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Type NM Cable Conduit Sleeves

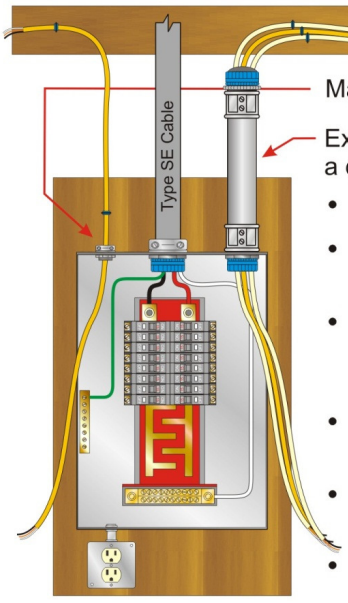
49. **Why can't a conduit that sleeves Type NM conductors above a panel penetrate a finished ceiling?**

Reference: *NEC* 312.5(C) Exception

Answer: This section first appeared in the 1999 *NEC* as 373-5(c) Exception.

The conduit sleeve was restricted from penetrating a structural ceiling by CMP-9 to prevent this sleeve from acting as a "chimney" into the above ceiling area in the event of a fire at the panelboard area.

312.5(C) Cable Entries to Cabinets



Main rule: Cables must be secured to cabinet

Exception: Cables permitted to enter through a common sleeve as follows:

- Surface mounted enclosure
- Raceway is sealed at top and does not penetrate structural ceiling
- Fittings provided on each end of raceway to protect from abrasion (fittings accessible after installation)
- Nonflexible raceway used and is minimum 450 mm (18 in.). Not more than 3.0 m (10 ft)
- Cable sheath extends into enclosure at least 6 mm (¼ in.)
- Cables are fastened within 300 mm (12 in.)

Work Area/GFCI-AFCI Protection

Question Number 50

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 receptades need to be arc-fault or ground fault protected?

NEC 210.8(A)(5) 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.

(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.

210.12 Arc-Fault Circuit-Interrupter Protection

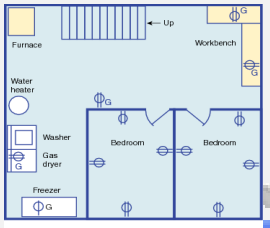
(A) Dwelling Units. All 120-volt, single phase, 15- and 20-ampere branch circuits supplying outlets installed in dwelling unit family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, or similar rooms or areas shall be protected by a listed arc-fault circuit interrupter, combination-type, installed to provide protection of the branch circuit.

Answer

Basement storage or work areas are not included in the types of rooms stated in Section 210.12(A) for AFCI requirements. Therefore AFCI protection would not be required.

GFCI protection would be an AHJ call for the receptacle outlets located in the work/storage area. The term "unfinished" first appeared in the 1990 NEC. CMP 2 formulated a panel statement in Comment 2-647 of the 1989 TCR that stated "Determination of whether a basement is "finished" or "unfinished" is subject to the authority having jurisdiction". One should realize wall and/or ceiling cover does not reduce the hazards that exist in those areas that may required to have GFCI protection.

Reference: 210.12(A) and 210.8(A)(5)



51. 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]

Reference:

NEC 501.140 Flexible Cords, Class I, Divisions 1 and 2. (A) Permitted Uses. Flexible Cord shall be permitted: (3) For electric submersible pumps with means for removal without entering the wet-pit. The extension of the flexible cord within a suitable raceway between the wet-pit and the power source shall be permitted. (4) For electric mixers intended for travel into and out of open-type mixing tanks or vats. (5) For temporary portable assemblies consisting of receptacles, switches, and other devices that are not considered portable utilization equipment but are individually listed for the location.

51. 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]

Answer:

Cords are allowed for temporary equipment per 501.140 (A) and must be installed per 501.140 (B).

See also CONDUIT FITTINGS FOR USE IN HAZARDOUS LOCATIONS (EBNV). "Cord connectors are intended for use in making connections between threaded rigid metal conduit systems or hazardous location devices and extra hard service type flexible cord, having a grounding conductor, for portable equipment."

Question Number 52

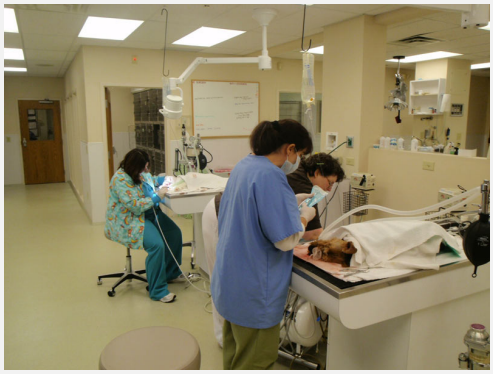
Can you install metallic-sheathed cable (such as MC) in PVC conduit in a slab in a health care facility?

Answer Number 52

Sometimes, maybe, depends…

Health Care Facility

Buildings or portions of buildings in which medical, dental, psychiatric, nursing, obstetrical, or surgical care are provided.



Part II Wiring and Protection

…applies to *patient care areas* of all health care facilities

517.2 Patient Care Area

Any portion of a health care facility wherein patients are intended to be examined or treated.

Informational Note:

Business offices, corridors, lounges, day rooms, dining rooms, or similar areas typically are not classified as patient care areas.

517.13 Patient Care Areas

General Care + Critical Care + Wet Procedure Locations

517.13 Patient Care Areas (2014)

Basic Care + General Care + Critical Care + Support





NFPA 99

Basic: not likely to cause injury to the patients or caregivers but may cause patient discomfort.

General: likely to cause minor injury to patients or caregivers.

Critical: likely to cause major injury or death of patients or caregivers.

Support: not likely to have a physical impact on patients or caregivers.

Degree of Injury

517.13(A) Wiring Methods

The metal raceway system, or metallic cable armor, or sheath assembly shall itself qualify as an equipment grounding conductor in accordance with 250.118.

330.30 Securing and Supporting

(A) General. …shall be supported and secured by staples, cable ties, straps, hangers, or similar fittings or other approved means

(B) Securing. Unless otherwise provided, cables shall be secured at intervals not exceeding 1.8 m (6 ft).

Aircraft Hangers

53. Is wiring installed only below the floor of an unclassified room as described in Art. 513.3 D, that is inside of an aircraft hanger, considered to be under the hanger floor and therefore required to be sealed?

Reference: NEC 513.8, particularly 513.8(A).

Answer: This section requires all wiring in or under the hanger floor to comply with the requirements of Class I, Division 1 locations. Note the entire structure is considered the Aircraft Hanger and there is no exception provided for the area described in Areas Suitably Cut Off and Ventilated in 513.3(D).

Question #54

Would ice cream/frozen yogurt or custard prep area without "cooking" equipment be considered a kitchen?

Supplementary Grounding – Wind Generators

55. Are there any special conditions required for supplementary grounding electrodes used to limit voltages imposed by lightning on a wind generator?

References: NEC 694.1 & 694.40(C)(1)
NFPA 780 (Standard for lightning protection)

- Answer: Yes. A wind turbine tower is required be connected to one or more auxiliary electrodes to limit voltage imposed by lightning. Auxiliary electrodes are permitted.
- NOTE: NEC 694 applicable to individual wind generators having a rated power up to and including 100 KW.

10 KW Wind turbine located at a WWTP

Output voltage of 480 volts

Supplementary Grounding – Wind Generators

- **694.40(C) Tower Grounding.**
- (1) Auxiliary Electrodes. A wind turbine tower shall be connected to one or more auxiliary electrodes to limit voltages imposed by lightning. Auxiliary electrodes shall be permitted to be installed in accordance with 250.54. Electrodes that are part of the tower foundation and meet the requirements for concrete encased electrodes in accordance with 250.52(A)(3) shall be acceptable. A grounded metal tower support shall be considered acceptable where meeting the requirements of 250.136(A). Where installed in close proximity to galvanized foundation or tower anchor components, galvanized grounding electrodes shall be used.

Supplementary Grounding – Wind Generators

694.40(C) Tower Grounding.

(4) Lightning Protection Systems. Auxiliary electrodes and grounding electrode conductors shall be permitted to act as lightning protection system components where meeting applicable requirements. If separate, the tower lightning protection system grounding electrodes shall be bonded to the tower auxiliary grounding electrode system. Guy wires used as lightning protection system grounding electrodes shall not be required to be bonded to the tower auxiliary grounding electrode system.

Informational Note: See NFPA 780-2011, *Standard for the Installation of Lightning Protection Systems, Informative* Annex N, Wind Turbine Generator Systems, for information on lightning protection of wind turbines.

•Supplementary Grounding – Wind Generators

Example of 1 Engineers specification for grounding wind generator

Grounding: Metallic components within the WTG shall be bonded to the WTG and the tower shall be bonded to a single earth-grounding system with a resistance of not more than 5 ohms to ground under all atmospheric and climatic conditions. The foundation reinforcing steel and foundation piles (if used) shall be electrically bonded together to supplement the ground system electrodes.
To minimize lightning damage to the blades, bearings, and WTG (in general), the blades and nacelle shall be designed to have a clear electrical path to ground, without going through bearings. The design for lightning immunity shall conform to standard IEC 61400-24.

•Supplementary Grounding – Wind Generators

Example of 1 Engineers specification for grounding wind generator

4.2.6 Grounding Requirements

The turbine installation requires an earth electrode system. An earth electrode system typically is comprised of driven ground rods and buried copper wire in the surrounding soil and/or connection to foundation concrete and steel.

The customer is responsible for the design, installation and connection of/to the earth electrode system in compliance with codes mandated by the local authority having jurisdiction and the following Northern requirements:

- The earth electrode system shall have a resistance value of 5 ohms or less.
- The interconnection transformer ground shall be connected to the tower earth electrode system using #1/0 AWG copper wire minimum.
- Ground conductors of ancillary structures shall be bonded to the tower earth electrode system with #1/0 AWG copper wire minimum.
- Tower foundation bolts shall not be used as terminations for ground conductors
- The foundation reinforcing steel and foundation piles (if used) shall be electrically bonded together to serve as or supplement the foundation electrode.
- Two conductors shall be attached using an exothermic welding process to the electrically interconnected reinforcing steel in two separate locations that are on opposite sides of the turbine tower. Each conductor shall be connected to the turbine tower bonding bus. Refer to Figure 1 for connection detail.
- The turbine bonding bus is pre-drilled and tapped to accept ground conductors with crimp type or compression lugs and is located at the turbine tower base. Anti-oxidation compound shall be used on these connections.
- Ground conductors used for attachment to the earth electrode system shall be protected with a plastic sleeve, conduit, or insulation to provide corrosion/physical protection where conductors enter or exit the concrete floor of the tower interior.
- If ground conductors are to be routed through metallic conduit, the conductors shall be electrically bonded to the conduit at both ends.

•Supplementary Grounding – Wind Generators

Example of 1 Engineers specification for grounding wind generator

For low-impedance earth electrode systems, Northern recommends:

- A ring earth electrode encircling the foundation, in addition to the electrode system formed by foundation reinforcing steel.

When designing and installing the earth electrode system, Northern recommends the following references:

- IEC 62305 (Protection Against Lightning)
- Germanischer Lloyd Guideline for the Certification of Wind Turbines
- MIL-HDBK 419, Grounding, Bonding and Shielding for Electronic Equipment and Facilities
- IEEE 141-1993 (Red Book)
- IEEE 142-2007 (Green Book)
- NFPA 780 art 3 (Standard for Installation of Lightning Protection Systems)
- NFPA 70 art 250 (Grounding and Bonding)
- Motorola R-56, "Standards and Guidelines for Communications Sites"

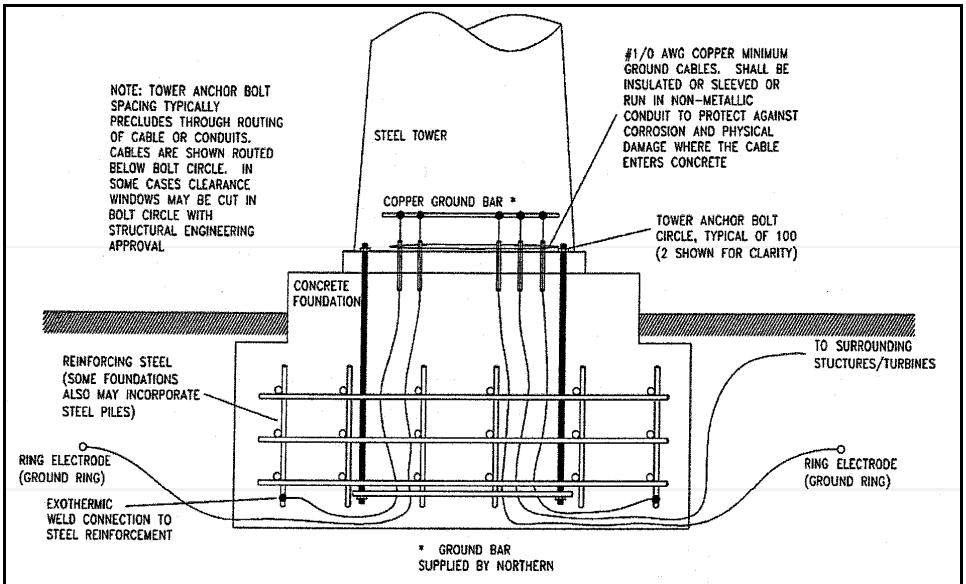


Figure 1 Grounding Detail Example

For low-impedance earth electrode systems, Northern recommends:

- A ring earth electrode encircling the foundation, in addition to the electrode system formed by foundation reinforcing steel.

Box Fill Calculation

56. **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?**

Reference: *NEC* 314.16(B)

No, Not Permitted

Answer: Type MC "single" circuit conductors 4 x 2.25 = 9.00 cu. in.
(What size? 12 AWG? 120 volt? Clamps?)
EGC's *(count as one)* 2.25 = 2.25 cu. in.
Device (GFCI receptacle) 2 x 2.25 = 4.50 cu. in.
Total Cu. In. Required 15.75 cu in.

2 In. Deep Handi-Box (3 x 2 x 2) = 10.00 cu. in.

314.16(A)(1) Standard Sizes for (Metal) Boxes

The volumes of standard (metal) boxes that are not marked with a cubic-inch capacity shall be as given in Table 314.16(A)

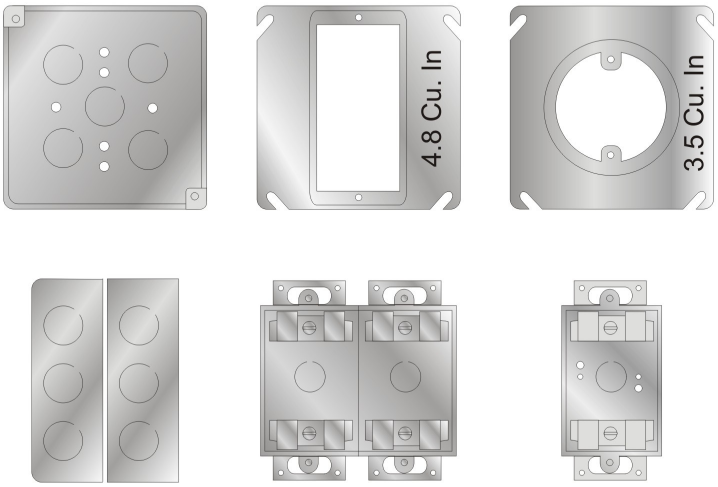
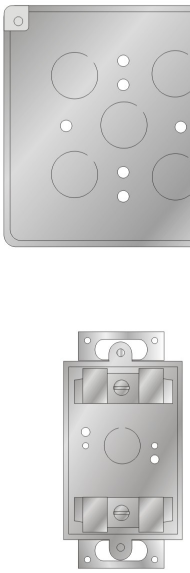
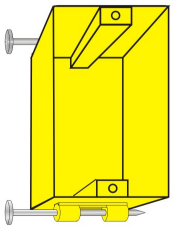


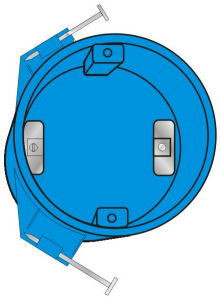
Table 314.16(A) Standard Sizes Provided



- Dimensions of "standard metal boxes" provided in *NEC* Table 314.16(A)
- Minimum cubic inch capacity given
- Maximum number of conductors shown for 18 AWG through 6 AWG
- Boxes described in the Table that have larger cubic-inch capacity are permitted to be marked with that

314.16(A)(2) Other Boxes (Nonmetallic)





- Cubic-inch volume of "nonmetallic other boxes" to be durably and legibly marked by manufacturer
- Other markings like suitability for fire wall or ceiling "Class __ hr, __ (F, W, C or FC)"
- Marked if suitable for supporting a luminaire
- Volume requirements determined from the volume required per conductor as provided in *NEC* Table 314.16(B)

Volume Required per Conductor*

Sizes in AWG	cm³	in.³
18	24.6	1.5
16	28.7	1.75
14	32.8	2.00
12	36.9	2.25
10	41.0	2.50
8	49.2	3.00
6	81.9	5.00

* Values taken from *NEC* Table 314.16(B)

314.16(B) Box Fill Calculations

Conductor, Device or Type of Fitting	Conductor Volume Allowance
Each conductor originating outside and terminating inside the box	1
Each conductor passing through the box unbroken	1
Looped or coiled conductor longer than 12 in.	2
Conductors that do not leave box	0
Max. of (4) fixture wires smaller than 14 AWG plus EGC (domed luminaire canopy)	0
Cable clamps (all) (LB)	1
Support fittings (luminaire stud or hickey)(per fitting) (LB)	1
Device or equipment (receptacle, switch, etc.)(per yoke) (LC)	2
Large device wider than 2 in. with double mounting yokes (LC)	4
Equipment grounding conductors (all) (excluding isolated EGC) (LB)	1
Additional equipment grounding conductors for isolated EGC (LS)	1

LB = Largest conductor in box

LC = Largest conductor connected to device

LS = Largest conductor of additional set

**No allowance is required for small fittings like locknuts and bushings*

Parking Lot Light Pole Grounding/Auxiliary Grounding Electrode Requirements

Question Number 57

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?

NEC Section 250.54 Auxiliary Grounding Electrodes

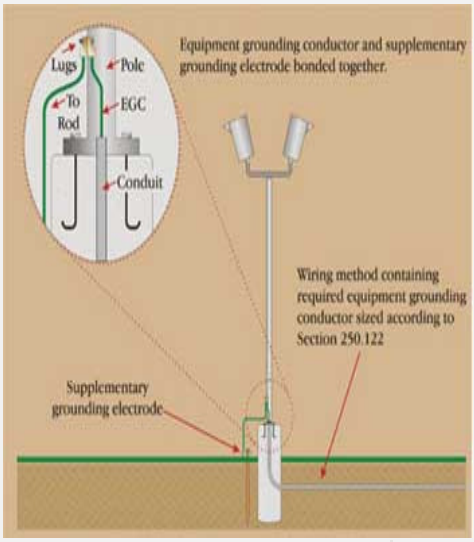
One or more grounding electrodes shall be permitted to be connected to the equipment grounding conductors specified in 250.118 and shall not be required to comply with the electrode bonding requirements of 250.50 or 250.53(C) or the resistance requirements of 250.53(A)(2) Exception, but the earth shall not be used as an effective ground-fault current path as specified in 250.4(A)(5) and 250.4(B)(4).

NEC 250.4(A)(5) Effective Ground-Fault Current Path

Electrical equipment and wiring and other electrically conductive material likely to become energized shall be installed in a manner that creates a low-impedance circuit facilitating the operation of the overcurrent device or ground detector for high-impedance grounded systems. It shall be capable of safely carrying the maximum ground-fault current likely to be imposed on it from any point on the wiring system where a ground fault may occur to the electrical supply source. The earth shall not be considered as an effective ground-fault current path.

Answer

Yes. This is a common violation observed many times in the field. Grounding electrodes, such as auxiliary ground rods, that are connected to equipment are not permitted by 250.54 to be used in lieu of the equipment grounding conductor, but they may be used to provide a local earth reference connection at electrical equipment locations. Section 250.54 is clear the EGC and GEC are required to be connected together.



Reference 250.54 and 250.4(A)(5)

58. What is the maximum number of #12AWG THHN conductors allowed in a 3/8" flex metal conduit supplying a motor circuit?

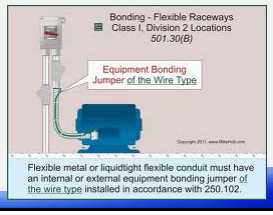
Reference:

Table C.3 on page 756 of the 2011 NEC does not show 3/8" flexible metal conduit. It shows 9 maximum #12 THHN conductors for 1/2" FMC.

Table 4 Chapter 9 for Article 348 (FMC) shows a maximum of 30 mm^2 or 0.046 in^2 for the maximum cross sectional area of the conductors for 3/8" FMC

Table 5 Chapter 9 for THHN on page 718 shows a cross sectional area for 12 AWG of 8.581mm^2 or 0.0133 in^2.

Answer: 30 mm^2/ 8.581 mm^2= 3.496 or a maximum of 3 conductors.



Question Number 59

What is the rule for adjusting the ampacity of conductors based on the number of conductors in the raceway?

Answer Number 59

It's all found in Table 310.15(B)(3)

310.15(A) Ampacities for Conductors

- Use the tables or engineering supervision
- More than one? The lowest value shall be used
- Don't exceed the temperature limitation

310.15 (B)(3) Adjustment Factors.

(a) *More Than Three Current-Carrying Conductors in a Raceway or Cable.* …the allowable ampacity of each conductor shall be reduced per Table 310.15(B)(3)(a)

Table 310.15(B)(3)(a) Adjustment Factors for More Than Three Current-Carrying Conductors in a Raceway or Cable

Number of Conductors[1]	Percent of Values in Table 310.15(B)(16) through Table 310.15(B)(19) as Adjusted for Ambient Temperature if Necessary
4–6	80
7–9	70
10–20	50
21–30	45
31–40	40
41 and above	35

[1]Number of conductors is the total number of conductors in the raceway or cable adjusted in accordance with 310.15(B)(5) and (6).

Table 310.15(B)(3)(a)

Adjustment Factors for More Than Three Current-Carrying Conductors in a Raceway or Cable

Number of Conductors[1]	Percent of Values in Table 310.15(B)(16) through Table 310.15(B)(19) as Adjusted for Ambient Temperature if Necessary
4–6	80
7–9	70
10–20	50
21–30	45
31–40	40
41 and above	35

[1] Number of conductors is the total number of conductors in the raceway or cable adjusted in accordance with 310.15(B)(5) and (6).

Grounding for Service and Feeder

60. 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.

Reference: NEC Article 100, 225.31 through 225.37, 215.6, 250.134 and 250.32(B), 250.50, 250.24(A)(1), 250.32(B), and 250.94.

Grounding for Service and Feeder

60. Answer: The service disconnect is at the meter/service that is located by the front sidewalk. The conductors from the meter/service to the structure are a feeder as defined in Article 100. The disconnecting means at the dwelling constitute a building or structure disconnecting means as covered in 225.31 through 225.37.

- Four conductors are required in the feeder to the building; two ungrounded, one neutral and one equipment grounding conductor. 215.6, 250.134 and 250.32(B).
- (Continued)

Grounding for Service and Feeder

60. Answer: (Continued)

- Consider the service and structure to each be an "island" for purposes of grounding electrodes and connections. Comply with 250.50 at the service and at the building. Connect all grounding electrodes together to create a grounding electrode system. At the service, connect the grounding electrode conductor to the neutral. At the building, connect the grounding electrode conductor to the equipment grounding conductor terminal bar. Isolate the neutral from the equipment grounding conductor at the subpanel. See 250.50, 250.24(A)(1), 250.32(B).
- Install an intersystem bonding termination as required in 250.94 and perform proper bonding.

Question #61

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?

Power Strips – Relocatable power taps

62. 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?

References: UL White Book Category "XBYS" (relocatable power taps)
NFPA 1 (Uniform Fire Code) Section 11.1.6 & 11.1.7.6
IFC (International Fire Code) Section 605.4.1

- Answer: The power strip (relocatable power tap) is not considered an extension cord and may be used provided the power strip meets certain conditions.

•Power Strips – Relocatable Power Taps

- UL White book category "ELBZ" covers extension cords, and in part states "Cord sets and power-supply cords are not intended to be used as a substitute for the fixed wiring of a structure and, hence, are not intended to be fastened in place".
- NEC 400.8(1) also prohibits flexible cords from being used as a substitute for the fixed wiring of a structure
- UL White book category "XBYS" covers relocatable power taps rated 250 V ac or less, 20 A or less. 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.

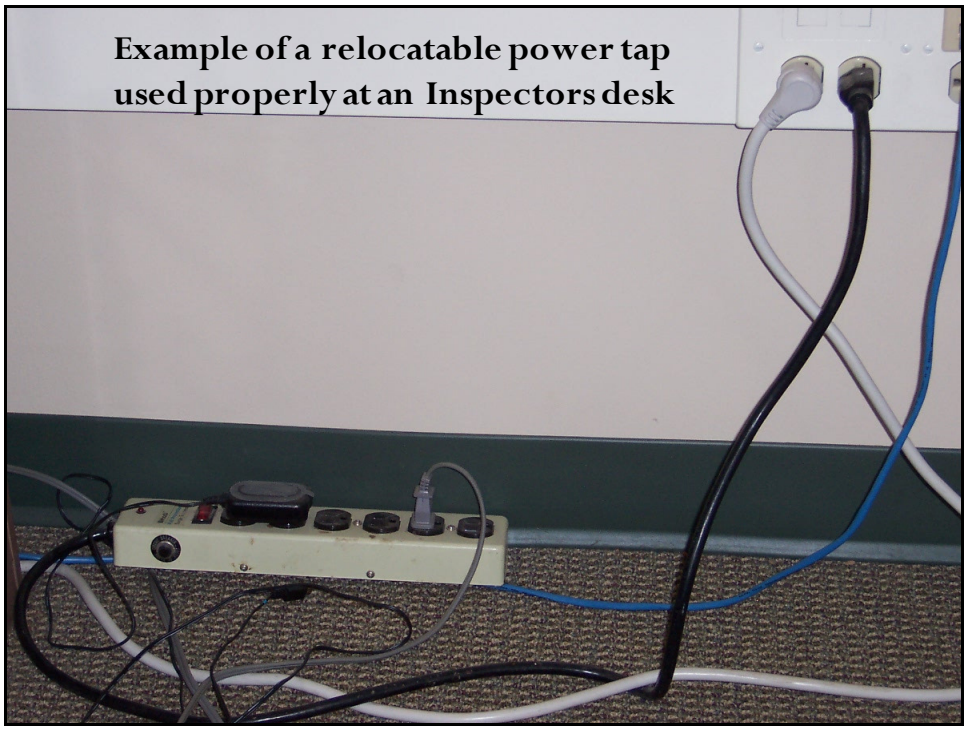
•Power Strips – Relocatable Power Taps

- "UL" category "XBYS" also states:
- "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 with general patient care areas or critical patient care areas of health care facilities as defined in Article 517.

•Power Strips – Relocatable Power Taps

- NFPA 1- 11.1.6.1 & IFC 605.4.1 Relocatable power taps shall be grounded and polarized, and shall also be listed and have overcurrent protection.
- NFPA 1-11.1.6.2 & IFC 605.4.2The relocatable power tap shall be directly connected to a permanently installed receptacle.
- NFPA 1-11.1.7.6 & IFC 605.5 Extension cords shall be not be used as a substitute for permanent wiring

- Summary – Relocatable power taps are acceptable to be used and are not classified as an "extension cord"
- Fire Inspector is incorrect with his or her interpretation.



Neutral Conductor at Switch Locations

63. **Is a neutral conductor to be installed in all 3 and 4 way switches?**

Reference: *NEC* 404.2(C) and Exception

Answer: **No**. See Exception at 404.2(C)

Note: 2014 *NEC* ROP 9-89 proposes to require the grounded (neutral) conductor at only one switch location involving 3-way and 4-way switch locations in the same room, etc.

404.2(C) Grounded Conductor at Switch Locations

- Where switches control lighting loads are supplied by a grounded branch circuit, the grounded conductor is required to be provided at the switch location
- An exception permits the grounded (neutral) conductor to be omitted from the switch enclosure where one of the following conditions applies:
  - (1) Conductors enter the switch box through a raceway having sufficient cross-sectional area to permit adding a grounded conductor at a later date
  - (2) where cable assemblies enter the box through a framing cavity that is open at the top or bottom on the same floor level, or through a wall, floor, or ceiling that is unfinished on one side

Article 725 Signaling Circuits/Conductor Fill

Question Number 64

What are the conductor fill requirements for signaling circuits?

Photo: IAEI Archives

NEC Section 725.3(A)

- **725.3 Other Articles.** 725.3 Other Articles Circuits and equipment shall comply with the articles or sections listed in 725.3(A) through 725.3(G). Only those sections of Artide 300 referenced in this artide shall apply to Class 1, Class 2, and Class 3 circuits.

(A) Number and Size of Conductors in Raceway Section 300.7.

NEC Section 300.17 Number and Size of Conductors in Raceway

The number and size of conductors in any raceway shall not be more than will permit dissipation of the heat and ready installation or withdrawal of the conductors without damage to the conductors or to their insulation.

Informational Note: See the following sections of this *Code*: … Class 1, Class 2, and Class 3 circuits, Article 725…

Answer

The number of control and signaling cables installed in a raceway are limited to the percent fill limitations of Chapter 9, Table 1. This requirement of proposal 16-36 in the 2001 ROP. This proposal did not intend required Class 2 or Class 3 cables to comply with the raceway fill limitations. Although this may or may not have been the intention of the submitter. In reality there is no physical way to install these cables anywhere near the 40% fill allowed in Chapter 9, Table 1 without destroying them, in which would be a violation of the main test of Section 300.17.

Reference 725.3(A) and 300.17.

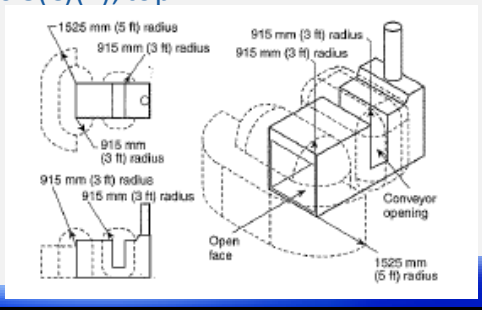
65. **(1)How far does a Class I, Division 2 area at an open paint spray extend?** (2)Is there any other method of sealing the conduit that is approved other than sealing compound leaving a Class I, Division 2 area?

Reference: (1) 516.3(B), 516.3(C)(2), Figure 516.3(C)(2)

- 516.3(B) identifies those areas designated as Class I Div 1/Zone 1, or Class II Division 1.
- 516.3(C)(2) addresses Class I Div II locations for Closed-Top, Open-Face, and Open-Front Spraying.
- If spray application operations are conducted within a closed-top, open-face, or open-front booth or room, any electrical wiring or utilization equipment located outside of the booth or room but within the boundaries designated as Division 2 or Zone 2 in Figure 516.3(C)(2) shall be suitable for Class I, Division 2, Class I, Zone 2, or Class II, Division 2 locations, whichever is applicable.

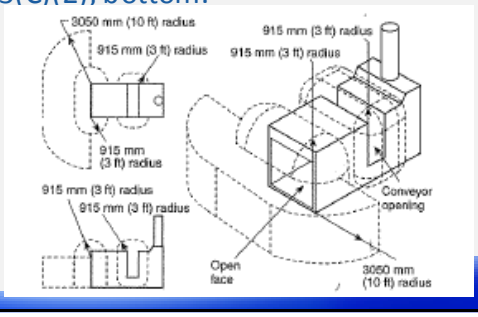
65. **(1)How far does a Class I, Division 2 area at an open paint spray extend?** (Continued)

- **The Class I, Division 2, Class I, Zone 2, or Class II, Division 2 locations shown in Figure 516.3(C)(2) shall extend from the edges of the open face or open front of the booth or room in accordance with the following:**
- If the exhaust ventilation system is interlocked with the spray application equipment, the Division 2 or Zone 2 location shall extend 1.5 m (5 ft) horizontally and 900 mm (3 ft) vertically from the open face or open front of the booth or room, as shown in Figure 516.3(C)(2), top.

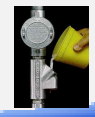


65. **(1)How far does a Class I, Division 2 area at an open paint spray extend?** (Continued)

- **The Class I, Division 2, Class I, Zone 2, or Class II, Division 2 locations shown in Figure 516.3(C)(2) shall extend from the edges of the open face or open front of the booth or room in accordance with the following:**
- If the exhaust ventilation system is not interlocked with the spray application equipment, the Division 2 or Zone 2 location shall extend 3 m (10 ft) horizontally and 900 mm (3 ft) vertically from the open face or open front of the booth or room, as shown in Figure 516.3(C)(2), bottom.



- 65. (Continued) **(2) Is there any other method of sealing the conduit that is approved other than sealing compound leaving a Class I, Division 2 area?**
- Reference: (2) 501.15(B)(2), 501.15(C), 501.15(C)(1), 501.15(C)(3)
- Answer: (2) 501.15(B)(2) requires seals at the Class I, Div II boundary, therefore 501.15(C), which covers specific requirements for seals in Class I, Div I & II locations is applicable. 501.15(C)(1) covers fittings and requires enclosures for connections or equipment be provided with an integral means for sealing, or sealing fittings listed for the location shall be used. Sealing fittings shall be listed for use with one or more specific compounds and shall be accessible.
- 501.15(C)(3)The sealing compound must have a minimum thickness of not less than the trade size of the conduit and in no case less than 5⁄8 in. Conduit fittings for sealing are to be used only with sealing compound that is supplied with the fitting and specified by the manufacturer in instructions furnished with the fitting.



Question Number 66

Is a group therapy room in a health care facility considered a patient care area, requiring compliance with 517.13?

Answer Number 66

Yes.

Health Care Facility

Buildings or portions of buildings in which medical, dental, psychiatric, nursing, obstetrical, or surgical care are provided.

517.2 Patient Care Area

Any portion of a health care facility wherein patients are intended to be examined or treated.

Informational Note:

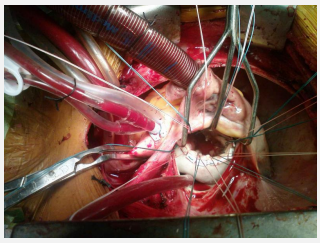
Business offices, corridors, lounges, day rooms, dining rooms, or similar areas typically are not classified as patient care areas.

517.11 Informational Note:

…the occurrence of a conductive or capacitive path can be established through instrumentation directly connected to the patient

…hazard increases as more apparatus is associated

…patient may be electrocuted at extremely low current levels



517.13 Patient Care Areas

Treated: to deal with (a disease, patient, etc.) in order to relieve or cure.

Insulating Restrictions

67. 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?

Reference: NEC 250.30(A)(5), 250.30(A)(1) Ex No. 2, 250.30(A)(2)

Answer: The bonding of the neutral in the transformer in considered the system bonding jumper. The grounding electrode conductor is required to be connected at the same point the system bonding jumper is connected. See 250.30(A)(5)

- A system bonding jumper connection at both the source and first disconnecting means is permitted if doing so does not create a parallel path for neutral current to flow through.

Insulating Restrictions

67. 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?

Answer: (Continued)

See 250.30(A)(1) Exception No. 2. Note that 250.30(A)(2) requires a supply-side bonding jumper to be installed between enclosures if they are located in separate enclosures. This conflict is being removed in the 2014 NEC.

Question #68

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?

Bonding at Swimming Pools

69. Can we use the reinforcing rods in the concrete deck around a swimming pool to bond the metal pool accessories?

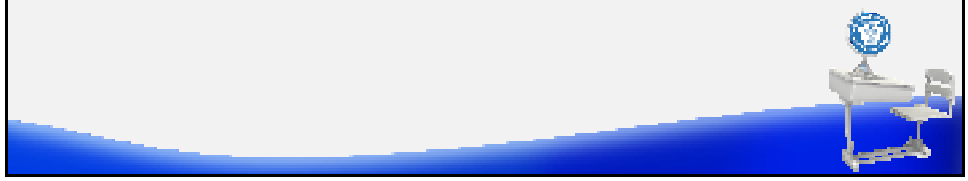
Reference: NEC 680.26(B)(1) Conductive pool shells
680.26(B)(2) Perimeter surfaces
(NEC handbook – Article 680 Exhibits /diagrams)

Answer: Yes, it is permitted/required to use the reinforcing rods in the concrete deck to bond the other metallic parts such as wet niche fixture shells, handrails, ladders and similar metal components.

•Bonding at Swimming Pools

NEC 680.26(B)

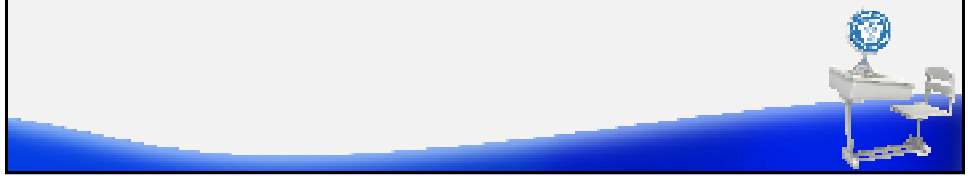
- The parts specified in 680.26(B)(1) through (B)(7) shall be bonded together using solid copper conductors, insulated covered, or bare, not smaller than 8 AWG or with rigid metal conduit of brass or other identified corrosion-resistant metal. Connections to bonded parts shall be made in accordance with 250.8. An 8 AWG or larger solid copper bonding conductor provided to reduce voltage gradients in the pool area shall not be required to be extended or attached to remote panelboards, service equipment, or electrodes.



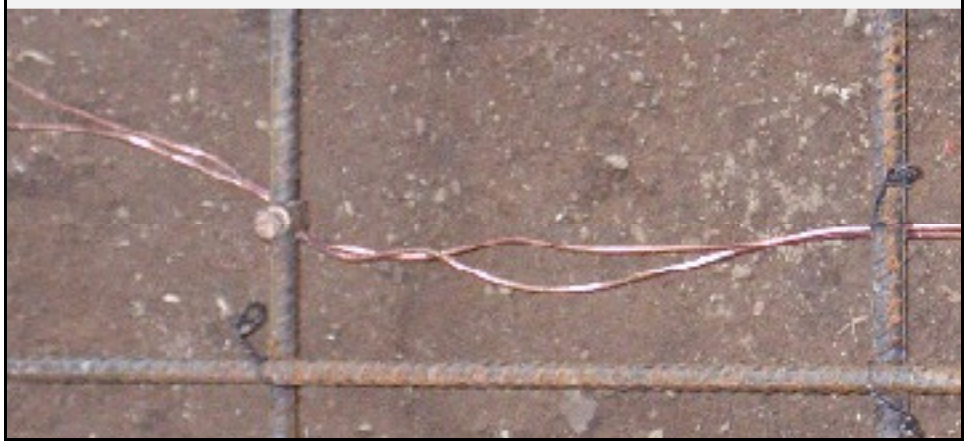
•Bonding at Swimming Pools

NEC 680.26(B)(1) – (B)(7)

- (B)(1) Conductive Pool Shells
- (B)(2) Perimeter surfaces (within 3' of pool)
- (B)(3) Metallic Components
- (B)(4) Underwater Lighting – forming shells
- (B)(5) Metal fittings attached to or within pool
- (B)(6) Electrical Equipment associated with circulating system
- (B)(7) Fixed metal parts within 5' of pool (fences, piping, etc)



•Perimeter reinforcing rod
680.26(B)(2)(a)



Transformer Installation

70. **Is an above grid return air plenum considered a hollow space for the installation of a transformer smaller than 50 kVA?**

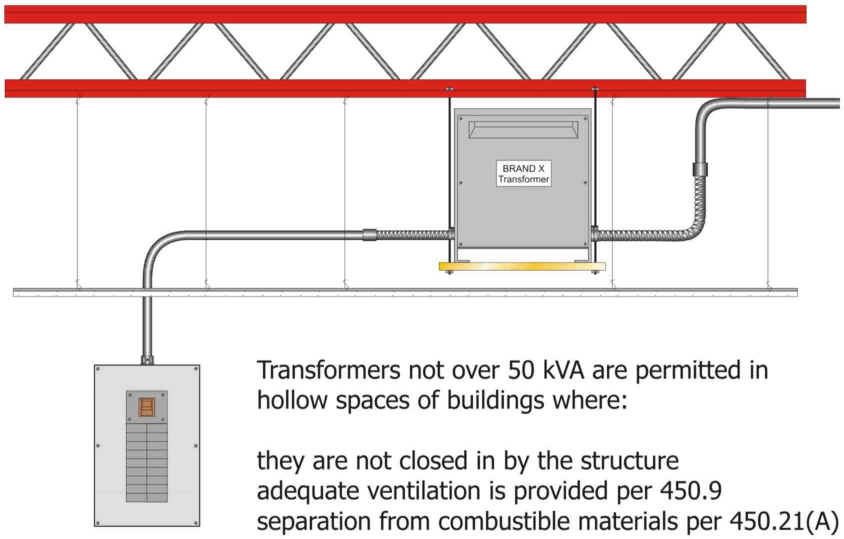
Reference: *NEC* 450.13(B), 300.22(C)(3)

Answer: **Yes**, the area above a grid lay-in ceiling is a hollow space for this type transformer installation.

If this space is being used as an environmental air space (return air plenum), the transformer would need to be in a metal enclosure and suitable for the ambient air temperature within the space *[see 300.22(C)(3)]*.

This space would need to be fire resistant, ventilated, and accessible.

450.13(B) Hollow Space Installations



Transformers not over 50 kVA are permitted in hollow spaces of buildings where:

they are not closed in by the structure
adequate ventilation is provided per 450.9
separation from combustible materials per 450.21(A)

Solar Panel Clips/Listing Requirements

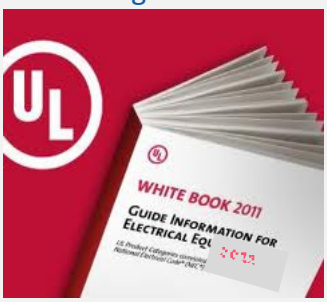
Question Number 71

Is it required to have a listing for Solar Panel on clips and supports of the Solar Panels?

NEC Section 110.3(B)

Listed or labeled equipment shall be installed and used in accordance with any instructions included in the listing or labeling.

USE AND INSTALLATION
PHOTOVOLTAIC MODULES AND PANELS (QIGU)
located on Page 325
MOUNTING SYSTEMS, MOUNTING DEVICES,
CLAMPING DEVICES AND GROUNDING LUGS FOR USE
WITH PHOTOVOLTAIC MODULES AND PANELS
(QIME), located on page 329



Answer

Are clips required to be listed.

Yes. While not specifically required by the NEC. Section 690.4(D) requires PV modules, PV panels and several other types of PV equipment to be identified and Listed for the application. However, each PV modules or panel will detail what hardware to use to install and ground their modules or panels. UL Lists mounting hardware as well as grounding connectors for specific Listed PV module systems under the product category (QIMS). Section 1609 of the IBC addresses wind load calculation including wind tunnels.

Reference: 110.3(B)

- 72. What type of metal halide lamp is required in open type luminaires?

Reference: 410.10 (E)

Answer: Must protect the lamp from breakage so that glass shards are not falling on players/coaches/spectators

(E) Luminaires in Indoor Sports, Mixed-Use, and All-Purpose Facilities. Luminaires subject to physical damage, using a mercury vapor or metal halide lamp, installed in playing and spectator seating areas of indoor sports, mixed-use, or all-purpose facilities shall be of the type that protects the lamp with a glass or plastic lens. Such luminaires shall be permitted to have an additional guard.

- 72. What type of metal halide lamp is required in open type luminaires?

Reference: 410.130 (F)(5)

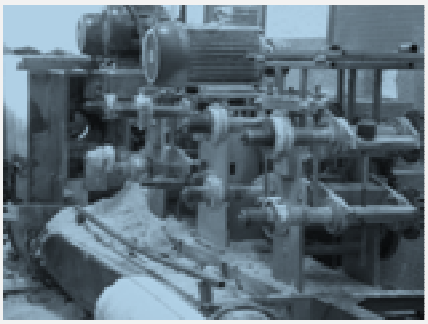
Answer: Must either use Type O or Type S lamp or enclose the lamp so that it is not a fire hazard if physical damage occurs to arc tube.

(5) Metal Halide Lamp Containment. Luminaires that use a metal halide lamp other than a thick-glass parabolic reflector lamp (PAR) shall be provided with a containment barrier that encloses the lamp, or shall be provided with a physical means that only allows the use of a lamp that is Type O.

Informational Note: See ANSI Standard C78.389, *American National Standard for Electric Lamps — High Intensity Discharge, Methods of Measuring Characteristics.*

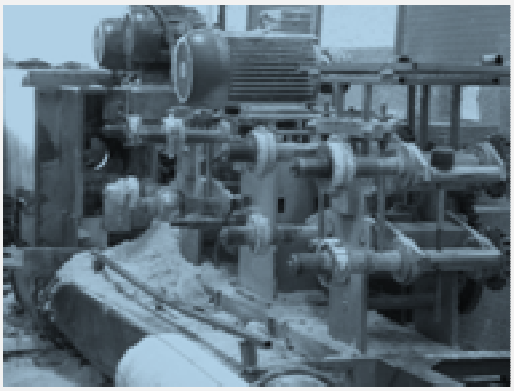
Question Number 73

In a local hardwood mill, some of the dust is too fine to be handled by the dust collector system. Should these areas also meet the requirements for Class II combustible dust?



Answer Number 73

Yeah, sure. The NEC specifies types of electrical wiring and equipment, but does not classify the area.



500.1 Scope

… the requirements for electrical and electronic equipment and wiring in locations where fire or explosion hazards may exist due to flammable gases, flammable liquid–produced vapors, combustible liquid–produced vapors, combustible dusts, or ignitable fibers/flyings.

Preventative Maintenance

Never allow dust deposits on surfaces to exceed a thickness of 1/16."

Dust should be removed with vacuum cleaners approved for use

Compressed air should not be used to blow dust off of surfaces.

Auxiliary Grounding Electrode

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

Reference: NEC 250.54

Answer: Yes. The grounding electrode installed at the parking light pole is considered an Auxiliary Grounding Electrode which is covered in 250.54. This grounding electrode supplements the equipment grounding conductor and is not required to be become a part of the grounding electrode system.

Question #75

Is the room side of a kitchen Island counter, to be considered wall space, i.e. when there is a kitchen nook that is part of the same area and the counter back side is facing the nook?

Terminating Fine Stranded Conductors

76. NEC 110.14 requires connectors and terminals for conductors more finely stranded than Class B and Class C stranding to be identified for the specific class or classes. Is such identification uniform among all manufacturers and can you provide examples of the identification?

Reference: NEC 110.14 Termination requirements.
NEC 690.31(F)Connectors used for fine strandeded cables.
NEC 690.74(A) Battery interconnection flexible cables.
UL White Book category ZMVV.

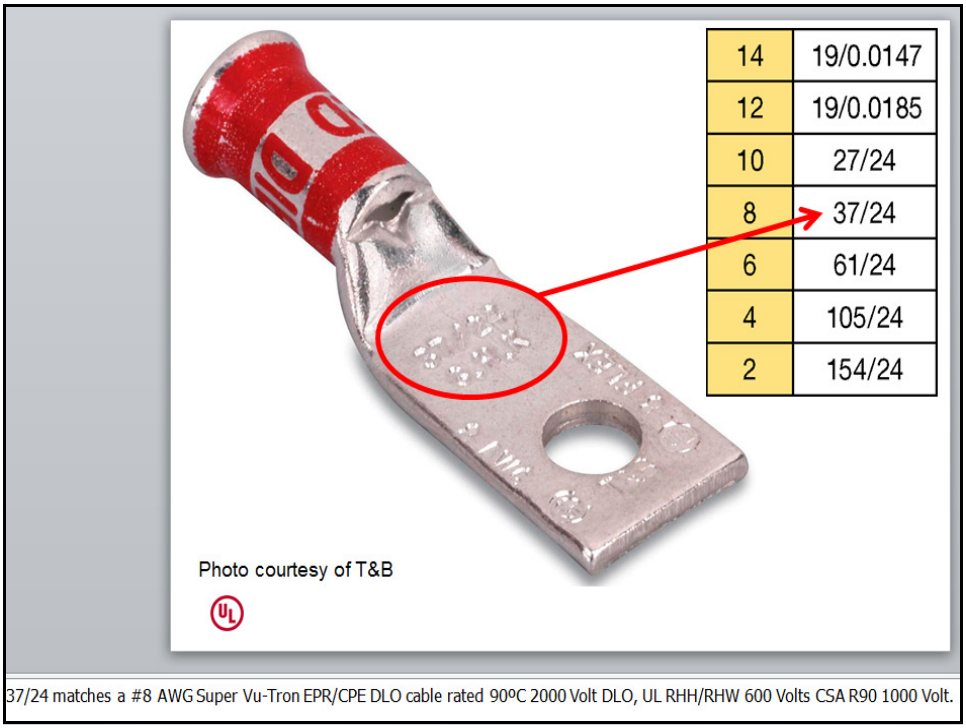
Answer: NO. Checking the connector markings, on the shipping container, the instruction sheets for this information is the best option.

•Example of terminals not listed for fine stranded conductors

Failed terminal lug and conductor

Failed termination

Photo Credits: John Wiles



37/24 matches a #8 AWG Super Vu-Tron EPR/CPE DLO cable rated 90ºC 2000 Volt DLO, UL RHH/RHW 600 Volts CSA R90 1000 Volt.

Terminating Fine Stranded Conductors

1 Manufacturers example of lugs listed for fine stranded conductors

- **Features and Benefits**
- • High SCCR rated, UL Listed Class CC holder with
- indicator option for 600Vac/dc
- • UL Recognized midget and 10 x 38 holders
- • Terminals rated for use with 75ºC or 90ºC wire, fine stranded wire, spade terminals and comb-bus bars. Use any higher temperature rated wire with appropriate derating
- • Complete range of UL Listed and high SCCR rated
- 1- and 3-phase finger-safe comb-bus bars and power feed lugs

Terminating Fine Stranded Conductors – cont'd

- UL 486 states that "A connector, a unit container, or an information sheet packed in the unit container for a connector tested with conductors other than Class B, SIW, or Class C stranding shall also be marked with the conductor class or classes and the number of strands."
- Fine Stranded wire is commonly used in: Photovoltaic systems, Medical Equipment, Wind turbine systems, UPS systems and other systems.
- More information available @ IAEI website on PV Articles by John Wiles and from www.nema.org

Spare Ungrounded Conductor at Ceiling Box

77. **If a spare ungrounded conductor is installed from switch locations in dwelling units to ceiling mounted outlet boxes, but not connected to a switch, would the ceiling mounted outlet box be required to be suitable for fan support?**

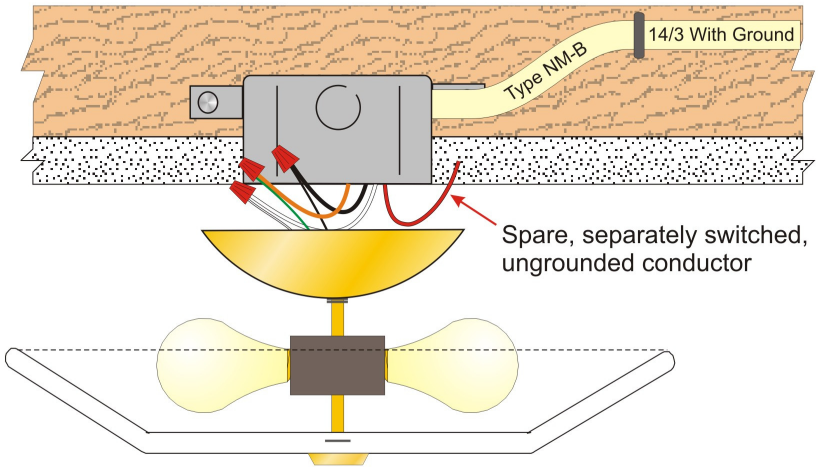
Reference: *NEC* 314.27(C)

Answer: **Yes**. This ceiling-mounted outlet box or outlet box system would be required to be listed for sole support of a ceiling-suspended (paddle) fan.

This was a new requirement added to the 2011 *NEC*.

314.27(C) Boxes at Ceiling Fan Outlets

At single or multi-family dwellings, spare, separately switched, ungrounded conductors at ceiling-mounted outlet boxes (in a location acceptable for a ceiling fan) require outlet box or system listed for sole support of a ceiling-suspended (paddle) fan



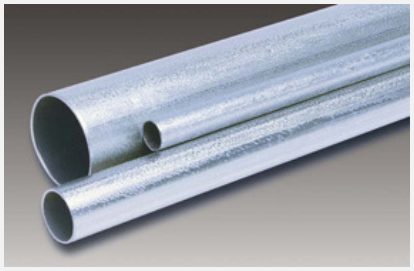
Conduit Fill Requirements

Question Number 78

Can I install 5 # 6 AWG, THHN conductors in a three quarter inch diameter EMT or do I have to use 1- inch diameter?

NEC 358.20 Number of Conductors

- The number of conductors shall not exceed that permitted by the percentage fill specified in Table 1, Chapter 9.
- Cables shall be permitted to be installed where such use is not prohibited by the respective cable articles. The number of cables shall not exceed the allowable percentage fill specified in Table 1, Chapter 9.



Answer:

Can I install five 6 AWG conductors in the 3/4 inch EMT?

No. 1 inch EMT is required. The conductors would exceed the maximum fill allowance for ¾ inch EMT. Since all conductors are of the same size and type Table C1 could be referenced which limits the installation to 4 THHN conductors. An additional method would be to calculate the fill by applying Tables 4 and 5 of Chapter 9. See the calculation below.

Table 5	#6 AWG THHN = .0507 in² X 5 = .285 in²
Table 4	¾" EMT 40% fill = .213 in²

Reference: NEC 358.20, Chapter 9 Tables & Annex C

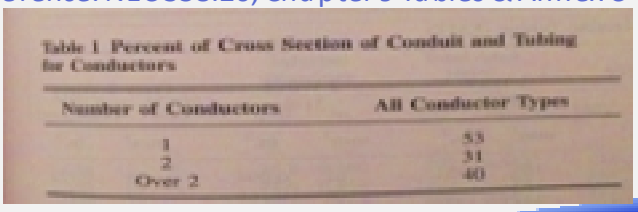


Table 1 Percent of Cross Section of Conduit and Tubing for Conductors

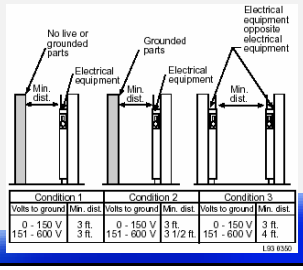
Number of Conductors	All Conductor Types
1	53
2	31
Over 2	40

79. We installed a 1200 Ampere, 480 Volt panel with a front workspace of 3 ½ feet to a concrete wall. The inspector says we need 7 feet of workspace. Is she correct?

Reference:

- Table 110.26(A)(1) Condition 2 calls for a 3.5' working space.
- 110.26(C)(2) calls for a door at each end of the working space for equipment rated 1200 amperes or more, but it also allows for a single entrance when the depth of the working space is doubled.

Answer: The inspector is always right. Likely scenario is that there was only one door to the working space. This would be permissible if the working space were doubled to 7'. Choice seems to be to either move the concrete wall or install another door.



Condition 1		Condition 2		Condition 3	
Volts to ground	Min. dist.	Volts to ground	Min. dist.	Volts to ground	Min. dist.
0 - 150 V	3 ft.	0 - 150 V	3 ft.	0 - 150 V	3 ft.
151 - 600 V	3 ft.	151 - 600 V	3 1/2 ft.	151 - 600 V	4 ft.

L93 8350

Question Number 80

When calculating the load at an RV park that contains a 50, 30 and 20 at each pedestal, do I calculate each at 9600 or can I use the ratio of 20% are 50's and 70% are 30's and the last 10% are 20s?

Answer Number 80

When calculating the load at an RV park that contains a 50, 30 and 20 at each pedestal, do I calculate each at 9600 or can I use the ratio of 20% are 50's and 70% are 30's and the last 10% are 20s?

551.71 Type Receptacles Provided

Every RV site = at least one 20-amp, 125-volt

20% = 50-ampere, 125/250-volt receptacle

70% = 30-ampere, 125-volt receptacle

10% = (remainder) 1 or more of the above

551.73(A) Basis for Calculations

Electrical services and feeders:

- 9600 VA per 50-ampere
- 3600 VA per 20-amp and 30-amp
- 2400 VA per 20-ampere (only)
- 600 VA per 20-ampere only [tents]

551.73(A) Calculated Load

Where the electrical supply for a recreational vehicle site has more than one receptacle, the calculated load shall be calculated only for the highest rated receptacle.

551.73 Calculated Load

The demand factors set forth in Table 551.73(A) shall be the minimum allowable demand factors that shall be permitted in calculating load for service and feeders.

Table 551.53(A) Demand factor for Sites Feeders and Service-Entrance Conductors for Parks Sites

Number of RV Sites	Demand Factor %
1	100
2	90
3	80
4	75
5	65
6	60
7 - 9	55
10 – 12	50
13 – 15	48
16 – 18	47
19 - 21	45
22 – 24	43
25 – 35	42
36 plus	41

Expansion Fittings

81. Are expansion fittings required where a conduit emerges from the ground and runs up a wall to a junction box? For arguments sake, the expansion will exceed ¼ inch. Is the earth considered a "securely mounted item"?

Reference: NEC 300.5(J), 300.7(B), 300.7(B) , 314.23(E) and (F).

Answer: Note that the NEC treats differently the expansion due to earth movement in 300.5(J) and from temperature changes in 300.7(B). The installation must compensate for the applicable condition.

- See the Information Note following 300.7(B) for information on expansion fittings. Appropriate fitting(s) must be installed for the type of conduit that is installed.

Expansion Fittings

81. Are expansion fittings required where a conduit emerges from the ground and runs up a wall to a junction box? For arguments sake, the expansion will exceed ¼ inch. Is the earth considered a "securely mounted item"?

Answer: (Continued)

Except for floating objects, the earth ultimately supports all electrical equipment. See NEC 314.23(E) and (F).

Question #82

Is the room side of a kitchen Island counter, to be considered wall space, i.e. when there is a kitchen nook that is part of the same area and the counter back side is facing the nook?

Motor thermal protection

- 83. A motor nameplate does not state "thermally protected", but has a winding embedded motor thermostat. Can you consider that this thermostat provides the thermal protection for the motor?

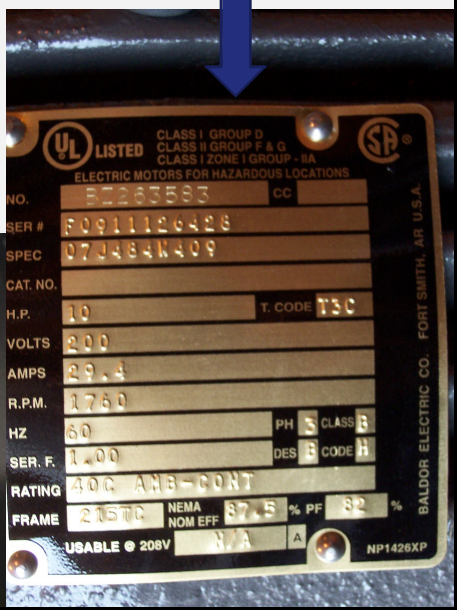
Reference: 430.32(A)(3)

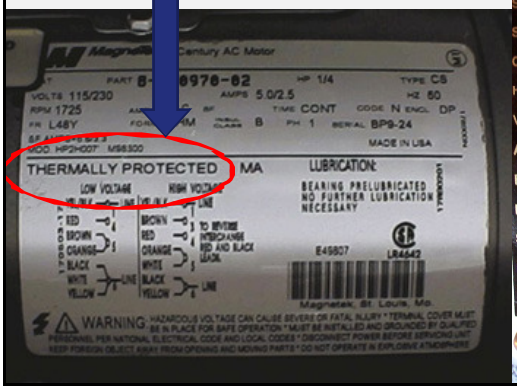
Answer: Yes, if the thermostat within the motor is connected to a control device which disconnects power to the motor.

Both the thermally protected motor and a motor equipped with a thermostat sense the heat within the motor and disconnect power to the motor in some manner.

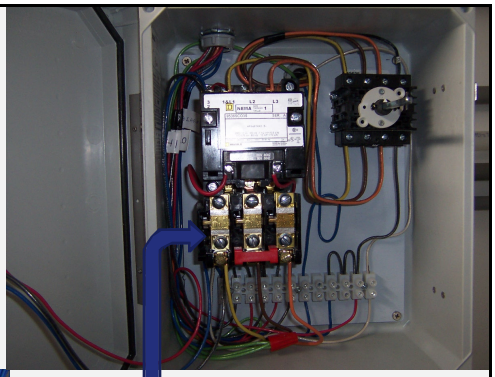
No thermal protection provided within motor

Example of a thermally protected motor

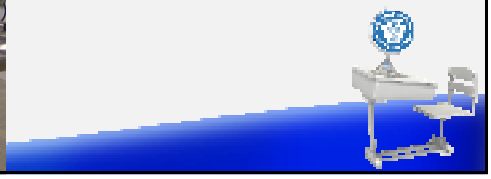




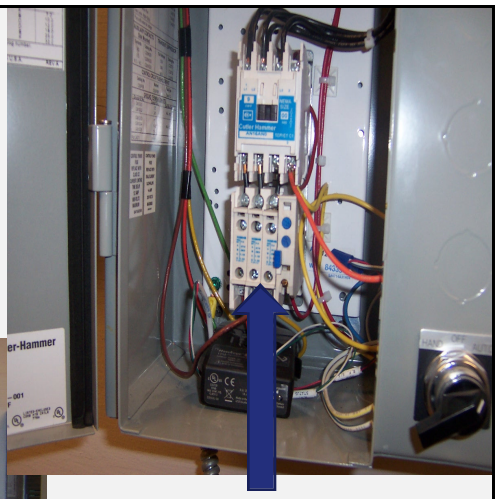
Adjustable speed drive electronic overload protection



Overload relays/heaters



Motor disconnect starter with solid state overload device



Close up view

Motor thermal protection – cont'd

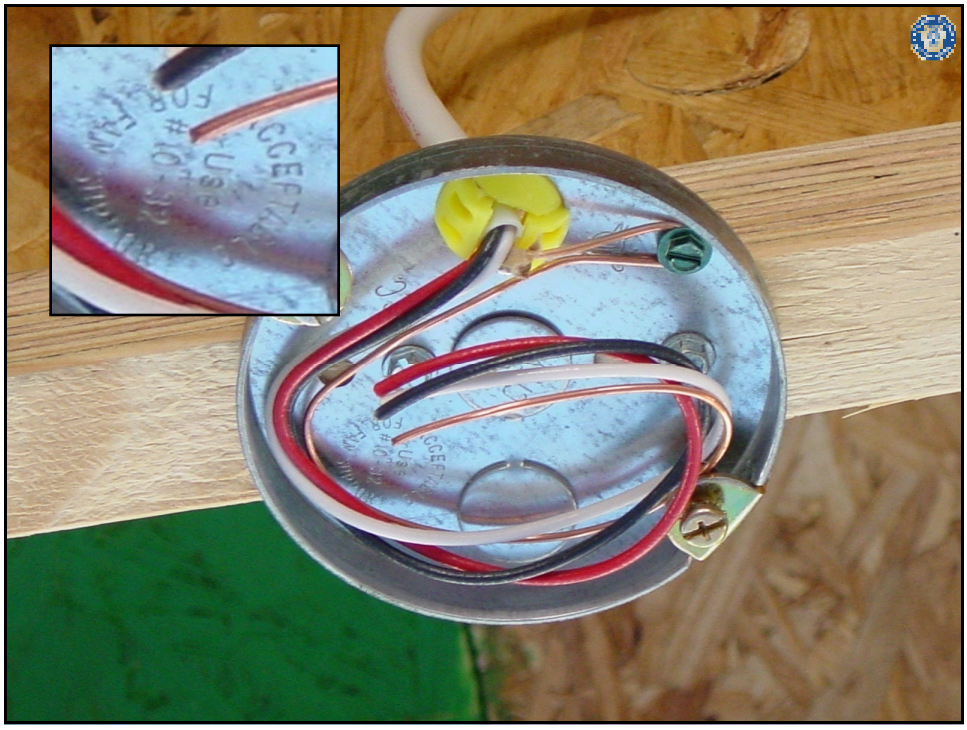
- A thermostat differs from a thermal protector in that a thermostat will only relay a temperature, but won't take any direct action. A control device, such as an Adjustable Speed Drive unit must create the action in order to remove the power from the motor.
- A thermal protector, similar to an overload heater/relay will open and remove the power from the motor so that it won't run until the desired temperature is once again reached thru the cooling process of the overload heater.

Ceiling Outlet Boxes

84. ***NEC* 314.27(A)(2) seems to require all ceiling boxes used to support luminaires be able to support a minimum of 50 pounds. Are all round and octagon outlet boxes, including ½-inch pancake boxes, evaluated to support 50 pounds?**

Reference: *NEC* 314.27(A)(2)

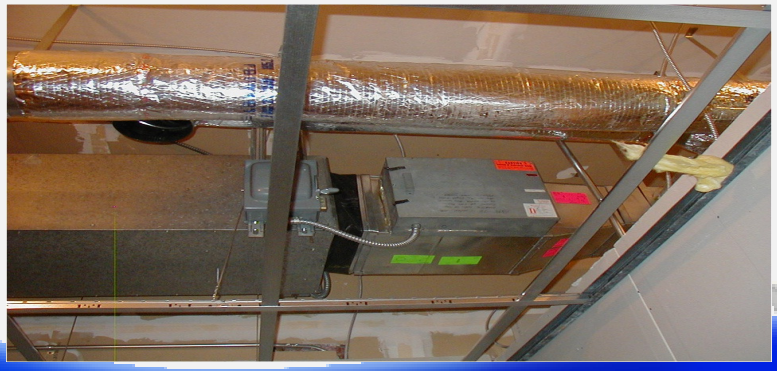
Answer: **No**, not all boxes are evaluated for up to 50 lbs, only the ones marked in accordance with the applicable UL Product Category. "QCIT" for metal boxes and "QCMZ" for non-metallic boxes.



Communication Cables/Fabricated Air Ducts

Question Number 85

Are there any communications cables designed for use in ducts specifically fabricated for environmental air as identified in 300.22(B) and would these cable, if any, be allowed for any wiring application?



NEC 800.113 Installation of Communications Wires, Cables and Raceways

Installation of communications wires, cables, and raceways shall comply with 800.113(A) through (L). Installation of raceways shall also comply with 800.110.

(B) Fabricated Ducts Used for Environmental Air. The following wires and cables shall be permitted in ducts used for environmental air as described in 300.22(B) if they are directly associated with the air distribution system:

(1) Up to 1.22 m (4 ft.) of Type CMP cable

(2) Types CMP, CMR, CMG, CM, and CMX cables and communications wires installed in raceways that are installed in compliance with 300.22(B).

NEC 110.3(B) Installation and Use

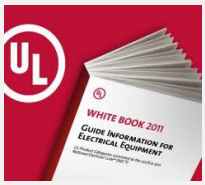
Listed or labeled equipment shall be installed and used in accordance with any instructions included in the listing or labeling.

Answer

Yes. Communication cables are permitted to be installed in ducts specifically fabricated for environmental air provided they are of the types of listed in and meet the requirements of Section 800.113(B).

No. Communication cables are listed under the category DUZX (Communications Cable). This listing is specific only for use as described in Article 800. Use of these cables in other than communications as described in there listing would not be permitted.

Reference: 800.113(B) and 110.3(B).



86. The installation has a 75 KVA dry-type transformer. Can this transformer be loaded to its full rating (75 KVA) or is it limited to 80% maximum load?

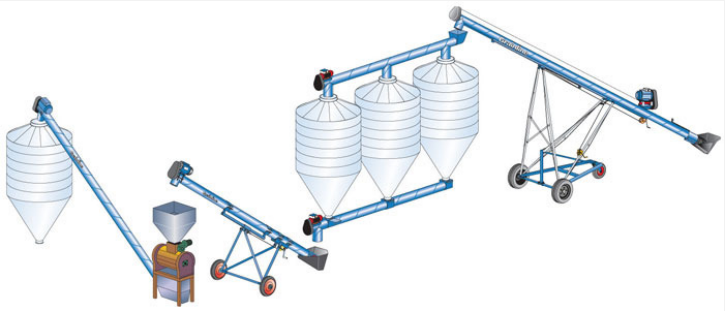
Reference:

- Article 450-There are no requirements in Article 450 about the loading of transformers
- TRANSFORMERS, DISTRIBUTION, LIQUID-FILLED TYPE, OVER 600 VOLTS (XPLH) has no requirements
- TRANSFORMERS, GENERAL PURPOSE (XPTQ) has no requirements
- POWER AND GENERAL-PURPOSE TRANSFORMERS, DRY TYPE (XQNX) has no requirements
- UL 1561 (Dry type, General Purpose, and Power Transformers) has no limits on loading

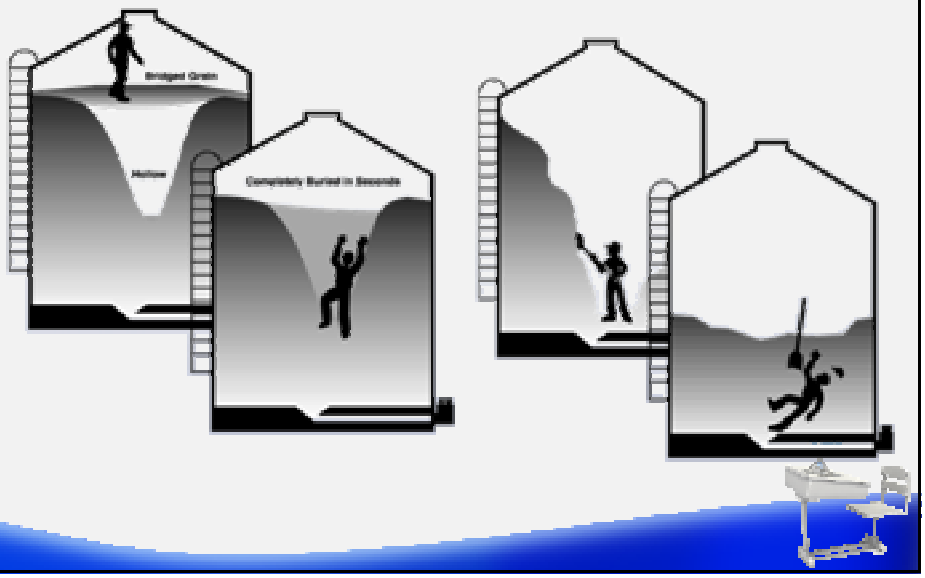
Answer: There are no limitations in the NEC or in UL for transformer loading. Therefore, transformers can be fully loaded.

Question Number 87

An owner says he has to remove the takeout auger if the bin plugs up with hard grain. Is it permitted to wire the motor with Type SO cord?



Stay Out of Grain Bins



Answer Number 87

Maybe.

If the auger is portable, then Type SO cord is appropriate

[unless it is a PTO]

Answer Number 87

Maybe. If the auger is permanently installed, then Type SO cord is not appropriate

400.7 Uses Permitted.

(1) Pendants
(2) Wiring of luminaires
(3) Connection of portable luminaires, portable and mobile signs, or appliances
(4) Elevator cables
(5) Wiring of cranes and hoists
(6) Connection of utilization equipment to facilitate frequent interchange
(7) Prevention of the transmission of noise or vibration
(8) Appliances where the fastening means and mechanical connections are specifically designed to permit ready removal for maintenance and repair, and the appliance is intended or identified for flexible cord connection
(9) Connection of moving parts
(10) Where specifically permitted elsewhere in this *Code*

400.8 Uses Not Permitted

(1) As a substitute for the fixed wiring of a structure
(2) Where run through holes in walls, structural ceilings, suspended ceilings, dropped ceilings, or floors
(3) Where run through doorways, windows, or similar openings
(4) Where attached to building surfaces
Exception to (4): Flexible cord and cable shall be permitted to be attached to building surfaces in accordance with the provisions of 368.56(B)
(5) Where concealed by walls, floors, or ceilings or located above suspended or dropped ceilings
(6) Where installed in raceways, except as otherwise permitted in this *Code*
(7) Where subject to physical damage

Sealtight Restrictions

88. Why is sealtight limited to 6ft outside the hot tub? Should it not be up to the inspector to determine if it is subject to physical damage?

Reference: NEC 680.42(A)(1) , 350.10 or 350.12, 356.12(3), 356.10(5)

Answer: It seems we see a "judgment call" on the part of the Code Panel as what wiring method will provide the protection needed for the supply conductors. See 680.42(A)(1) for the restriction on the length of LFMC or LFNC outside the spa or hot tub. (Continued)

Sealtight Restrictions

88. Why is sealtight limited to 6ft outside the hot tub? Should it not be up to the inspector to determine if it is subject to physical damage?

Answer: (Continued)

- Note there is no length restriction on the use of LFMC in 350.10 or 350.12.
- See 356.12(3) which does not permit LFNC to be used in lengths longer than 6 ft unless permitted by 356.10(5) or where a longer length is approved as essential for a required degree of flexibility. 680.42(A)(1) provides for this 6 ft length to provide the contemplated flexibility.

Question #89

What type of sealing compound can be used for the conduit seals at the boundaries of a Class 1 Division 2 location where they are not required to be explosion-proof?

Concrete encased electrodes

90. In a new structure where the rebar was covered before the electrician was on site, what would be some other options to provide a Ufer ground that would be acceptable?

Reference: 250.52(A)(3)

- Answer: *Install an additional concrete footing, possibly next to the existing footing with a minimum of 20' of ½" or larger reinforcing rod covered by a minimum of 2" of concrete, and use this as your "UFER" ground for this building.*
- *In larger buildings, there is also the option in some cases to connect to a reinforcing rod in a pad style footing which are many times poured after the perimeter footings are installed.*

•Concrete encased electrodes

250.52(A)(3)

- Metallic components shall be encased by at least 2 inches of concrete and shall be located horizontally within that portion of a concrete foundation or footing that is in direct contact with the earth or within vertical foundations or structural components or members that are in direct contact with the earth. If multiple concrete-encased electrodes are present at a building or structure, it shall be permissible to bond only one into the grounding electrode system.

•Concrete encased electrodes

250.52(A)(3)

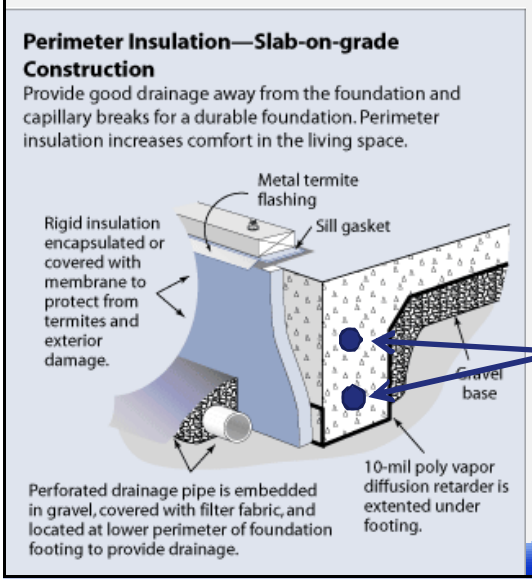
If footing was poured, but foundation was not completed, reinforcing rod could be installed in foundation wall.

Concrete encased electrodes

Concrete encased electrode within a foundation column. Reinforcing rod tied into footing rod also.

•Concrete encased electrodes

250.52(A)(3) New Informational Note in 2011 NEC



IN – "*Concrete installed with insulation, vapor barriers, films or similar items separating the concrete from the earth is not considered to be in "direct contact" with the earth".*

These concrete encased electrodes do not meet criteria set in 250.52(A)(3)