard fuse and circuit breaker ratings in 240.6, I would choose the 70 ampere rating.

If this were a specific-purpose branch circuit or a specific-purpose conductor application, such as motors, air-conditioning, refrigeration, etc., then the specific NEC articles indicated in T210.2 and T240.4(G) respectively would apply.

9. NFPA 79 5.3.5.4 now specifies orange wire. What about existing machines with yellow wire? And what about DC?

I assume you are referring to the requirement for ungrounded conductors that remain energized when the main supply circuit disconnecting means is in the OFF position to be ORANGE in color in industrial machinery. (This reference is 13.2.4.1 in the 2007 edition). Older editions required these conductors to be YELLOW, but section 1.3.1 states that this standard is not retroactive. Therefore, existing machines do not have to be rewired to the new standard. If desired, to avoid confusion, the conductors could be tagged to indicate their use.

The standard for dc conductors in industrial machinery is BLACK for ungrounded power conductors and BLUE for ungrounded control conductors (in section 13.2.4.3) and WHITE with a BLUE stripe for grounded dc circuit conductors (in section 13.2.3.1).

10. When I add the ampacity of all my conductors, my main breaker is less than the total, is that allowed?

Yes, 220.40 General.

The calculated load of a feeder or service shall not be less than the sum of the loads on the branch circuits supplied, as determined by Part II of this article, after any applicable demand factors permitted by Part III or IV or required by Part V have been applied.

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).

11. Do I need an equipment grounding conductor if I run a 5' piece of liquid-tite to a motor?

Yes. 250.118(6)(e) and 350.60.

12. Table 300.50 says that you need 2" of concrete or marking tape over underground cables. What do you do when you bore them in?

300.50 deals with minimum cover requirements for installations over 600 volts.

300.50(A)(1) allows shielded and non-shielded cables or cable assemblies to be either direct buried or installed in raceways identified for the use. If direct buried, the installation needs to comply with the minimum burial requirements of T300.50, which includes the language from the question in footnote "d". This footnote specifically mentions "trenching" as where these wiring methods must have concrete protection or a warning ribbon placed a distance above the wiring method.

Article 300.5(K) also states "Directional Boring. Cables or raceways installed using directional boring equipment shall be approved for the purpose." The NEC Handbook goes on to explain that "Manufacturers of both metal and nonmetallic raceways suitable for underground use offer products that can endure the rigors of boring-type installation methods. One wiring method recently introduced — high density polyethylene conduit: Type HDPE conduit (Article 353) — also can be used with boring-type installation methods". Therefore, if the cables are installed using directional boring, a raceway approved for the purpose must be used. Bored holes do not require a warning ribbon or concrete protection.

13. Is a panelboard installed in other than a dwelling unit or guest suite bathroom acceptable?

Maybe. If not exposed to physical damage, (Section 240.24(C) of the NEC), not in the vicinity of easily ignitable materials, (240.24(D)), and if in a wet or damp location, meeting the requirements of 240.32, 312.2 and 408.37, this might be acceptable.

14. A job trailer is set on a construction site. The service inside the trailer is a 150 amp panelboard with a main breaker. Can a meter socket be set on a pole 10' from the trailer and the service entrance conductors be installed in PVC on top of the ground up to the trailer? Shouldn't there be a disconnect on the pole after the meter? Ground rods at the disconnect would be required, but are ground rods required at the trailer also?

[Comment: the supply to the construction trailer falls under Article 550. (See 550.1 and 550.4.) Therefore the supply is a feeder (see 550.10) meaning there must be a SE disconnect and overcurrent protection away from the construction trailer. 550.32(B) would not apply to this installation.]

- a. Can a meter socket be set on a pole 10 ft from the trailer and the service entrance conductors be installed in PVC on top of the ground up to the trailer?

[Comment: 550.32(A) limits SE disconnect to no more than 30 ft from the exterior walls of the construction trailer. (See 550.32) Article 550 is silent on placement of feeder supply PVC; therefore, Article 352 must be consulted. 352.12(C) does not permit PVC to be installed where subject to physical damage, and 352.10(F) allows identified Schedule 80 PVC to be installed where not subject to severe physical damage. 352.100 requires it be sunlight resistant.]

- b. Shouldn't there be a disconnect on the pole after the meter?

[Comment: The meter location is subject to utility or REC rules, and a plug-in meter for this would typically be located ahead of the SE disconnect.]

- c. Grounds at the disconnect would be required, but are ground rods required at the trailer also?

[Comment: Never install ground rods at the construction trailer, only at the SE disconnect location. The supply to the construction trailer is to include an insulated equipment grounding conductor terminated at a separate grounding bar within the 150 ampere panelboard. The neutral conductor (grounded conductor) would terminate on an insulated bus within the 150 ampere panelboard, and there would be no bond between the 150 ampere panelboard and this neutral bus. (See 550.16)]

Sections reviewed were 352.10(F); 352.12; 352.100; 550.4(A); 550.4(B); 550.4(C); 550.10(A); 550.10(I)(2); 550.11; 550.15(H); 550.16; 550.32(A); 550.32(B); 550.32(C), (D), (E), (F), (G) has portions that should be reviewed; 550.33; 550.33(B) reference to 310.15(B)(6) would not apply because this is not a dwelling application.

15. Could a 3-way switch be used as a generator transfer switch for a single circuit in a house?

Possibly. 404.2 requires the ungrounded conductor to be switched, 404.8 does not permit greater than 300 volt between devices (does not apply because there is only the single device), 404.14 has rules for switches for AC and DC functionality. Because there are 2 power sources to this one switch body, they could be 180° out of phase resulting in 240 volts across the switch contacts. 110.3(B) would require consulting UL and manufacturer for the voltage rating across the open contacts as well as the voltage to ground rating.

NOTE: Article 445 does not address transfer switching, 702.(B)(1) permits manual transfer switching, and 702.6 does not require "listing" but does require it be "suitable."

16. Article 547.5 (F) states that when a separate equipment grounding conductor is installed, it must be copper. When it is installed underground, can it be insulated aluminum or covered copper or does it mean insulated copper or covered copper? Please clarify.

The section of Article 547 the question is referring to also includes the words "is installed within a location". This would refer to any work done inside a building using wiring methods allowed in 547.5(A) and the requirement is that the equipment grounding

conductor is to be a covered or insulated copper conductor. Where an equipment grounding conductor is installed underground to a building housing livestock, it must be a (fully) insulated or covered copper conductor. "Conductor, Insulated" and "Conductor, Covered" are defined in Article 100, Definitions.

Unless the exterior wiring above ground is considered to be subject to corrosion, either aluminum or copper can be used. However, note that in 547.9(B)(3)(1), the equipment grounding conductor must be the same size as the largest supply conductor if of the same material, or adjusted in size in accordance with T250.122 if of different materials. If the cable messenger is to serve as the required equipment grounding conductor, it must be the same size as the largest supply conductor. The more restrictive wiring methods are required because of the highly corrosive locations...

17. When wiring a floor box in a doctor's clinic exam room, I assume I would have to run EMT in the wall and then install rigid conduit under the floor to the floor box to satisfy the redundant grounding requirement? Right?

Section 517.13(A) requires a metal raceway system or a cable having a metallic armor or sheath assembly. Any of these would have to qualify as an equipment grounding conductor in accordance with 250.118. Since this lists EMT, there would be no obvious reason to change to rigid metal. However, section 517.13(B) requires an insulated copper equipment grounding conductor to be installed in the metal raceway. It is this conductor which must be connected to the grounding terminal of the receptacle and constitutes the redundant ground.

18. I am installing a service that is an 800amp 3 phase main 42 circuit panelboard with feed through lugs to go to another 42 circuit panelboard immediately adjacent. Should the neutrals or grounded conductors in the second panel be bonded or should they be isolated?

I would say the grounded conductors in the second panel should be isolated. The main in the first panel is the service disconnect for the service and the second panel would be a feeder panel. If the service isn't bonded before the main disconnect enclosure as permitted in 250.24(A)(1), then 250.24(A)(5) restricts the second panel from being regrounded and NEC 250.24(B) requires the main bonding jumper to be in the main disconnect enclosure, which is the first panelboard.

19. I wiring an 800 amp 3 phase service with 2 PVC conduits with four 500 MCM copper conductors in each conduit out to the CT cabinet. The engineer has asked that a #1/0 copper wire to also be installed in each conduit to bond the CT cabinet. Is this the correct size? My understanding is that I could use the grounded conductors as the CT bond as long as I installed a bonding jumper from a lug in the CT metal cabinet to the grounded conductors in the CT cabinet. What size would this bonding jumper have to be? Am I correct in assuming I don't want to do both the #1/0 conductors and the bonding jumper within the CT cabinet?

Several items. Is this the right size? No. The understanding is correct in that the grounded conductor can be used to bond to enclosures ahead of the SE disconnect that it passed through (250.92(B)(1)). What size would a bonding jumper have to be? 2/0 AWG copper or 4/0 AWG aluminum (250.28(D)(1) and T250.66). You are correct in that you do not want to use both the grounded conductor and a bonding jumper ((250.92(A)(2) and 250.92(B)(1) and 250.8 and 310.4). NOTE: A grounded conductor terminal bus is required to be bonded to and within the CT cabinet.

20. If you are using the copper water pipe as your grounding electrode, can the supplementary electrode (rods, plate, concrete encased) be attached anywhere along the grounding electrode conductor between the panel and within 5' of where the water pipe enters the building? Can a split bolt be used to make this connection if it will be accessible?

Interior water piping more than 5 feet from the point of entrance cannot be used as a grounding electrode conductor (250.52(A)(1). 250.53(D)(2) allows the supplemental (not supplementary) electrode to be bonded anywhere along the grounding electrode conductor by a method permitted in 250.8(A). If the split bolt is listed for the grounding electrode conductor duty, its use would be allowed.

21. If an automatic transfer switch is to be installed between a meter and a 200amp residential panelboard service, wouldn't a disconnect have to be installed before the transfer switch? Or could a service rated transfer switch be installed without any overcurrent protection between the meter and panelboard as long as the transfer switch was rated to carry the entire load of a home (200 amp service)?

Either of these solutions could be possible. If the transfer switch is not listed for use as service equipment, then a disconnect switch that is listed as such would have to be installed ahead of it. If the transfer switch is listed for use as service equipment, then no disconnect switch is required (230.82 and 230.66). However, NEC section 702.5(B)(2) tells us that if the transfer switch is automatic, then the standby source must be capable of supplying the entire load, or a load management system must be employed.

22. I have observed a metallic, Myers hub installed on top of a plastic junction box and then PVC continuing on to a NEMA 3R pedestal with RV receptacles enclosed. Is there a problem with not bonding the Myers hub?

Yes, NEC 250.4 requires the metallic hub to be bonded.

23. What about the increasing use of Versa-foam and similar products where rim joists and other areas are covered with a 2" to 4" layer of foam? These foam agents are shot from a gun using two pressurized tanks with the product mixed at the gun. They effectively entomb any wiring in. What effect does this have on different wiring methods?

Several items. What about the increasing use of foaming agents? So? It is assumed the circuit conductors are contained within appropriate wiring methods found within Chapter 3 starting with Article 320 to the end of Chapter 3 and excluding Article 392. Each appropriate Article has information concerning wiring method damage control. Those for the more general market would include 320.80; 382.80; 334.80; 338.10; 340.10 and 340.80; and always consult 110.3(B). Heat entrapment of the foaming agent and effect on the conductors are subject to 310.15.

24. If a luminaire is added to an existing circuit, would this circuit have to be AFCI protected?

Article 210.12(B) requires any circuit installed in a dwelling unit supplying outlets in the areas listed to be AFCI protected. The NEC is in itself not retroactive, so the additional outlet installed on an existing circuit would not require the installation of AFCI protection for that existing circuit.

25. What is the purpose of lightning rods? Why do they ground a communications tower when it probably would attract lightning? What's the theory?

In NFPA documents, lightning rods of a lightning protection system are referred to as "air terminals", ground rods as "ground terminals" and the conductors as "grounding down conductors" (see NEC sections 250.60, 250.106 and 620.37(B)). The purpose of a lightning protection system is to help dissipate and discharge lightning strikes into the earth safely.

While communications towers undoubtedly are targets for lightning, the lightning protection system is designed to keep the lightning from damaging the communications conductors and equipment.

There are at least two competing theories about lightning, and I do not feel qualified to discuss either of them here. For further information, I recommend NFPA 780 -2008, *Standard for the Installation of Lightning Protection Systems*.

As an interesting side note, when Benjamin Franklin first proposed the use of lightning protection there was great religious controversy over the idea. Some said humanity should not presume to thwart the power of God; others said that, in the same way God had given the technology to protect ourselves from snow and rain, God had given Franklin the wisdom to develop lightning protection, and the technology should be used.

26. When installing self-grounding receptacles in flush outlet boxes, is an equipment bonding jumper required from the metal box to the grounding terminal on the receptacle?

No, see 250.146 (B) which states "Contact Devices or Yokes. Contact devices or yokes designed and listed as self-grounding shall be permitted in conjunction with the supporting screws to establish the grounding circuit between the device yoke and flush-type boxes."

Grounding receptacles are Listed under the product category RECEPTACLES FOR PLUGS AND ATTACHMENT PLUGS (RTRT), located on page 295 in the 2008 UL White Book. The Guide Information for RTRT states: Self-grounding Receptacles — Self-grounding receptacles have special integral means for establishing the grounding circuit between device yokes and (1) the grounded metallic flush-type boxes, or (2) the grounded nonmetallic flush device boxes employing a grounding strap and terminal; without the use of bonding jumpers as permitted by Section 250.146(B) (formerly Exception No. 2 to Section 250-74) of the NEC. These devices are identified by the statement: "This receptacle is Listed by Underwriters Laboratories Inc. and has a special pressure spring clip to establish the grounding circuit between device yokes and (1) the grounded

27. Is there any problem with shortening or extending the white conductor on an arc fault breaker?

No technical reason. May be a product listing issue and 110.3(B) and listing agency would need to be consulted.

28. We installed 3 parallel conduits for a feeder to refeed an existing 600amp panelboard. When the new MDP interior arrived on the job, the new 600 amp breaker has only 2 holes per phase (the breaker does not come with 3 holes). Is it permissible to take a 5 hole insulated tap connector and install the three 3/0AWG conductors/phase and two short lengths of 350MCM/phase and make them up in the new MDP?

I could not find any reason that the insulated tap connector cannot be used for this function. However, since all conductors have to be the same length (310.4(B)(1)), these connectors would all have to be in the same area of the panelboard. At approximately 75-100 cubic inches each, these four taps and associated conductors would exceed the allowable cross-sectional area allowed for conductors, splices, and taps in 312.8.

The best solution would be to contact the manufacturer and either exchange the breaker terminal lugs with ones that have the correct number of termination lugs, or exchange the entire breaker for one with the proper number of terminal openings in the lugs.