1. The installation consists of a breaker–breaker 480v series rated system and a industrial controller. The line side breakers are 65k, the downstream panel contains 14k aic breakers. The fault current at the downstream panel is 28,000 A. Next to the downstream panel attached by a close nipple is an industrial controller that was a field evaluated an issued a 14k short-circuit current rating (SCCR). The fault current is approximately 25,000 A at the line terminals of the controller. Is this controller protected and NEC compliant since it has the same rating as the breakers in the panel? If not what is a solution?

Reference: 2011/2014 NEC 240.86 – Series Ratings
in line current limiting fuses had to be installed
1b. **Answer:** No, the industrial controller is not protected and NEC compliant.

Series ratings only apply to equipment, not the circuit breaker or other OCPD. The downstream panelboard equipment series rating provides the necessary SCCR for the available fault current at this point in the system, 28,000 A. All equipment and devices downstream must have an SCCR which meets or exceeds the available fault current at the point on this system where connected. Series ratings don’t apply to industrial controllers.

**What can be done?** The product safety standard, UL 508A, has supplement Equipment Series Ratings SB which provides the determination of the industrial controller SCCR. Modifications to the industrial controller with current limiting breakers or fuses may permit the controller to have an SCCR which meets the 25,000 A available. Another field evaluation would be required to certify the new controller SCCR rating.
Set Screw EMT Connectors in Wet Locations

2. Is it permissible to install a 8” piece of ¾” emt with set screw connectors between the bottom of a panel (below live parts) and a 3r pull box installed outdoors?

Reference: NEC 334.15 and 110.3(B), 2013 UL White Book, Pg. 151, Electrical Metallic Tubing Fittings (FKAV)

Answer: No, See NEC 314.15, which states that in damp or wet locations, “Boxes, conduit bodies, outlet box hoods, and fittings installed in wet locations shall be listed for use in wet locations.” A set screw fitting would not be Listed as a suitable for wet locations or rain tight. See EMT Fittings (FKAV) in the 2013 UL White Book.
3. When the local traveling carnival comes to town they have a couple of distribution panels located throughout the carnival site. From these distribution panels a feeder ranging from a 60a 3 pole to a 20a 2 pole pole are ran to each ride controller. These controllers then supply the rides that typically have motors & lights. Is it required to install an electrode at each controller?

Reference: Article 525 525.3(A) Where other Articles differ 525 applies, 525.30 7 525.31

Answer: No, this article seems to depend on the EGC and bonding. It clearly states the GEC is at the service or separately derived system.
Listed Equipment Questions

4) When the AHJ does his inspection and notices 1 or multiple violations in a listed piece of equipment. Does the AHJ have a duty or even the right to contact the testing laboratory to discuss the “violation”?

Reference: NEC 110.2 and 90.7

Answer: The listing process depends on the AHJ as a final line to ensure products meet the requirements of the product safety standards and are constructed correctly in accordance with the listing. If the AHJ observes what he believes to be improper construction on a listed product then he should definitely contact the listing agency to get resolved. This can be done informally with a call to Regulatory Services for UL Listed products or submitting a Product Incident Report to the listing agency for more formal investigation.
4) (Cont.)
AHJ’s need to remember products are tested and listed to product safety standards so they can be installed to the NEC. What part of 90.7 states is:

.....It is the intent of this *Code* that factory-installed internal wiring or the construction of equipment need not be inspected at the time of installation of the equipment, except to detect alterations or damage, if the equipment has been listed by a qualified electrical testing laboratory that is recognized as having the facilities described in the preceding paragraph and that requires suitability for installation in accordance with this *Code*.

So caution is needed if the apparent violation is because of NEC prescriptive requirements or truly due to improper construction.
5. Does a UPS require a disconnecting means ahead of it and within sight?

Is the UPS considered an appliance for installation guidelines?
Standby Power System:

5a. an independent reserve source of electric energy that, upon failure or outage of the normal source, provides electric power of acceptable quality so that the user’s facilities may continue in satisfactory operation.

NFPA 110 Emergency Power System Types Table 10-1

<table>
<thead>
<tr>
<th>Type</th>
<th>Power restoration time</th>
</tr>
</thead>
<tbody>
<tr>
<td>U</td>
<td>Basically Uninterruptible (UPS Systems)</td>
</tr>
<tr>
<td>10</td>
<td>10 sec</td>
</tr>
<tr>
<td>60</td>
<td>60 sec</td>
</tr>
<tr>
<td>120</td>
<td>120 sec</td>
</tr>
<tr>
<td>M</td>
<td>Manual stationary or nonautomatic – no time limit</td>
</tr>
</tbody>
</table>
422 Appliances

5b. 422.2 Definition

Vending Machine. Any self-service device that dispenses products or merchandise without the necessity of replenishing the device between each vending operation and is designed to require insertion of coin, paper currency, token, card, key, or receipt of payment by other means.

Dictionary.com

Appliance: an instrument, apparatus, or device for a particular purpose or use.
Battery Systems
480.6(A) DC Disconnect Methods

5c. A disconnecting means shall be provided for all ungrounded conductors derived from a stationary battery system with a nominal voltage over 50 volts.

A disconnecting means shall be readily accessible and located within sight of the battery system.
5d. **422.30** A means shall be provided to simultaneously disconnect each appliance from all ungrounded conductors...

![Front](image1.jpg) ![Back](image2.jpg)

422.33 For cord-and-plug-connected appliances... an accessible plug and receptacle shall be permitted to serve as the disconnecting means.
5e. a) Does a UPS require a disconnecting means ahead of it and within sight?

**Answer: No.** I found nothing in the NEC or other NFPA documents specifically requiring a disconnecting means for the line side of a UPS.

5(b) Is the UPS considered a appliance for installation guidelines?

**Answer: Maybe.** Cord-and-plug connected units could be considered appliances and would inherently meet the disconnecting means requirements of 422.
Feeder or Branch Circuit

• 6. Are the conductors between a 30 amp breaker and a 30 amp fused disconnect feeding a single air condition unit defined as a feeder or a branch circuit? Would the answer change if the fuses in the 30a disconnect are reduced to 20 amps to meet the name plate rating of the equipment?

Reference:
NEC 100

Branch Circuit-The circuit conductors between the final overcurrent device protecting the circuit and the outlet(s).

Feeder-All circuit conductors between the service equipment, the source of a separately derived system, or other power supply source and the final branch-circuit overcurrent device.
Magic, if I install a fused disconnect ahead of a piece of equipment for whatever reason, I now change a branch circuit to a feeder. Does that mean I can now do any feeder tap I want? :-(}
6a. Are the conductors between a 30 amp breaker and a 30 amp fused disconnect feeding a single air condition unit defined as a feeder or a branch circuit? Would the answer change if the fuses in the 30a disconnect are reduced to 20 amps to meet the name plate rating of the equipment?

Answer (1):
If the nameplate on the HVAC unit showed a maximum 30 ampere overcurrent device, the circuit from the 30 ampere CB in the panelboard all the way to the HVCA unit would be the branch circuit and the 30 ampere fuse would be providing additional or supplementary protection.
• 6b. Are the conductors between a 30 amp breaker and a 30 amp fused disconnect feeding a single air condition unit defined as a feeder or a branch circuit? Would the answer change if the fuses in the 30a disconnect are reduced to 20 amps to meet the name plate rating of the equipment?

Answer (2):

If the nameplate on the HVAC unit showed a maximum 20 ampere overcurrent device, the circuit from the 30 ampere CB in the panelboard to the switch at the HVCA unit would be the feeder circuit and the circuit from the 20 ampere fused switch to the HVAC equipment would be the branch circuit.
7. We have a Eaton panel that does not recognize a 208v three pole breaker to be series rated with a type (J) fuse. Could we install three single pole breakers, use a listed 3 pole tie handle to achieve the series rating?

Reference: 2011/2014 NEC 240.86 – Series Ratings

Answer: Series ratings must be achieved using one of the methods provided in NEC 240.86 along with the equipment product standard. A handle tie provides a means of common disconnect for multiwire circuits and the NEC restricts the use to line to neutral connected loads unless they supply single utilization equipment.
7A. Answer: NEC 240.86 Methods

- Engineered
  - Documentation provided and stamped by PE
  - Design must ensure that the downstream circuit breaker(s) that are part of the series combination remain passive during the interruption period. Field marking of equipment required.

- Tested
  - Equipment manufacturer’s recommended method
  - Supported by the equipment product standard
  - Marking included on the product covering the series rating requirements

- Motor Contribution
  - Prohibits use of either method where motors are connected between the series combination and the sum of motor FLA exceed 1% of the lower device interrupting rating.
Deck Boxes in Walls?

8. Can a listed deck box for pool lights be located in a wall with an access cover for aesthetic reasons?

Reference: NEC 314.20 and 314.29 and 680.24 110.3(B)

Answer: No, See 314.20 that requires for boxes in walls or ceilings that the front edge of the box will not be set back more than ¼ in. from the surface. If this had an access cover over it would be set back more than ¼ in. from the face of the wall. NEC 314.29, shall be accessible without removing any part of the building or structure.
24v card readers

9. We have a 6 story building with about 20 low volt cabinets installed in 10 different. Is required to ground or bond every low voltage cabinet that contains low volt cables for these card readers?

Reference: NEC 725.133 must comply w. 725.135 and 143. Grounding is not covered 250.3, 250.112(I) and 250.20(A).

Answer: Yes if supplied by a Transformer if the supply system exceeds 150V.
10) Health care facilities, for medical equipment such as a x-ray machine or a CT scan. At what point does the AHJ stop his inspection and depend on the listing of the equipment? Typically, there is a NEC required disconnect with THHN to the line terminals. From the load side of that disconnect there is typically a wire-way that is designed by the manufacturer but installed by the contractor. From the wire-way, the cables will leave go to 1 or more pieces of equipment, go back to the wire-way and ultimately feed the CT or large x-ray machine. From the load side of the disconnect, I normally witness multiple NEC violations such as wire bending radius issues and loss of redundant grounding.

Reference: NEC 90.7, 517.13
10) Answer: The medical equipment will be provided with drawings and installation instructions, especially for larger equipment. These drawings and installation instructions provide the demarcation of the field wiring and the assembly of the manufactured and listed equipment.

As part of the listing process, the effectiveness of the equipment grounding, performance, suitability of the internal wiring (including interconnecting wiring) insulation are all part of the evaluation that takes place.

There is not a requirement for having both a raceway and insulated conductor within the listed equipment assembly. Other NEC requirements may not be used where testing by the standard deals with the hazards.
10) (cont.) As explained in question 4, unless the AHJ sees some issue of non-compliance to the product standard, acceptance of the listing should cover all the product covered by that listing and his inspection can stop at the point of connecting the supply or other field wiring to the listed equipment in accordance with the installation instructions.
Health care facilities, for medical equipment such as an x-ray machine or a CT scan. At what point does the AHJ stop his inspection and depend on the listing of the equipment? Typically, there is a NEC required disconnect with THHN to the line terminals. From the load side of that disconnect there is typically a wire-way that is designed by the manufacturer but installed by the contractor. From the wire-way, the cables will leave go to 1 or more pieces of equipment, go back to the wire-way and ultimately feed the CT or large x-ray machine. From the load side of the disconnect, I normally witness multiple NEC violations such as wire bending radius issues and loss of redundant grounding.

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10) (cont.) As explained in question 4, unless the AHJ sees some issue of non-compliance to the product standard, acceptance of the listing should cover all the product covered by that listing and his inspection can stop at the point of connecting the supply or other field wiring to the listed equipment in accordance with the installation instructions.
11. Is the wiring method of an eye glass exam room required to comply with 517.13?
517 Part II. Wiring and Protection

11b. 517.10 (A) Applicability. Part II shall apply to patient care space of all health care facilities.

517.2 Health Care Facilities. Buildings or portions of buildings in which medical, dental, psychiatric, nursing, obstetrical, or surgical care are provided.
II. Wiring and Protection

11c. 517.13 Grounding of Receptacles and Fixed Electrical Equipment in Patient Care Areas.

(A) Wiring Methods. All branch circuits serving patient care areas shall be provided with an effective ground-fault current path by installation in a metal raceway system, or a cable having a metallic armor or sheath assembly.

The metal raceway system, or metallic cable armor, or sheath assembly shall itself qualify as an equipment grounding conductor in accordance with 250.118.
11d. Is the wiring method of an eye glass exam room required to comply with 517.13?

**ANSWER:** Yes. An eye clinic meets the definition of a health care facility and must comply with 517.13.

**Reference:** 517.2 and 517.10(A)
Feeder or Branch Circuit

- **12.** Are the PV output conductors that are connected on the supply side of a service disconnect as permitted in 705.12 (A), considered service conductors when they don’t meet the definition of a service.

Reference:

NEC 100

Service-The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

Feeder-All circuit conductors between the service equipment, the source of a separately derived system, or other power supply source and the final branch-circuit overcurrent device.
Feeder or Branch Circuit

• **12a.** Are the PV output conductors that are connected on the supply side of a service disconnect as permitted in 705.12 (A), considered service conductors when they don’t meet the definition of a service.

**Answer**

Since the PV output conductors are not supplied by the utility, they cannot be called service conductors. They are therefore considered feeder conductors.
**Equipment Ground Fault Protection**

13. Does a 480-volt, 1600-amp frame breaker with an 800-amp trip plug installed require GFCI protection?

**Reference:**
- 2011 NEC 215.10, 230.95, 240.13

**Answer:** No to GFCI but generally yes for GFPE.

Ground fault protection of Equipment (GFPE) is required for:

- Solidly grounded systems
- Greater than 150 V to ground and less than 1000 V phase to phase
- OCPD rated 1000 A or more
- Rating of the OCPD is considered the largest fuse that can be installed or the highest continuous current setting that a breaker can be adjusted to.

Continued …
However one must pay close attention to the terms used. Breaker trip unit plugs are adjustable with **the maximum setting being 1.0 x the breaker rating**. The NEC GFPE requirement applies to devices that can be adjusted or set to a value which meets the minimum requirements. Use of the term “frame” can create confusion as many manufacturers use the term to denote construction size limitations and this is not the same as the breaker rating for a particular breaker. The maximum setting on an 800 A rated breaker is 800 A regardless of the frame size since the highest adjustment on the trip unit plug is 1.0.
Reducing Washers

14. UL stands behind their reducing washers even when over 250v if they are installed by removing all rings in a concentric. If we have a installation that is 120v or 208v and use a reducing washer in a disconnect but do not remove all the rings is it now required to install a bonding bushing? Per UL

Reference: NEC 250.96, 110.3(B), UL White Book QCRV (Pg. 329)

Answer: Yes, NEC 250.96 requires the enclosure to be Bonded and remove the paint from the effected area. See Outlet Bushings and Fittings (QCRV) in the UL White Book that states:
Reducing Washers

**GROUNDING**

Metal reducing washers are considered suitable for grounding for use in circuits over and under 250 V and where installed in accordance with ANSI/NFPA 70, "National Electrical Code." Reducing washers are intended for use with metal enclosures having a minimum thickness of 0.053 in. for non-service conductors only. Reducing washers may be installed in enclosures provided with concentric or eccentric knockouts, only after all of the concentric and eccentric rings have been removed. However, those enclosures containing concentric and eccentric knockouts that have been certified for bonding purposes may be used with reducing washers without all knockouts being removed.
I recently installed a 300 ampere, 277/480 volt service located on a pole barn structure. As there is no concrete footing or foundation and there is no water supply to the building, I drove two 5/8" diameter, 8-foot long, copper-clad ground rods below the service equipment. I ran a single 6 AWG copper grounding electrode conductor to the closest ground rod, ran it unspliced through the approved ground clamp and then on to the second ground rod. The inspector required that I install an individual 6 AWG copper grounding electrode conductor from the service equipment to each ground rod. Of course to pass the inspection and get power turned on, I did what he asked. I recently attended an IAEI class on Soares Grounding and Bonding and feel that both methods would meet NEC requirements but that my initial installation should have been approved. Why does the State of Colorado not require that all electrical inspectors be IAEI members and that they have to attend classes to retain their inspector status?

Ans. 250.66(A) #6 Cu, 250.689A) exception 1
16) What is the minimum size grounding electrode conductor required to connect to a ground ring that has been increased in size from 2 AWG copper to 250 kcmil copper by the engineer, for an electrical service fed by six parallel runs of 500 kcmil copper?

Reference: 250.52(A)(4), 250.66(C)

250.52(A)(4) **Ground Ring.** A ground ring encircling the building or structure, in direct contact with the earth, consisting of at least 6.0 m (20 ft) of bare copper conductor not smaller than 2 AWG.
250.66(C) Connections to Ground Rings. Where the grounding electrode conductor is connected to a ground ring as permitted in 250.52(A)(4), that portion of the conductor that is the sole connection to the grounding electrode shall not be required to be larger than the conductor used for the ground ring.

Answer: 3/0 Copper
17. What size equipment bonding jumper is required to connect a 125-volt, 20-amp duplex receptacle located in the patient care area to the patient equipment grounding point of a critical care area located in a health care facility?

http://vam.anest.ufl.edu/simulations/ores.html
First, in a critical care area of a health care facility, an equipment bonding jumper is **not required** from a 125-volt, 20-amp duplex receptacle to the patient equipment grounding point.

517.2 Patient Equipment Grounding Point.

A jack or terminal that serves as the collection point for redundant grounding of electrical appliances serving a patient care vicinity or for grounding other items in order to eliminate electromagnetic interference problems. [99:3.3.140]
17b. 6.3.2.2.7.2 Patient Equipment Grounding Point. A patient equipment grounding point comprising one or more grounding terminals or jacks shall be permitted in an accessible location in the patient care vicinity.

6.3.2.2.7.3 Special Grounding in Patient Care Rooms. In addition to the grounding required to meet the performance requirements of 6.3.3.1, additional grounding shall be permitted where special circumstances so dictate.
17c. NEC 517.19(D) Patient Care Vicinity Grounding and Bonding (Optional)

A patient care vicinity shall be permitted to have a patient equipment grounding point.

An equipment bonding jumper not smaller than 10 AWG shall be used to connect the grounding terminal of all grounding-type receptacles to the patient equipment grounding point.
17d. The size and shape of the locking configuration is according to NFPA criteria. Designed in strict compliance with UL467 Grounding and Bonding Equipment

**Ground jacks are rated at 30A.**

The cord is a flexible #10 copper conductor encased in green neoprene insulation. Standard: 5, 8, 10, 12, 15, 20 and 25 feet
17. What size equipment bonding jumper is required to connect a 125-volt, 20-amp duplex receptacle located in the patient care area to the patient equipment grounding point of a critical care area located in a health care facility?

**ANSWER:** #10 AWG

**Reference:** 517.19(D)
Feeder or Branch Circuit

18. Our local Utility company requires a cold sequence installation with current limiting fuses when the fault current is above 10k to protect the meter. Since the meter is rated at only 10k, is it also permissible to protect the 10k rated breakers with those same fuses (Note: they do not series rate)

Reference
240.86

Answer
Series ratings are allowed two different ways, for existing systems and for new construction.
Feeder or Branch Circuit

- **18a.** Our local Utility company requires a cold sequence installation with current limiting fuses when the fault current is above 10k to protect the meter. Since the meter is rated at only 10k, is it also permissible to protect the 10k rated breakers with those same fuses? (Note: they do not series rate)

**Answer**

This doesn’t sound like it is an existing job, so we must meet 240.86 (B) for new installations. (B) requires the series rating to be tested and marked on the equipment. Doesn’t sound as though the series rating is marked on the equipment. Therefore, the 10kA CBs are not considered to be protected by the utility’s current limiting fuses.
19. Where is the disconnect for a Class 2 remote control transformer required to be located?

Reference: 2011/2014 NEC 725.127

Answer: The supply side wiring is installed using the requirements of Chapters 1 – 4 so the disconnect location will depend upon the installation. For example, 430.75 addresses motor control circuit disconnects. At a minimum, the disconnect would be installed at the origin of the branch circuit supplying the Class 2 power supply.
Cord Connected Water Heaters?

20. Is it permissible to connect a 240 volt 4500 watt water heater with a plug and cap?

Reference: NEC 10.3(B), 2013 UL White Book pg. 243 for KSDT

Answer: No. UL Lists water heaters under the product category Household Water Heaters, Storage Tank (KSDT) on page 243 in the 2013 UL White Book. The KSDT Guide Information states these are for permanent connection to a source of supply in accordance with the NEC.
These water heaters are evaluated for compliance with UL 174, the Standard for Safety for Household Electric Storage Tank Water Heaters. UL 174, only permits small capacity storage tank water heaters up to 5 gallons to be cord and plug connected, over 5 gallons they have to be hard wired. I doubt a 4.5kw water heater is 5 gallons or less.
Insulating Restrictions

21. A 400 amp service is installed using 500 kcmil copper conductors, based on table 250.66 a 1/0 copper conductor is required for the grounding electrode conductor. Is it permissible to install (2) #2 copper conductors instead of the 1/0? Assuming the installation meets all other requirements for the grounding electrode conductor.

Reference: NEC 250.66 and Table, 310.10(H) does not apply

Answer: No The Table gives you a size it does not say or equivalent
22) Is there any violation in reversing a standard 480v delta/208v wye step down transformer to a step up transformer?

Reference: 110.3(B), 2014 NEC 450.11(B)

2014 NEC 450.11(B) Source Marking. A transformer shall be permitted to be supplied at the marked secondary voltage, provided that the installation is in accordance with the manufacturer’s instructions.
Answer: Yes. The transformer is listed for stepping the voltage down from 480 Volts to 208Y/120 Volt and not for stepping up. There are constructional differences and also considerations for the inrush condition when a transformer is used to step up when designed and listed to step down. Transformers for stepping voltage up or where they can step or step down are specifically marked for that application.

One form of marking is to instead of “primary” and “secondary” to designate the windings as “High Voltage” and “Low Voltage”.
Reverse Feed (Back-feed), or Step-Up Operation

This step-down transformer may be reverse fed for step-up operation to increase voltage. This means that the incoming power is connected to the low voltage (X's) and the load is connected to the high voltage (H's). If the low voltage is wye, the X₉ terminal must NOT be connected in any way. Likewise, if the low voltage is a delta with a 120 volt lighting tap (high-leg), the X₄ terminal must NOT be connected in any way.

CAUTION: Much higher than normal inrush currents may occur with reverse feed operation and may cause nuisance fuse blowing or breaker tripping. For this reason, fuses and breakers with time-delay characteristics must be used.

If a breaker is used for incoming over-current protection, it must be a thermal-magnetic type breaker, not a time-delay type.
23. We have a free standing building that doubles as his consultation office and surgery center on an outpatient basis. He has a pre-op, post op and surgery room which does plastic surgery therefore patients are often under a general anesthesia. How do we treat these rooms?

In 2014 all surgery rooms in hospitals require 36 receptacles, they are all required to be GFCI or ungrounded. How does a jurisdiction address this in the plan review process?

This set up is becoming common.
3.3.138.2* **Critical Care Room.** Room in which failure of equipment or a system is likely to cause major injury or death of patients or caregivers.
517.19(C)(1) Operating Room Receptacles

23b. 1 Minimum Number and Supply. Each operating room shall be provided with a minimum of 36 receptacles, at least 12 of which shall be connected to either of the following:

(1) The normal system branch circuit required in 517.19(A)

(2) A critical branch circuit supplied by a different transfer switch than the other receptacles at the same location.
23(c) How do we treat these rooms?

**ANSWER:** The term “surgery room” is not defined, but the minimum 36 receptacles applies to an operating room only.

**Reference:** NEC 517.19(C)(1)

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23(b) How does a jurisdiction address this in the plan review process?

**ANSWER:** Pre-op and post op are not op.

**Reference:** NEC 517.19(C)(1)
• 24. We have multiple roof top exhaust fans that have starters controlling them. These starters are “hand auto off” type with heaters and fused in them. A common practice is to locate these controllers above the ceiling below the units that are on the roof. Is this location permissible

Reference:

430.102(A) Controller. An individual disconnecting means shall be provided for each controller and shall disconnect the controller. The disconnecting means shall be located in sight from the controller location.

430.102(B) Motor. A disconnecting means shall be provided for a motor in accordance with (B)(1) or (B)(2).

(1) Separate Motor Disconnect. A disconnecting means for the motor shall be located in sight from the motor location and the driven machinery location.

(2) Controller Disconnect. The controller disconnecting means required in accordance with 430.102(A) shall be permitted to serve as the disconnecting means for the motor if it is in sight from the motor location and the driven machinery location.
We have multiple roof top exhaust fans that have starters controlling them. These starters are “hand auto off” type with heaters and fused in them. A common practice is to locate these controllers above the ceiling below the units that are on the roof. Is this location permissible

Answer: The location for the controller is permissible, but it will not likely serve as the disconnecting means.

The “hand auto off” is most likely a “controller”, not a motor disconnect switch. If it is listed to UL 508, it is a motor controller, unless it is marked as suitable as a motor disconnect. As a motor controller, it needs a disconnecting means in sight. That disconnecting means will only meet the requirements of 430.102(B)(2), if it also is in sight from the motor and the driven machinery (fan). So, if the fan motor and fan blades are not accessible from under the ceiling, an additional disconnecting means would be required on top of the roof, to disconnect the fan motor.
Emergency Lighting

25. The industry is seeing inverters that feed multiple lights to obtain emergency lighting instead of individual frog eye or emergency ballasts. Is it required to treat the wiring method as required for generator emergency back up. IE... Identify all enclosures and keep wiring independent?

Reference: 2011/2014 NEC 700.10
2014 NEC 700.12(F)(5)

- Answer: Yes, the requirements of 700.10 apply to this installation.

700.12(F) Unit Equipment
(5) Emergency luminaires that obtain power from a unit equipment and are not part of the unit equipment shall be wired to the unit equipment as required by 700.10 and by one of the wiring methods of Chapter 3.
PV Racking as an ECG

26. 690.43(C) requires that the racking can be used as the equipment grounding conductor if it is identified as an EGC. What does this mean? What was the intent of that verbiage? Should it have a symbol located on the couplings, can the manufacturer write a letter stating it is identified as such. Can the inspector simply make a judgment call? The state of Co requires all equipment be listed by a National testing laboratory

Reference: NEC 690.43(C), Art. 100 Definition “Identified”, 2013 UL White Book pg. 343 (QIMS) or pg. 224 for (KDER)
PV Racking as an ECG

- **Article 100 Definitions**
- **Identified** (as applied to equipment).- Recognizable as suitable for the specific purpose, function, use, environment, application, and so forth, where described in a particular Code requirement. The INF note includes examples such as “investigations by a qualified testing laboratory (listing and labeling), an inspection agency, or other organizations concerned with product evaluation. So it sounds as if a manufacturers letter would not suffice, however up to the AHJ.

- **690.43(C) Structure as Equipment Grounding Conductor.** Devices listed and identified for grounding the metallic frames of PV modules or other equipment shall be permitted to bond the exposed metal surfaces or other equipment to mounting structures. Metallic mounting structures, other than building steel, used for grounding purposes shall be identified as equipment grounding conductors or shall have identified bonding jumpers or devices connected between the separate metallic sections and shall be bonded to the grounding system.
USE AND INSTALLATION
This category covers photovoltaic (PV) mounting systems, mounting devices, clamping devices (which may be for bonding and/or mechanical loading) and ground lugs intended for use with specific PV modules and panels and specified module frames and mounting structures as identified in the individual certifications. These systems and devices are investigated for one of two installation types: (1) ground mounted, or (2) intended to serve as part of a nonstructural component of a building, such as a stand-alone system on a building, curtain wall, facade, atrium, skylight, etc., which is applied extant to the primary building structure. Both mounting systems and clamping devices may be investigated for mechanical mounting alone, or mechanical mounting and ground bonding as identified in the individual certifications. Ground lugs may be investigated for use with specific PV modules, specific PV module frames, or specific mounting-system rails. The installation of these mounting systems, clamping devices or bonding devices is intended to be in accordance with ANSI/NFPA 70, "National Electrical Code," in addition to any applicable building codes.
PV Racking as an ECG

UL MARK

The Listing Mark of UL on the product or on the smallest unit container in which the product is packaged is the only method provided by UL to identify products manufactured under its Listing and Follow-Up Service. The Listing Mark for these products includes the UL symbol (as illustrated in the Introduction of this Directory) together with the word "LISTED," a control number, and one of the following product names: "Photovoltaic Mounting System," "Photovoltaic Module Clamping Device," "Photovoltaic Mounting Device," "Photovoltaic Bonding Device," "Photovoltaic Mounting and Bonding Device" or "Photovoltaic Ground Lug." The word "Photovoltaic" may be abbreviated "PV."
**QIMS.E351121**  
Mounting Systems, Mounting Devices, Clamping Devices and Ground Lugs for Use with Photovoltaic Modules and Panels

See General Information for Mounting Systems, Mounting Devices, Clamping Devices and Ground Lugs for Use with Photovoltaic Modules and Panels

**TRINA SOLAR LTD**  
2 Tian He Rd  
Electronics Park New District  
Changzhou, Jiangsu 213031 CHINA

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Investigated for Bonding</th>
<th>Investigated for Mechanical Loading</th>
<th>Tested in Combination With</th>
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<tbody>
<tr>
<td>F1A14</td>
<td>Y</td>
<td>Y</td>
<td>UL Listed PV Modules (E306515): TSM-310PD14.50</td>
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<tr>
<td>F1A05</td>
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<td>UL Listed PV Modules (E306515): TSM-260PD05.50</td>
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*Last Updated* on 2014-03-14
QIMS.E349133
Mounting Systems, Mounting Devices, Clamping Devices and Ground Lugs for Use with Photovoltaic Modules and Panels

See General Information for Mounting Systems, Mounting Devices, Clamping Devices and Ground Lugs for Use with Photovoltaic Modules and Panels

ERIC INTERNATIONAL CORPORATION
34600 SOLON RD
SOLON, OH 44139-2631 USA

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Max OCPD (A)</th>
<th>Standard Mounting Hardware Provided</th>
<th>Investigated for</th>
<th>Photovoltaic Ground Lug - Bolt-through Design - Tested in Combination With</th>
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<tr>
<td></td>
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<td>Bonding</td>
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<td>Y</td>
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<tr>
<td>EL6CS, EL6CSDB</td>
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<td></td>
<td>Bonding</td>
<td>Y</td>
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<td></td>
<td></td>
<td>Bonding</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>EL6CS8, EL6CSDB8</td>
<td>125 A</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
• Grounding PV Racks

- Grounding and Bonding Equipment (KDER) pg. 224 in White Book.

- **Grounding and Bonding for Photovoltaic (PV) Systems** — Grounding and bonding equipment intended for use in PV systems are additionally investigated in combination with the PV module/panel (see QIGU) to the applicable requirements for such products. Installation instructions provided with the PV system (see QIGU) identify the specific grounding and bonding device that has been investigated and intended for use with that system.
A local car wash facility had an existing 400 ampere, 277/480 volt service lateral consisting of two parallel runs of four 3/0 AWG copper conductors in 2 inch PVC conduits. To accommodate an additional load, the service was upgraded to 800 amperes by adding 2 parallel runs of 3/0 AWG copper conductors but the contractor used 2½ inch PVC conduits along-side the existing 2 inch conduits. The local inspector failed the installation citing Article 310.10(H) Conductors in Parallel and noting that the conduits needed to be the same size as the conduits in the initial installation. Is the inspector correct?

Reference: NEC 310.10(H) (3)

Answer: No PVC is nonconductive therefore I don’t believe this would violate the code.
28) The supply side bonding jumper has basically the same purpose as the equipment grounding conductor other than the lack of OCPD on the line side. However, the ssbj’s do not have the same restrictions, such as color requirement per 250.119, such as what constitutes a ssbj 250.118. and others, is this a oversight or intentional?

Reference: 250.24, 250.30, 2014 NEC 250.102(C)
The question statement is somewhat true. The purpose or function of the Supply Side Bonding Jumper is the same as an Equipment Grounding Conductor except the amount of fault current and the duration are generally unknown. One big difference though in the installation of a Supply Side Bonding Jumpers is that it is either wholly contained within an enclosure or would be short lengths without splices between service enclosures or the source of a separately derived system and the first disconnection panel. Whereas the Equipment Grounding Conductor can be of great length and passing through or spiced in many enclosures or boxes. Just from this difference, there is a clear need to identify the EGC where there has not been a demonstrated need to specifically identify the Supply Side Bonding Jumper. There is no prohibition of identification with the color green, but as with grounding electrode conductors, equipment bonding conductors, main and system bonding jumpers there are no requirements to provide identification.
29. Is it required to have 2 sources of power in a doctor’s office that does in-house facial reconstructive surgery, and oral surgery?

If so should the wiring method from the critical branch be hard piped?
517.45 Essential Electrical Systems for Other Health Care Facilities

29a. A Essential Electrical Distribution. The essential electrical distribution system shall be a battery or generator system.

B Electrical Life Support Equipment. Where electrical life support equipment is required, the essential electrical distribution system shall be as described in 517.30 through 517.35. (Essential Electrical Systems for Hospitals)

C Critical Care Areas. Where critical care areas are present, the essential electrical distribution system shall be as described in 517.30 through 517.35. (Essential Electrical Systems for Hospitals)
**29(b)** Is it required to have 2 sources of power in a doctor’s office that does in-house facial reconstructive surgery, and oral surgery?

**ANSWER:** Yes. However, unless there is a critical care area and/or electrical life support equipment is required, the essential system is permitted to be supplied by a battery.

**29(b)** If so should the wiring method from the critical branch be hard piped?

**ANSWER:** If there is a critical care area and/or electrical life support equipment is required, then it must comply with 517.30 through 517.35 using wiring methods detailed in exceptions noted in 517.30(C)(3)

**Reference:** 517.45
30. To save his company dollars, a contractor dug through his inventory to locate lugs to terminate four parallel runs of 250 kcmil service entrance conductors in a CT enclosure. He installed four single conductor lugs rated for 250 kcmil on Phase A. On Phase B, he installed a quadruple lug rated for 3/0 - 350 kcmil. On Phase C, he installed two double lugs listed for terminating two 4/0 conductors per lug. Do conductors of the all phases have to terminate in the same manner or just the conductors of each phase have to be of the same type of lugs?

Reference 310.10 (H) (2) and (3)

Answer-Conductors of all phases do not have to terminate in the same manner, but all conductors of the same phase must terminate in the same manner. It appears that the contractor is attempting to terminate the 250kcmil conductors in 4/0 lugs which would not be allowed by 110.3(B)
31. I installed a pump for a rancher at a location served by a 120/208 3 phase service. The pump supplied was a 480v 3 phase only. I installed a standard step down 277/480 to 120/208 transformer by reversing the primary and secondary to supply the 480v for the pump. The 480v side (originally the primary) has no XO connection. Do I need to ground one of the phase conductors, creating a corner grounded delta secondary to provide a ground fault return path back to the transformer?

Reference: 2011 NEC 250.20(B)
2014 NEC 250.20(B), 450.11(B)

Answer: I think the question needs a slight revision. If the HV side is a delta connection then the rated voltage should be 480v and not 277/480. No, grounding the secondary is not required see 250.20(B) but the choice is really application dependent. Additionally, follow manufacturer’s instructions and make no connection to the XO on the wye side.

Continued ...
2014 NEC

450.11(B) Source Marking. A transformer shall be permitted to be supplied at the marked secondary voltage, provided that the installation is in accordance with the manufacturer’s instructions.
32. UL requires ex fans that are in a damp location to have gfci protection. Is the exhaust fan for a residential or commercial hood considered to be in a damp location?

Reference: Art. 100 Definition of Damp Location, NEC 110.3(B)
• Are Exhaust Hoods in Damp Locations?

• Answer: No, the definition of Location, Damp. Locations protected from weather and not subject to saturation with water or other liquids but subject to moderate degrees of moisture. Informational Note: Examples of such locations include partially protected locations under canopies, marquees, roofed open porches, and like locations, and interior locations subject to moderate degrees of moisture, such as some basements, some barns, and some cold-storage warehouses.

• Look at the installation instructions provided with the Listed hood.
Insulating Restrictions

• 33. Having a effective water pipe as the only grounding electrode in a residence. Is it required to install 1 or 2 ground rods to supplement the water pipe?

Reference: NEC 250.50(A)(1), 250.53(D), 250.53(A)(1) & (2) + EX.

Answer: One of 25 ohms or less otherwise two
34) The Code change in the past two code cycles has brought about a dangerous situation in the rural areas of our country. Here in our unrecognized 51st state, little critters called “Gophers, Prairie Dogs, Moles, and Badgers” have learned that they can save on their orthodontist billings by cleaning their teeth while eating the insulation off of direct buried electrical cables and can keep their claws sharp by digging away at the insulation. Some of the rural feeders required by Article 250.32(A) and (B) (1) can be in excess of a quarter mile from the utility supplied, electrical service equipment at the county road. When our burrowing friends exposes aluminum wiring to the moisture in the ground, an “open” can occur in the phase and/or neutral conductor which will soon show up at our distant home or structures.
An “open” in the required equipment grounding conductor will not show until a ground fault occurs and someone gets hurt or electrocuted. The Northeast Division of the Rocky Mountain Chapter IAEI has developed the following design for decreasing the number of feeder conductors, being able to use smaller size of feeder conductors, and eliminating the opportunity of the rodents’ work to go undetected. The Division believes that this design does not violate any NEC articles and does not require that an equipment grounding conductor be run with the feeder conductors. Can you find any NEC violations with this design for a 1,650 foot, single phase feeder to a remote pole barn building in rural America where ingenuity can over-ride Code-driven obstacles?
Outside Feeder
Equipment Grounding Conductor

References: 300.4, 340.12(10), 250.32(B)(1)

Answer: Yes, unless the State or local jurisdictions have amended the NEC, then the proposed solution, as ingenious as it is, is in violation of the NEC.

First, the question clearly identifies where these direct buried conductors have been physically damaged from the environment (rodents) that they are installed in. Therefore it would appear the requirements of 300.4 and 340.12(10) are not being met. In other words for the conditions stated, direct burial underground feeder conductors are not a correct wiring method. So an alternative wiring method that would provide physical protection from the rodents would be one solution.
• Outside Feeder

Equipment Grounding Conductor

To the crux of the issue raised in the question. The present Code language in 2011, and 2014 is clear that for new construction, a feeder or branch circuit from one building or structure to another building or structure must have an equipment grounding conductor meeting 250.118 installed and where of the wire type be sized per 250.122.

Aside from the NEC violation, unless amended to deal with this very specific type of installation and having appropriate limitations on where it can be applied, the proposed solution will work electrically unless there is somehow a parallel path created from buried metallic water piping, buried metallic fencing, buried underground communications type utilities that are in the same general area and path as the direct buried circuit is installed.
35. A rooftop heating / ac unit is placed on metal framing to help distribute the weight. The RTU’s service breaker is now well above 6’7”. Would the installation of a platform be required to get the breaker to a height of 6’7” or less?

If so, would the platform have to be 30” x 36” to meet Section 110.26?
404.8 Accessibility and Grouping

35a. A Location. All switches and circuit breakers used as switches shall be located so that they may be operated from a readily accessible place. They shall be installed such that the center of the grip of the operating handle of the switch or circuit breaker, when in its highest position, is not more than 2.0 m (6 ft 7 in.) above the floor or working platform.
110.26 Spaces About Electrical Equipment.

35b. Access and working space shall be provided and maintained about all electrical equipment to permit ready and safe operation and maintenance of such equipment.

Depth - Width - Height

<table>
<thead>
<tr>
<th>Nominal Voltage to Ground</th>
<th>Minimum Clear Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Condition 1</td>
</tr>
<tr>
<td>0–150</td>
<td>914 mm (3 ft)</td>
</tr>
<tr>
<td>151–600</td>
<td>914 mm (3 ft)</td>
</tr>
</tbody>
</table>

Note: Where the conditions are as follows:

**Condition 1** — Exposed live parts on one side of the working space and no live or grounded parts on the other side of the working space, or exposed live parts on both sides of the working space that are effectively guarded by insulating materials.

**Condition 2** — Exposed live parts on one side of the working space and grounded parts on the other side of the working space. Concrete, brick, or tile walls shall be considered as grounded.

**Condition 3** — Exposed live parts on both sides of the working space.
35(c) Would the installation of a platform be required to get the breaker to a height of 6’7” or less?

Reference: 404.8
ANSWER: Yes

35(b) If so, would the platform have to be 30” x 36” to meet Section 110.26?

Reference: 110.26
ANSWER: Yes, but depending on voltage/clearances it may have to be larger
Feeder or Branch Circuit

• **36.** An indoor panel board enclosure subjected to hose down and splashing water shall be rated as a type:
  - A.) 3R
  - B.) 4
  - C.) 5
  - D.) 12

No mention of hose down, therefore not A.) 3R.
• **36a.** An indoor panel board enclosure subjected to hose down and splashing water shall be rated as a type:

A.) 3R  B.) 4  C.) 5  D.) 12

Answer B.) 4

---

**Table 1**

Comparison of Specific Applications of Enclosures for Indoor Nonhazardous Locations

<table>
<thead>
<tr>
<th>Provides a Degree of Protection Against the Following Conditions</th>
<th>Type of Enclosure</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Access to hazardous parts</td>
<td>X</td>
</tr>
<tr>
<td>Ingress of solid foreign objects (falling dirt)</td>
<td>X</td>
</tr>
<tr>
<td>Ingress of water (Dripping and light splashing)</td>
<td>...</td>
</tr>
<tr>
<td>Ingress of solid foreign objects (Circulating dust, lint, fibers, and flyings **)</td>
<td>...</td>
</tr>
<tr>
<td>Ingress of solid foreign objects (Settling airborne dust, lint, fibers, and flyings **)</td>
<td>...</td>
</tr>
<tr>
<td>Ingress of water (Hosedown and splashing water)</td>
<td>...</td>
</tr>
<tr>
<td>Oil and coolant seepage</td>
<td>...</td>
</tr>
<tr>
<td>Oil or coolant spraying and splashing</td>
<td>...</td>
</tr>
<tr>
<td>Corrosive agents</td>
<td>...</td>
</tr>
<tr>
<td>Ingress of water (Occasional temporary submersion)</td>
<td>...</td>
</tr>
<tr>
<td>Ingress of water (Occasional prolonged submersion)</td>
<td>...</td>
</tr>
</tbody>
</table>
Additional Auxiliary Electrodes for Array Grounding

37. Under the 2014 NEC, do I now have to have a grounding electrode system for roof top solar arrays? Are ground rods required? This was not required in the 2008 NEC.

Reference: 690.47(D)

Answer: Yes – 690.47(D) specifies that in addition to ground and pole-mounted PV arrays, it also requires a grounding electrode “as close as practicable to the location of roof-mounted photovoltaic arrays.”
This section further specifies, “grounding electrodes shall be installed in accordance with 250.52.” Ground rods are one type of electrode listed in this section.
This new section was previously in the 2008 NEC and was brought back in via an IAEI proposal and comment.
Use of the 90° Ampacities for conductors

38 Is there any situation that can be verified where a installer can use the 90 ° chart for the wires other than adjustment factors? I have done some research and come to realize that even if you use 90 ° wire, 90 ° lugs and terminate on a bus bar that the equipment is only listed for 75 ° therefore the 90 ° chart cannot be used. True or false? If false please give 1 example

Reference: 110.14(C)

(C) Temperature Limitations. The temperature rating associated with the ampacity of a conductor shall be selected and coordinated so as not to exceed the lowest temperature rating of any connected termination, conductor, or device. Conductors with temperature ratings higher than specified for terminations shall be permitted to be used for ampacity adjustment, correction, or both.
Use of the 90° Ampacities for conductors continued

38A. Answer: For terminations within equipment the answer is True.

However, connections NOT made on equipment, but between devices that are marked with higher temperatures, such as splice fittings the 90 ampacity may be used for that portion of the circuit.
A free standing building is designed for a bank, there are windows for about 75% of the building. Doing an electrical rough inspection, I notice & failed the inspection because there were no show window receptacles. The engineer responded that the bank will not install any electrified signs and stated the windows are there primarily for security and may hang material but will not display electrified signs. Does 210.62 need to apply?
Show Windows

39.

Reference: NEC 100 Definitions

Answer: In Article 100, Show Windows are defined as, “Any window ... for the display of goods or advertising material”. While windows serve other purposes, such as entry of daylight or security, the engineer admits that the window may be used to “hang material”.

The inspector was justified in this call. There should be attention to the placement of outlets plus provision for connection to branch circuits and demand load calculation for feeders and in the service.
Dwelling Unit Garages/Receptacle Location

40. In the 2014 NEC 210.52(G)(1) requires one receptacle for each car space. Therefore would a 4plex receptacle at the garage door of a 3 car garage meet this requirement?

- Reference: 210.52(G) Basements, Garages, and Accessory Buildings.
- (1) Garages. In each attached garage and in each detached garage with electric power. The branch circuit supplying this receptacle(s) shall not supply outlets outside of the garage. At least one receptacle outlet shall be installed for each car space.
40a. The analysis book indicates the intent is for a receptacle outlet “in” each space but the actual code language says “for” each space and the location is not specified. I think the installation would be code compliant.
The minimum rating of a disconnecting means for an outside feeder supplying a building with only 2 branch circuits shall be:

- a.) 15 amperes  
- b.) 30 amperes  
- c.) 60 amperes  
- d.) 100 amperes

B; **30A** per 225.39 2-circuit.

Not more than (2)2-wire branch circuits, *the feeder* or branch circuit **disconnecting means shall have a rating of not less than 30 amperes**

This is an appropriate question to bring attention to NEC 225.36 which removed the requirement for the “SUSE” label which basically, required the majority of feeder & branch circuit disconnects to be “suitable for service equipment”
225.31 through 225.36 will generally require a disconnect for any feeder or branch that feeds a "separate structure."

3 hots, 2 neutrals would require a disconnect (suse) if this drive through was defined as a structure.

These 60a EV stations typically don't come with a disconnect.
Attic Service Receptacles

42. A 15 ampere 125 volt receptacle located in an attic for servicing a furnace must be:
   a.) a listed weather-resistant type.   b.) GFCI protected.
   c.) located within 25 feet of the furnace.
   d.) supplied by an individual branch circuit.

Reference: NEC 210.63

Answer: C
A rooftop solar system is installed with 3 strings of panels with AC micro-inverters on the panels. The conductors are then installed in a combiner box and ran in conduit through the attic to an AC disconnect. Is an AC disconnect and overcurrent protection required on the roof?

Reference: 690.9, 690.15, & 705.12(D)(1)

Answer: Yes – 690.15(A)(1) & (2) requires AC and DC disconnects within sight of the inverters. 690.9(A) requires PV source circuit, PV output circuit, inverter output circuit, and storage battery circuit conductors and equipment shall be protected in accordance with the requirements of Article 240.
44. Is it compliant to use a factory LB condulet for conductors larger than #4 when the distance between raceway entries are less than 6 x the threaded entry?

Reference: NEC 314.16 and 314.28(A)(3)

Answer: Yes, if the conduit body (LB type) is listed and marked for the specific maximum number and size of conductors. There is new language in the 2014 that addresses this more fully.
(3) Smaller Dimensions. Listed boxes or listed conduit bodies of dimensions less than those required in 314.28(A)(1) and (A)(2) shall be permitted for installations of combinations of conductors that are less than the maximum conduit or tubing fill (of conduits or tubing being used) permitted by Table 1 of Chapter 9.

Listed conduit bodies of dimensions less than those required in 314.28(A)(2), and having a radius of the curve to the centerline not less than that indicated in Table 2 of Chapter 9 for one-shot and full-shoe benders, shall be permitted for installations of combinations of conductors permitted by Table 1 of Chapter 9. These conduit bodies shall be marked to show they have been specifically evaluated in accordance with this provision.

Where the permitted combinations of conductors for which the box or conduit body has been listed are less than the maximum conduit or tubing fill permitted by Table 1 of Chapter 9, the box or conduit body shall be permanently marked with the maximum number and maximum size of conductors permitted.
45.

Art- 338.10 (B) 4. A 200 amp main breaker for a home is installed on the exterior of the house and from there a 4/0 aluminum SER cable 75 degree is installed to the sub-panel (main feeder) the cable is run in a insulated area of the floor joist. Is the ampacity of the cable determined at 60 degrees because Art- 338.10 (B) 4 or does Informational note #2 allow the use of table 310.15 (B) 7 and the 4/0 cable is good for 200 amps?
Residential Feeders

45.

Reference: NEC 338.10 (B)(4)

Answer: The referenced paragraph indicates the process used to apply provision for feeders installed in thermal insulation. The Informational Note is provided for reference, but in no way negates or modifies this provision in Article 338 or any other part of the code. The #4/0 cannot be blindly applied in this manner.
Receptacle outlet at tub space.

46. In a Master bath there is a large claw foot tub that is set in a bump out of the room, the tub is very close to the side wall (2”) and the ends are 12” from tub. The homeowner would like to install a receptacle at the end of the tub at a height of six feet so they can hang a TV to watch while soaking in the tub. Is this a violation of 406.9 (C) ? Are there any dimensions that define this area?

- The installation appears to be code compliant. The outlet is not directly over the tub and there is no mention of a shower being present.
- 406.9 Receptacles in Damp or Wet Locations.
- (C) Bathtub and Shower Space. Receptacles shall not be installed within or directly over a bathtub or shower stall.
47. Is it a violation to use a pink wire for a 277v switch leg, when there are two voltages in a building and the 480/277 volt panel is labeled? A= Brown B= orange C= Yellow? Neutral = gray
A switchleg is part of a branch circuit and shall meet the requirements of a branch circuit.

This common practice is no longer NEC compliant :-(

It would be a violation unless the ungrounded conductor was identified as, BROWN, ORANGE OR YELLOW at all terminations, connections and splice points as required per 210.5(C)(1)

the old industry standard as using the other voltage color as the switch leg is no longer acceptable per NEC
Countertop Receptacle Spacing

48. No specific spacing is required for receptacle outlets installed for countertop spaces in a:
   a.) kitchen.   b.) pantry.   c.) breakfast room.   d.) wet bar.

Reference: NEC 210.52(C)

Answer: D

Wet bars are not included.
In the 2014 NEC, does article 690.12 about the rapid shutdown of a PV system apply to residential solar systems?

Reference: 690.12

Answer: Yes – The requirement applies to any building where PV system conductors of more than 5 ft in length inside the building, or more than 10 ft from a PV array on those buildings regardless of occupancy type.
690.12 Rapid Shutdown of PV Systems on Buildings

PV source circuits to be de-energized from all sources within 10 seconds of when the utility supply is de-energized or when the PV power source disconnecting means is opened.

1. PV Modules
2. Combiner Box
3. AC Disconnect
4. Rapid shutdown control

DC rated relays used as a means for “Rapid Shutdown” of PV systems.
50. Equipment inside Type 3R enclosures

50. Inside a listed 3R industrial controller, would a field installed receptacle that feeds a small 120v /24v transformer be required to have a WR? Would it also be required to be GFCI protected?

Reference:
NEC 300.5(B) and 300.9 only considers interiors of raceways to be wet locations, and not the interiors of enclosures.

HOWEVER
ANSWER: No, the interior of enclosures marked as Type 3R are considered to be “dry locations”.

However, to use a “service or convenience” receptacle would require a cover to be open and thus the receptacle is no longer in a “dry” location and would have to be WR, and also have GFCI protection and an in-use cover.

If the receptacle was for a component contained in the control panel (a PLC for example) where the cover is not required to be opened, and no other loads can be connected (as in a single receptacle) then the answer may be no.
• Is it a violation to have open wire nuts in a non-plenum ceiling for class 2 & 3 wiring methods for signs & occupancy sensors or does 300.15 apply?
Splices in Class 2 and Class 3 Wiring

51.
- Is it a violation to have open wire nuts in a non-plenum ceiling for class 2 & 3 wiring methods for signs & occupancy sensors or does 300.15 apply?

Reference: NEC 300.15

Answer: Yes. A box is required for each splice point in cables. There is no exception listed in subparagraphs (A) through (L) or in Article 725.
• **Arc fault protection/switch location.**

  • **52.** Under the 2014 NEC the areas for arc fault protection have increased. The garage is still exempt. If the lighting switch for the garage is inside the house and in an area that requires arc fault protection, does the garage branch circuit now need to be arc fault protected?

  • A change to the 2014 NEC now requires “devices” to be arc fault protected in the areas specified in 210.12 (A). This would make the switch located in an arc fault required area to also be subject to the same requirement.

(A) Dwelling Units. All 120-volt, single-phase, 15- and 20-ampere branch circuits supplying outlets or devices installed in dwelling unit kitchens, family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, laundry areas, or similar rooms or areas shall be protected by any of the means described in 210.12(A)(1) through (6):
• A hot tub is located in the basement of a single family dwelling that I was interested in buying. My home inspector wrote in his report that the recessed luminaires above the pool were in violation of the NEC as they were located only 6 feet 8 inches above the hot tub. The luminaires are listed for use in wet locations and the branch circuit supplying the luminaires is GFCI protected. Is the home inspector correct in his report?

• It is legal if the light complies with 680.43(B)(1)(C)(1)

• Recessed luminaires with a glass or plastic lens, nonmetallic or electrically isolated metal trim, and suitable for use in damp location
hot tubs indoors are becoming the new "fun thing" :-)

[Image of children playing with a hot tub indoors]
Receptacle Spacing

54. Is an outlet within 6ft of a sink but located thru a door in another room required to be GFCI protected?

Check with your inspector! I say No. Such measurements are normally taken along the path a cord for an appliance might follow, in a straight line. Whereas we do not expect cords to be run through doorways, I don’t think there is a need to provide GFCI protection for an outlet in another room that happens to measure out within 6 feet of a sink not in that room. If the door is shut there is no problem, right? You can protect it, if you are concerned about it but I do not believe the code requires it.
Rooftop Temperature Adders

55. Why is temperature derating in 310.15(B)(3)(c) still required for rooftop installations when it has been shown not to be an issue in a recent IAEI magazine?

Reference: 310.15(B)(3)(c)

- Answer: CMP 6 Panel Statement ROP 6-18: Technical substantiation was provided during the 2008 and 2011 Code cycles to support the ambient adjustment factors to conduit exposed on rooftops. This testing proved to the panel’s satisfaction that the adjustments are required. Additional testing has been provided via a fact-finding report in Proposal 6-31 during the 2014 cycle to support the application of adjustment factors. Adequate technical substantiation has not been provided to support removal of this requirement.
310.15(B)(3)(c) Rooftop Adjustment Factors

310.15(B)(3)(c) **Circular Raceways and Cables** Exposed to Sunlight on Rooftops. Where conductors or cables are installed in circular raceways or cables are exposed to direct sunlight on or above rooftops, the adjustments shown in Table 310.15(B)(3)(c) shall apply.

**Exception:** Type XHHW-2 insulated conductors shall not be subject to this ampacity adjustment.

### Table 310.15(B)(2)(c) Ambient Temperature Adjustment for Raceways or Cables Exposed to Sunlight On or Above Rooftops

<table>
<thead>
<tr>
<th>Distance Above Roof to Bottom of Raceway or Cables</th>
<th>Temperature Added</th>
</tr>
</thead>
<tbody>
<tr>
<td>On roof 0 - 13 mm (0 - ½ in.)</td>
<td>33 °C 60 °F</td>
</tr>
<tr>
<td>Above 13 mm (½ in.) - 90 mm (3½ in.)</td>
<td>22 °C 40 °F</td>
</tr>
<tr>
<td>Above 90 mm (3½ in.) - 300 mm (12 in.)</td>
<td>17 °C 30 °F</td>
</tr>
<tr>
<td>Above 300 mm (12 in.) - 900 mm (36 in.)</td>
<td>14 °C 25 °F</td>
</tr>
</tbody>
</table>

Informational Note to Table 310.15(B)(3)(c): The temperature addsers in Table 310.15(B)(3)(c) are based on the measured temperature rise above the local climatic ambient temperatures due to sunlight heating.
56. Ticky Tacky Installations

56. 3 runs of 4-3/0cu are connected by 3-2” rigid close nipples. The top close nipple is located above live parts. The bottom 2 are below live parts. This is noticed after the installation and will require some painstaking retro work. UL requires a sealing locknut when installed above live parts to achieve a wet location listing. Since these are installed in parallel would all 3 require the sealing locknut to have the same characteristics or would a single gasket not affect the installation and therefore be a ticky tack violation

Reference: 110.12 and 310.10(H)(3)
56A. Ticky Tacky Installations

56 Reference: 110.12 and 310.10(H)(3)

The code allows ticky tacky but not un-neat and un-workmanlike, see 110.12.

For parallel installations a close reading of 310.10(H)(3) says the raceways and cables that contain paralleled conductors must have the same “electrical” characteristics, not to be confused with physical properties such as a gasket.
Residential Feeder

57. What size THHN copper conductors are required for a 200 amp, 120/240-volt, 3-wire, single-phase dwelling service located in an ambient temperature of 105°F

Reference: NEC Table 310.15 (B)(2)(a) with NEC 310.15(B)(7)(1)

Answer: Using Table 310.15(B)(2)(a), the adjustment factor for the ambient temperature increase to 105 degrees F would be 0.87. By applying the residential Dwelling Services and Feeders procedure new in New 2014. The minimum ampacity calculation would be:

200 amperes x 0.83 = 166 amperes

But the temperature adjustment would be

166 / 0.87 = 191 amperes, requiring #3/0 THHN.
58. Is AFCI protection required for a lighting circuit located in a kitchen of a dwelling unit where there is no clear line of demarcation between a dining room or living room requiring AFCI protection, such as in an efficiency apartment?

- With the changes to the 2014 NEC this is not a valid question. There is no demarcation line between the areas.

- **210.12 Arc-Fault Circuit-Interrupter Protection.**
  - (A) Dwelling Units. All 120-volt, single-phase, 15- and 20-ampere branch circuits supplying outlets or devices installed in dwelling unit kitchens, family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, laundry areas, or similar rooms or areas shall be protected by any of the means described in 210.12(A)(1) through (6):
• 15 & 20a GFCI protection hard wired
• #59
• Does a hard wired dishwasher, without a receptacle, still need to be GFCI protected under the 2014 Code?
• Yes 210.8(D)
• FYI: From reading the proposals, technology is coming along that is allowing most equipment at most voltages and amperes to have GFCI protection
Accessibility

60. With the new changes in the 2014 code requiring GFCI for disposal receptacles located under the kitchen sink, are these receptacles generally accepted to be readily accessible?

Yes.

- **Accessible, Readily (Readily Accessible). Capable of being**
- reached quickly for operation, renewal, or inspections
- without requiring those to whom ready access is requisite
- to climb over or remove obstacles or to resort to portable
- ladders, and so forth.
Garage Circuit Requirements

61. The NEC® 2014, in 210.52(G)(1), requires a separate branch circuit to supply receptacles in dwelling unit garages. Can lighting outlets in the garage be installed on this circuit? Is a lighting outlet for a personnel door of the garage considered to be outside the garage since the wiring and junction box are located in the garage?

- Reference: 210.52(G)(1)

- Answer: Yes, lighting outlets in the garage may supplied from this circuit. However, the lighting outlet for the personnel door would be an outlet outside of the garage and would not be permitted to be supplied by this circuit.
• **210.52(G) Basements, Garages, and Accessory Buildings**

  • “Basements, Garages, and Accessory Buildings” receptacle provisions revised into list format.
    - 210.52(G)(1) Garages
    - 210.52(G)(2) Accessory Buildings
    - 201.52(G)(3) Basements

  • Branch circuit supplying garage receptacle(s) to supply only the garage.

  • Receptacle required for each car space in a garage.

  • This is an effort to recognize the possibility of electric vehicle (EV) and plug-in hybrid electric vehicle (PHEV) charging in these garages.
At least one receptacle outlet shall be installed in each attached garage and in each detached garage with electric power.

The branch circuit supplying this receptacle(s) shall not supply outlets outside of the garage.

At least one receptacle outlet shall be installed for each car space.
The main service disconnects for a single family dwelling consists of a 200 ampere, main breaker panel with space for eight breakers and feed-thru lugs. I want to use the feed-thru-lugs to run Type NM-B cable out the backside of the panel enclosure to feed a 60 ampere main breaker subpanel in the basement. The length of the feeder will be less than 20 feet. What is the minimum size of nonmetallic sheathed cable that I can install for this application?

Reference: 240.21(B)(2), 334.80, and 334.10 through 334.15
NEC 240.21(B)(2) requires the conductor to be $\frac{1}{3}$rd the supply which is 66.6A.

NEC 334.80 requires Type NM-B ampacity to be taken from the 60-degree column of Table 310.15(B)(16).

Allowed Ampacity per Table 310.15(B)(16): 6 AWG = 55A

The tap rules do not allow the “round up rule at 240.4(B) to the next highest size” so therefore a 4 AWG must be used.

The tap conductors must be protected from physical damage by being enclosed in a raceway or “other approved means”. Consider both 240.21(B)(2) and 334.10 through 334.15 to determine acceptability of how the NM cable is routed.
Area Classification Repair Garages

- **63.** The non-ventilated ceiling area of a commercial garage repairing natural gas vehicles shall be:
  - a.) Unclassified  
  - b.) Class 1 Div 2  
  - c.) Class 1 Div 1  
  - d.) Class 2 Div 1

Reference: NEC Article 511
Answer: a) and b).

Commercial garage activities in this concern are categorized as Major Repair and Minor Repair facilities.

Major Garages are facilities involve activities that require transfer of the gaseous fuels. For this application, the unventilated ceiling space is classified as Class 1, Division 2 – 511.3 (C)(2)(b).

Minor Garages perform work that does not require transfer of fuel and have ceiling areas that are unclassified – 511.3(D)(2).
• Carbon monoxide detector requirements.

64. Where are carbon monoxide detectors required to be located in a new dwelling unit and are they required to be inter-locked with the required smoke detectors and also have battery back-up? The question was originally written as “carbon dioxide” detectors.

• Smoke detectors and carbon monoxide detectors are not part of the NEC. The requirements are found in the building codes. Check with the local AHJ for requirements.
SECTION R315 CARBON MONOXIDE ALARMS

64a. R315.1 Carbon monoxide alarms. For new construction, an approved carbon monoxide alarm shall be installed outside of each separate sleeping area in the immediate vicinity of the bedrooms in dwelling units within which fuel-fired appliances are installed and in dwelling units that have attached garages.

R315.2 Where required in existing dwellings. Where work requiring a permit occurs in existing dwellings that have attached garages or in existing dwellings within which fuel-fired appliances exist, carbon monoxide alarms shall be provided in accordance with Section R315.1.
• Carbon monoxide Detector Requirements

64b. R315.3 Alarm requirements. Single station carbon monoxide alarms shall be listed as complying with UL 2034 and shall be installed in accordance with this code and the manufacturer's installation instructions.
#65 MC cables: is it NEC compliant to re-identify a #12 white wire to be a gray wire for a 277 neutral by using gray tape at the splices and terminations in a MC Cable that is black & white. This building has 2 voltages 120/208 A= Black B = Red C =Blue N= white & 277/480v A= Brown B= orange C= Yellow? N = gray

200.6 (A) “Commentary” For #6 awg or smaller, identification of the grounded conductor solely through marking that is applied at the time of the installation “is not permitted” except for “cords” & “multi-conductor cables in 200.6(C) & (E) exception #1

200.6(E) exception #1 states yes under this condition

200.6(E) exception #1 : Grounded conductors of multiconductor cables; “where the conditions of maintenance and supervision ensure that only qualified persons service the installation. Grounded conductors in multiconductor cables shall be permitted to be permanently identified at their terminations at the time of installation by a distinctive white marking or other equally effective means
• #65a 200.6(D); states yes, as long as the MC cable is not being used as being both 277v & 120v

• 200.6(D) Where grounded conductors of different systems are installed in the same raceway, cable, box, auxiliary gutter, or other type of enclosure, each grounded conductor shall be identified by system. Identification that distinguishes each system grounded conductor shall be permitted by “one of the following”
  1. one system grounded conductor shall have an outer covering conforming to 200.6(A) or (B)
  2. the grounded conductors of other systems shall have a different outer covering conforming to 200.6(A)
  3. other means of identification as allowed by 200.6(A)

• The means of identification shall be documented in a manner that is readily available or shall be permanently posted where the conductors of different systems originate
#65B 210.5(A) The grounded conductor of a branch circuit shall be identified in accordance with 200.6 5-30 Log #2744 NEC-P05 Final Action: Reject (200.6(D)_.

Submitter: Randal Hunter, City of Las Vegas  Comment on Proposal No: 5-42
Recommendation: Revise text to read as follows:

(D) Grounded Conductors of Different Systems. Where the premises wiring system has grounded conductors of different systems are installed in the safe raceway, cable, box, auxiliary gutter, or other type of enclosure, each grounded conductor shall be identified by system. Identification that distinguishes each system grounded conductor shall be permitted by one of the following means:

Substantiation: This was presented originally due to the fact that we are currently having to accept jobs which have different voltages both with the same colored neutrals. The current code language allows the same color neutrals within the same premise as long as they are not in the same raceway (120/208 and 277/480 within the same building both with white neutrals). This has lead to confusion for both the inspectors and the contractors, especially when performing service work
Is it permissible to lay Schedule 40 PVC, unsecured, containing the main feeder conductors, on the ground under a skirted mobile home?

No.

352.30(A) requires PVC conduit be secured within 3 feet of termination unless otherwise permitted. Table 352.30 specifies support intervals. Obviously, if the conduit is laying on the ground, it is supported continuously. Securing it to the ground is the only question. I recommend you ask your inspector, but we don’t usually require it to be staked down at anything less than 10-foot intervals.
Pool Panelboard Feeders

67. Why was the exception for existing feeders for panels supplying pool equipment in 680.25 removed in the 2014 NEC? This causes inspectors problems and adds expense to the job.

- Reference: 680.25

- Answer: Proposal 17-119 was accepted:
  - Substantiation: Inspectors struggle with the term “existing” in this section. The grounding and bonding requirements for pools and spas are there for the safety of the users. The exception for “existing” feeders allows the installation of the feeder without an insulated EGC and after some arbitrary time period the installation becomes “existing” and the pool equipment can be installed without this important electrical safety requirement. This should not be allowed.
• **680.25(A)(1) Exception:** Wiring Methods (Feeders)

  - 67a Note from IAEI

  - An errata from NFPA will remove the exception for 680.25(A)(1) from the second printing of the 2014 NEC.

  - See 2014 NEC errata at NFPA website.

  - Proposal 17-119 removed the exception.

  - Comment 17-37 sought to remove references to this exception found at 680.25(B) and 680.25(B)(2) (*not to reinstate deleted exception*).
68. Is it permissible to install a 6 AWG solid copper grounding electrode conductor in a 4’ PVC riser that contains the service entrance conductors or feeder conductors when that PVC riser is used as a transition to above ground for a direct buried wiring method for the purpose of connecting the grounding electrode?

Reference: NEC 230.7 and 310.106(C)
68A  GEC in a Service Raceway

NEC 230.7 exception #1 specifically permits grounding electrode conductors or equipment bonding jumpers or conductors to be contained within a service raceway. (it should say Supply side bonding jumpers).

NEC 310.106(C) requires conductors 8 AWG and larger to be stranded when installed in raceways unless there is specific permission or requirement elsewhere in the NEC that allows/requires a larger conductor to be in a raceway.

Article 250 allows a GEC to be solid or stranded, and allows it to be installed in a raceway but does not mention the use of a solid conductor in a raceway, therefore the 6 AWG can be used, but it must be stranded, not solid.
Parallel Feeders in Same Raceway

69.

Reference: NEC 240.6, 240.4(C), 310.15(B)(5) with Tables 310.15(B)(3)(a)

Answer: d) 1250 KCMIL

The use of non-standard fuses in 240.6(A) is permitted. The two feeders in one conduit include four hot legs and two neutrals that carry the unbalance of current per 310.15(B)(5). The adjustment factor in Table 310.15(B)(3)(a) is 0.80.

For a 900 ampere load, the adjusted ampacity is $900/0.80 = 1,125$ A.

The size per conductor is $1,125/2 = 563$ amperes.

The “round up rule” does not apply per 240.4(C), so the size needed is **1250** KCMIL (ampacity = 590) for a total of 1,180A.
70. Is it a violation to install multiple 480v electrical feeder conduits right above a 208v panel?

- No. 110.26(E)(1)(a) through(d) states the space above the electrical equipment is dedicated to electrical equipment so the 480 volt feeder is allowed.

- **110.26 Spaces About Electrical Equipment.**
  - (E) Dedicated Equipment Space. All switchboards, switchgear, panelboards, and motor control centers shall be located in dedicated spaces and protected from damage.
70a. (1) Indoor. Indoor installations shall comply with 110.26(E)(1)(a) through (E)(1)(d).

(a) Dedicated Electrical Space. The space equal to the width and depth of the equipment and extending from the floor to a height of 1.8 m (6 ft) above the equipment or to the structural ceiling, whichever is lower, shall be dedicated to the electrical installation. No piping, ducts, leak protection apparatus, or other equipment foreign to the electrical installation shall be located in this zone.

Exception: Suspended ceilings with removable panels shall be permitted within the 1.8-m (6-ft) zone.

(b) Foreign Systems. The area above the dedicated space required by 110.26(E)(1)(a) shall be permitted to contain foreign systems, provided protection is installed to avoid damage to the electrical equipment from condensation, leaks, or breaks in such foreign systems.

(c) Sprinkler Protection. Sprinkler protection shall be permitted for the dedicated space where the piping complies with this section.

(d) Suspended Ceilings. A dropped, suspended, or similar ceiling that does not add strength to the building structure shall not be considered a structural ceiling.
#71. 411.4 requires the system be listed;

110.3(B) requires it be installed per the instructions included in the listing;

411.6(D) requires the wiring method be installed either per Art 725 or a Chapter 3 wiring method; by using a Chapter 3 wiring method to feed the factory leads, an outlet box is required per 300.15.

725.130(A) allows for class 1 wiring methods when installed per 725.46, which states “Class 1 circuits shall be installed in accordance with Part I of Art. 300 and with wiring methods from the appropriate articles of Chapter 3”, and the exceptions to 725.46 do not apply to this installation. 725.130(B) also does not apply since NM cable is used.

If a class 2 wiring method was used, a junction box would not be required.

If the driver is not identified as a class 2, class 1 wiring methods and chapter 3 would apply; good luck 😊
Use of Flexible Cord

72. Is it NEC compliant to use SO cord in a gymnasium (place of assembly) to wire the collapsing bleachers?

No.

518.4 prescribes metallic wiring methods, with 4 exceptions, none of which apply. Article 400.8 would prohibit most flexible cord usage as well. The only flexible cord usage which would be acceptable would be that used as part of a listed assembly. If the product is supplied with flexible cord or the manufacturer’s installation instructions specify flexible cord use, and the product is listed for use in this occupancy, follow the instructions explicitly for a compliant installation.