

# Code Panel Questions

## 2017 Iowa Chapter Spring Meeting

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1. Is it allowed to use the grounding grid of a swimming pool's patio to be used as the grounding electrode system for a separate structure's pool equipment room?

First of all, the grid referred to in the question is NOT a grounding grid. It is an equipotential bonding grid. In sections 680.26(A) and (B), the NEC states that the purpose of this bonding is to reduce voltage gradients in the pool area. In addition, section 250.52(B)(3), which is new in the 2017 NEC, specifically prohibits the structures and structural steel described in 680.26(B)(1) and (B)(2) from being used as grounding electrodes. This would include the conductive pool shell mentioned in 680.26(B)(1) and the perimeter surfaces (which would be any area within 3 ft of the inside walls of the pool) mentioned in 680.26(B)(2).

No, it is not allowed once the 2017 NEC is adopted, and not recommended in the meantime.

References: 680.26(A), 680.26(B)(2), 250.52(B)(3)

2. 2017 NEC Art. 396.2 defines Insulated Conductor. Can duplex, triplex and quadplex be used for feeders and branch circuits? It was stated these cannot be used as the conductors are covered rather than insulated. There is no reference in the IAEI *2017 Analysis of Change*. Some of the plex type cables utilities use are not made with Listed building type wire or cables permitted by the NEC

Answer: No, if the cables are constructed of covered conductors. If the cables are made up of Listed building type cables or insulated conductors covered in Article 310 Tables 310.104 (A) and (B) and are permitted in NEC 396.10 that would be permitted for messenger supported wire.

3. Is it permissible to use 240.4(B) and round up to the next standard size over current device on a feeder tap? Example: Can 23 feet of 500 kcmil, Type THHN/THWN copper conductors be tapped off of a 1200 ampere feeder and terminated on a 400 amperes main breaker in a subpanel?

No. Per 240.21(B)(2)(1) 500 kcmil Cu THHN would satisfy the 1/3 ampacity of the rating of the overcurrent device protecting the feeder conductors.

(2) The tap conductors terminate into a single circuit breaker or single set of fuses that limit the load to the ampacity of the tap conductors. Table 310.15(B)(16) 500 kcmil Cu 430A.

110.14(A)(C)(b) Termination provisions of equipment for circuits rated over 100A, or marked for conductors larger than 1AWG, shall be used only for one of the following:

1. Conductors rated 75C

2. Conductors with higher temperature ratings, provided the ampacity of such conductors does not exceed the 75C ampacity of the conductor size used, or up to their ampacity if the equipment is listed and identified for use with such conductors. Per Table 310.15(B)(16), 500 kcmil Cu 75C is 380A. 600 kcmil Cu is 420A and would be the minimum size Cu conductor allowed

4. Can I bond the interior metal water piping to a feeder panel ground bar and not at the main panel if the incoming waterline is plastic and the house waterline is copper? If so, should the bonding conductor be sized from the service conductors or the feeder conductors?

No, 250.104 The interior metal water pipes must be bonded to the grounding electrode system. The requirement for bonding the metal water pipe is found in 250.104(A)(1) and reads like this: "The metal water piping system shall be bonded as required in (1), (2), (3) or (4) of this section. The bonding jumper(s) shall be installed in accordance with 250.64(A), (B) and (E). The points of attachment of the bonding jumper(s) shall be accessible."

Part (1) of 250.104(A) specifies which parts of the grounding electrode system are suitable for bonding the water pipe. They are the service equipment enclosure, the grounded conductor at the service, the grounding electrode conductor if it is large enough, or to the one or more grounding electrodes used.

5. Can you run NM cable from a panel in a residence through wood walls & ceiling and then run it in 1/2" EMT surface mounted? This is a run to several devices on a concrete basement wall. Can it be done without stripping the outer jacket off the NM cable, or does it need to be removed?

Yes, this is permitted if you follow all the requirements in section 334.15(C). These would include:

- Installing a suitable bushing or adapter at the point the cable enters the raceway
- Leaving the outer sheath on the cable and extending it at least 1/4 in. into the box
- Securing the cable within 12 in. of the point it enters the raceway
- Connecting any metal raceway and box to an equipment grounding conductor.

Reference: 334.15(C)

6. There is a residence that has a library 16' x 20' with book cases floor to ceiling along all 4 of the walls. Do I have to install floor boxes to meet wall space receptacle requirement of 210.52 or are no receptacles required?

Answer: Code reference 210.52(A)(2)(1) New veribaige in the 2017 says fixed cabinets do not qualify as wall space for this requirement If there are no countertops or work surfaces present with those fixed cabinets. So is floor to ceiling book cases considered a fixed cabinet? I can see with a book case, perhaps someone wanting to put in a flat screen TV, they remove a few shelves and they have no power. I would say for book cases they would be considered wall space and require receptacles. However, it is up to the AHJ.

7. Does the NEC require sizing raceways and their support racks to allow for future expansion?

No. 90.1(B) This Code contains provisions that are considered necessary for safety. Compliance therewith and proper maintenance results in an installation that is essentially

free from hazard, but not necessarily efficient, convenient, or adequate for good service or future expansion of electrical use.

90.8 Future Planning and Expansion. Plans and specifications that provide ample space in raceway, spare raceways and additional spaces allow for future increases in electric power and communications circuits. Distribution centers located in readily accessible locations provide convenience and safety of operation.

This is a suggestion only. 110.26(E) does support the intent of 90.8 by requiring dedicated space for equipment.

8. In a residence, I have an electrical panel located in a mechanical room 12'w x 8'd x 8'h meeting all the requirements of 110.26 for space and clearances, but it is only accessed through the crawl space which is only 4 feet in height and 10 feet long. Is this an acceptable location for the electrical panel for the house?

AHJ Decision, 110.26 (C) Entrance to and Egress from Working Space

(1) Minimum Required. At least one entrance of sufficient area shall be provided to give access to and egress from working space about electrical equipment.

2017 110.26 (A) (4) Limited Access

(4) Limited Access. Where equipment operating at 1000 volts, nominal, or less to ground and likely to require examination, adjustment, servicing, or maintenance while energized is required by installation instructions or function to be located in a space with limited access, all of the following shall apply:

(a) Where equipment is installed above a lay-in ceiling, there shall be an opening not smaller than 559 mm × 559 mm (22 in. × 22 in.), or in a crawl space, there shall be an accessible opening not smaller than 559 mm × 762 mm (22 in. × 30 in.).

(b) The width of the working space shall be the width of the equipment enclosure or a minimum of 762 mm (30 in.), whichever is greater.

(c) All enclosure doors or hinged panels shall be capable of opening a minimum of 90 degrees.

(d) The space in front of the enclosure shall comply with the depth requirements of Table 110.26(A)(1). The maximum height of the working space shall be the height necessary to install the equipment in the limited space. A horizontal ceiling structural member or access panel shall be permitted in this space.

9. Can we install Nonmetallic Sheathed Cable in a wet location above ground if we place it inside a raceway?

No, this is not permitted. Section 334.12(B)(4) states that Type NM cable is not permitted to be used in wet or damp locations. Section 300.5(B) clarifies that the interior of a raceway installed underground is considered to be a wet location. And 300.9 makes the same statement for raceways in wet locations above grade.

References: 334.12(B)(4), 300.5(B), 300.9

10. My grounding electrode system consists of a water pipe, a UFER, and a ground rod. My service conductors are 500 kcmil 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?

Answer: Yes, see 250.66(A) and (B).

11. There is a 150 amp 120/240 volt Federal Pacific circuit-breaker panel with spare spaces in a house. They want to add a new 20 amp 120 volt branch circuit in the kitchen. If I can find a breaker for this panel is it allowed? Do I need to supply AFCI protection if AFCI breakers are not available for this panel?

Yes. If the calculated load including the new circuit to be installed is less than 150A (230.79) as determined in accordance with Part III, IV, or V of Art 220. In doing a brief internet search, listed replacement circuit breakers for Federal Pacific Stablock panels are available. It must be true because it is on the internet Yes, AFCI protection is required by 210.12(A). There are other options in addition to AFCI circuit breakers.

12. Am I allowed to install cord and plug connected heat mats by a swimming pool or hot tub outdoors? The manufacturer's plug comes with ground-fault protection of equipment. Do I need to have ground-fault circuit interrupter protection for the receptacle also?

Yes, if listed for the purpose. 210.8 Ground-Fault Circuit-Interrupter Protection for Personnel.

(A) Dwelling Units. (3) Outdoors

(B) Other Than Dwelling Units. (4) Outdoors

13. 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? If conduit is required, how do I support it if the exposed bar joists are 18' off the floor?

The answer to the first question is no, SO cord cannot be used in this application. Section 400.10 lists all the uses permitted and this is not one of them. In addition, I would interpret 400.12(1) as not permitting a flexible cord or cable to be used as a substitute for fixed wiring. Section 400.12(6) would not permit the SO cord to be installed inside a raceway.

Both sections 342.30(B)(3) for IMC and 344.30(B)(3) for RMC would allow the use of either of those wiring methods to be supported by attachment at the bar joist and at the box as long as threaded couplings were used.

References: 400.10, 400.12(1), 400.12(6), 342.30(B)(3), 344.30(B)(3)

14. I have a detached 2- car garage. I am supplying 100-amp power from the house feeding the garage panel. I have six 20 amp breakers in the panel feeding lights and receptacles. The inspector wants me to install a main breaker. Does the 6-switch rule in NEC Art 230.71 apply?

Answer: No, this is not a service it is a feeder for an outside feeder, see NEC 225.31 and 225.33(A) which would permit up to six disconnects for the feeder in a single enclosure

15. I have a 10KW 120/240 generator with 100 amp automatic transfer switch supplying a house with a 100 amp service, gas heat and gas stove. The transfer switch will supply

either utility or generator power. The calculated load is 60 amps and the inspector says I have to use load shedding. Why?

A 10kw generator will supply 41.7A. 702.4(B)(2) Automatic Transfer Equipment(a) Full load. The standby source shall be capable of supplying the full load that is transferred by the automatic transfer equipment. Because the calculated load of 60A, we need to look at (b) Load Management. Where a system is employed that will automatically manage the connected load. The standby source shall have a capacity sufficient to supply the maximum load that will be connected by the load management system.

16. In a residential building does the NEC have requirements for how many lights can be installed on 1- 20 amp circuit? How about how many receptacles?

The NEC doesn't limit the number of receptacle and lighting outlets on a general-purpose branch circuit in a dwelling unit. See the NFPA's NEC Handbook for more information. Although there's no limit on the number of lighting and/or receptacle outlets on dwelling general-purpose branch circuits, the NEC does require a minimum number of circuits to be installed for general-purpose receptacles and lighting outlets [210.11(A)]. In addition, the receptacle and lighting loads must be evenly distributed among the required circuits [210.11(B)]

Local amendments may restrict how many receptacles may be on one branch circuit.

17. We are installing a single-phase 208 Volt coffee maker next to the sink in the kitchen of a new restaurant. It will be plugged into a 30-ampere receptacle. Is GFI protection required?

Yes, GFCI protection is required once the 2017 NEC is adopted, but not until then. Section 210.8(B) for other than dwelling units, has been expanded to require GFCI protection for all single-phase receptacles rated 150 volts to ground or less, 50 amperes or less and three-phase receptacles rated 150 volts to ground or less, 100 amperes or less. 210.8(B)(2) would cover receptacles in kitchens and (B)(5) would cover receptacles within 6 ft of any sink.

References: 210.8(B), 210.8(B)(2), 210.8(B)(5)

18. Are hold-down clips or screws required for PV system back-fed breakers?

Yes for a stand-alone system See 690.10 which refers to 710.15€ which requires compliance with 408.36(D). For grid connected see 705. 12(B)(5) which does not require it if connected to a Listed interactive inverter

19. A bank is built having about 75% full-length windows mostly for security reasons. Is it required to have the contractor install show window receptacles every 12' per 210.62 even if the engineer does not design them, stating the bank will not hang any electric signs in them?

No. The definition of a show window in Art 100 is "Any window used or designed for the display of goods or advertising material ...". The intent of the full length windows is security and not display or advertising.

20. What types of wiring methods should be used inside a walk-in cooler or freezer? Are bell boxes, compression fittings, and sealite required, or are regular four-square boxes with set screw fittings, and flexible metal conduit acceptable?

Damp Location wiring methods should be used or possibly wet location if subject to wash down.

300.6 Protection Against Corrosion and Deterioration.

Raceways, cable trays, cablebus, auxiliary gutters, cable armor, boxes, cable sheathing, cabinets, elbows, couplings, fittings, supports, and support hardware shall be of materials suitable for the environment in which they are to be installed.

300.7 Raceways Exposed to Different Temperatures.

(A) Sealing. Where portions of a raceway or sleeve are known to be subjected to different temperatures, and where condensation is known to be a problem, as in cold storage areas of buildings or where passing from the interior to the exterior of a building, the raceway or sleeve shall be filled with an approved material to prevent the circulation of warm air to a colder section of the raceway or sleeve. An explosionproof seal shall not be required for this purpose

21. Can you install a single 20-ampere receptacle on a 15-ampere branch circuit and comply with the code?

Section 210.21(B)(1) states that a single receptacle installed on an individual branch circuit cannot have an ampere rating less than that of the branch circuit. If the circuit is rated at 15 amperes, then the 20 amp receptacle is NOT less than 15 and should be permitted. However, it is not clear from the question if this is an individual branch circuit. Section 210.21(B)(3) states that a branch circuit with two or more receptacles (even single ones) must conform to Table 210.21(B)(3). This table does not allow a receptacle rated over 15 amperes on a 15-ampere branch circuit. In addition, the question does not address the load, which by 210.22 cannot exceed 15 amps.

So my answer is "it depends".

References: 210.21(B)(1), 210.21(B)(3), Table 210.21(B)(3), 210.22

22. An extended stay motel has small apartment type suites with a kitchen, living room, bathroom, and one or two bedrooms. Are these units required to be wired as dwelling units?

Answer: Yes, they would comply with the definition of dwelling unit in Article 100.

Dwelling Unit. A single unit, providing complete and independent living facilities for one or more persons, including permanent provisions for living, sleeping, cooking, and sanitation. (CMP-2)

23. Can I jump a grounding electrode conductor from the metal water pipe to a metal beam and go to the other end of the building and then go from the metal beam to the service and call this my continuous grounding electrode? Are there restrictions on how small a beam or bar joist that can be used?

Yes. 250.64 Grounding Electrode Conductor Installation (C) Continuous. Except as provided for in 250.30(A)(5) and (A)(6), 250.30(B)(1) and 250.68(C), the grounding electrode conductor(s) shall be installed in one continuous length without a splice or joint. If necessary, splices or connections shall be made as permitted in (1) through (4):

(3) Bolted, riveted or welded connections of structural metal frames of buildings or structures.

250.68 Grounding Electrode Conductor and Bonding Jumper Connection to Grounding Electrodes. (C)(2) The metal structure of a building shall be permitted to be used as a conductor to interconnect electrode that are part of the grounding electrode system, or as a grounding electrode.

There are no size limitations noted as to the structural steel component

24. In a remodel or retrofit of an existing dwelling, is AFCI protection required in all existing bedrooms?

Yes, 2014 NEC 210.12 (B)/2017 NEC (D)

(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:

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

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

Exception: AFCI protection shall not be required where the extension of the existing conductors is not more than 1.8 m (6 ft) and does not include any additional outlets or devices.

(D) Branch Circuit Extensions or Modifications — Dwelling Units and Dormitory Units.

In any of the areas specified in 210.12(A) or (B), where branch-circuit wiring is modified, replaced, or extended, the branch circuit shall be protected by one of the following:

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

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

Exception: AFCI protection shall not be required where the extension of the existing conductors is not more than 1.8 m (6 ft) and does not include any additional outlets or devices.

25. Does the NEC allow a 125-volt receptacle for refrigeration equipment in a commercial kitchen not to be GFCI protected if it is located normally behind the appliance and not readily accessible?

Section 210.8(B)(2) in the 2014 NEC requires all 125-volt, single-phase, 15- and 20-ampere receptacles in other than dwelling kitchens to be GFCI protected. Since the current rating of this receptacle is not given, only if it is a 30-ampere receptacle would GFCI protection not be required (until the 2017 NEC is adopted; see my answer to question 17).

If the receptacle must have GFCI protection by either edition of the NEC, section 210.8 requires the GFCI device to be readily accessible. So it would not be permitted behind the refrigerator. The receptacle could be there, but it would need to be protected by a GFCI breaker.

References: 210.8, 210.8(B)(2)

26. A kitchen counter has the receptacles properly spaced on the counter. At the end of the counter there is a two-foot wall space with no counter. Is a receptacle required in the two-foot wall space?

Answer: Yes, see 210.52(A)(4) that states (4) Countertop and Similar Work Surface Receptacle Outlets. Receptacles installed for countertop and similar work surfaces as specified in 210.52(C) shall not be considered as the receptacle outlets required by 210.52(A). Because of the need to provide a sufficient number of receptacles for the appliances used at the kitchen counter area, receptacle outlets installed to serve kitchen or dining area counters cannot also be used as the required receptacle outlet for an adjacent wall space that is subject to the requirements of 210.52(A)(1) and (A)(2).

27. Are Type NM cables allowed to be routed through a PVC stub out of the bottom of a panel into a basement or crawl space?

Yes. 334.15 Exposed Work, (B) Protection from Physical Damage, Where passing through a floor, the cable shall be enclosed in Schedule 80 PVC conduit extending at least 6 inches above the floor. If the raceway exceeds 24" in length, ampacity adjustment factors may apply per 310.15(B)(3).

28. What is the minimum size grounding electrode conductor for the underground metal water line in a 4-plex with a service consisting of (5) 100-Amp service disconnects with a 600-Amp rated meter center? The meter center is fed by 350 kcmil aluminum by the utility. There are no service-entrance conductors by which to use T250.66 for sizing.

Where there are no service-entrance conductors, the grounding electrode conductor size shall be determined by the equivalent size of the largest service-entrance conductor required for the load to be served.

No load calculation provided  
2 parallel 350 Kcmil Copper  
75 Degree Column 310 Amps  
Combined Cir Mil 700 Kcmil  
250.66 2/0 Copper, 4/0 AL

29. I have a 2000-amp service that is maxed out. Can I set another service at a different location or do they have to be grouped? They are going to be the same systems, but I have no room for the new service to group them.

Section 230.2(C)(1) allows an additional service where capacity requirements are in excess of 2000 amperes at a supply voltage of 1000 volts or less. Section 230.70 requires a disconnecting means for each service. Section 230.71(A) states that each service disconnecting means can have no more than six switches or circuit breakers in a single enclosure or in a group of separate enclosures. Section 230.72(A) requires the two to six disconnects to be grouped. This does not appear to allow what the questioner is asking. However, sections 90.2(C) and 90.4 allow the authority having jurisdiction to work with the contractor to find a solution that may satisfy everyone.

Reminder: If a second service is installed at a different location, section 250.58 requires both services to be connected to the same grounding electrode.

90.2(C) Special Permission. The AHJ may grant exception for the installation of conductors and equipment that are not under the exclusive control of the electric utilities

and are used to connect the utility supply system to the service conductors of the premises, provided such installations are outside a building ...

90.4 By special permission, the AHJ may waive specific requirements in this Code or permit alternative methods where it is assured that equivalent objectives can be achieved by establishing and maintaining effective safety.

Article 100, definition: Special Permission. The written consent ...

References: 230.2(C)(1), 230.70, 230.71(A), 230.72(A), 90.2(C), 90.4

30. At a McDonalds there are computer screens mounted on the ceiling at 7 feet with a 120-volt, 20-amp isolated ground receptacle with a twist lock. This is in the kitchen area. Would GFCI protection be required?

Answer: Yes, see 210.8(B)(2) which requires for kitchens in (B) Other Than Dwelling Units. All single-phase receptacles rated 150 volts to ground or less, 50 amperes or less and three-phase receptacles rated 150 volts to ground or less, 100 amperes or less installed in the following locations shall have ground-fault circuit-interrupter protection for personnel.

31. When bonding hydro massage tubs, what is required to be bonded if a plastic water line supplies the tub and the motor has a plastic housing? Is the bond required to be routed back to the service panel?

No bonding is required. 680.74 Bonding. Both metal piping systems and grounded metal parts in contact with the circulating water shall be bonded together using a solid copper bonding jumper, insulated, covered, or bare, not smaller than 8AWG. Since these are not present, bonding is not required.

680.74 further states: "The 8 AWG or larger bonding jumper shall be required for equipotential bonding in the area of the hydromassage bathtub and shall not be required to be extended or attached to any remote panelboard, service equipment, or any electrode."

32. Can I use a 3-wire w/ground NM cable for temporary wiring on a construction site as a multi-wire branch circuit if I feed temporary receptacles on one circuit and lighting on the other circuit?

No, Article 590.4 (D) (1)

(D) Receptacles.

(1) All Receptacles. All receptacles shall be of the grounding type. Unless installed in a continuous metal raceway that qualifies as an equipment grounding conductor in accordance with 250.118 or a continuous metal-covered cable that qualifies as an equipment grounding conductor in accordance with 250.118, all branch circuits shall include a separate equipment grounding conductor, and all receptacles shall be electrically connected to the equipment grounding conductor(s). Receptacles on construction sites shall not be installed on any branch circuit that supplies temporary lighting.