**PDHonline Course E357 (3 PDH)**

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# Revisions for the 2011 National Electrical Code® - Part 3

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**PDH Course E357**

# Revisions for the 2011 *National Electrical Code*®
# Part 3

Patrick S. Ouillette, P.E.

## Introduction

Part 3 of this 4-part series covers Article 334 through Article 590. The course covers only major Code changes, but provides depth of coverage.

The layout and the method of presentation will enable new Code users to navigate through the changes. Those well experienced in the Code will find depth in the coverage. Through the heading(s) at the beginning of each Code change addressed in the document, the reader will readily identify the section affected by the change and the specific subject being discussed. The Significance section serves as an introduction to the Code change under discussion. An Analysis of the Code change follows, with explanation as necessary to help the student understand the revision, its background, and the logic of the change. Graphics, photographs, examples, or calculations are used to illustrate the change and to enhance learning. The Summary is a brief re-statement of the highlights of the Code change. An Application Question, with Answer and key to the correct answer, is included at the end of each Code section studied for exercise in applying the change and to broaden learning. Many of the sections analyzed contain a Code Refresher that addresses existing Code requirements related to the change. The author attempts to tie the entire *NEC*® together through the study of the changes.

Although there are many references to the 2011 *NEC*® throughout this document, the course and quiz can be completed without the need to refer to the *NEC*® itself. For further study on any Code section within this course, the 2011 *NEC*® should be consulted.

## Uses Permitted

### Significance

The permitted uses for nonmetallic-sheathed cable have been expanded to include detached garages and storage buildings associated with one- and two-family dwellings.

### Analysis

Previous Code editions implicitly permitted nonmetallic-sheathed cable for one- and two-family dwelling attached garages, since attached garages are part of the overall structure. For detached garages and outbuildings associated with one- and two-family dwellings, NM cable has been permitted only where covered by ½″ gypsum board or other material providing at least a 15-minute fire resistance rating. The Code change permits NM cable for exposed wiring in detached garages, sheds, and storage buildings associated with one- and two-family dwellings. The permission is for cable Types NM, NMC, and NMS.

Accessory buildings like children's playhouses, pool houses, game rooms, etc. are not permitted to be wired with NM cable, unless the wiring is concealed within the building construction that provides a thermal barrier of material having at least a 15-minute finish rating.

Detached garages and storage buildings associated with one- and two-family dwellings are permitted to be wired with Type NM cable.

### Summary

Type NM, NMC, and NMS cables are now permitted to be installed as exposed wiring in garages, sheds, and storage buildings associated with one- and two-family dwellings.

### Application Question

Type NM cable is run horizontally through bored holes in studs in a one-family dwelling garage. The wiring remains exposed (no finish covering the framing members). The AHJ cites the installation as a violation of the *NEC*. Is the AHJ correct?

### Answer

Yes. Section 334.15 requires that exposed NM wiring closely follow the surface of the building finish or the surface of running boards.

**Uses Permitted – Branch Circuits or Feeders – Installation Methods for Branch Circuits and Feeders – Interior Installations**

**Significance**

The ampacity of Type SE service-entrance cable used for interior wiring is no longer limited to its 60°C ampacity.

**Analysis**

The 2011 *NEC* no longer requires SE cable installed indoors to comply with the ampacity restrictions for NM cable in 334.80. Essentially, the change brings back the rule as it appeared in the 2005 *NEC*. Type SE cable is manufactured with either 75°C or 90°C rated conductors. Type SE cable can be used according to its rating, except that when embedded in thermal insulation the ampacity shall be in accordance with the 60°C temperature rating. The maximum conductor temperature rating is permitted to be used for ampacity adjustment and ambient temperature correction, if the final derated ampacity does not exceed that for a 60°C rated conductor.

**Summary**

The ampacity of Type SE cable conductors can be selected in accordance with the marked temperature rating, except that when embedded in thermal insulation the ampacity shall be in accordance with the 60°C conductor temperature rating.

**Example**

An aluminum SER (service-entrance, round) cable is to be used for a 200-A feeder circuit in a commercial building. Calculate the required conductor size when the cable is installed exposed and when the cable is embedded in thermal insulation. The conductors in the SER cable are rated for 90°C.

**Exposed feeder**

From Table 310.15(B)(16), 75°C column for aluminum conductors:

Select 4/0 conductors, 180 A. (The 75°C column ampacity must be used unless all circuit components including terminations are rated for 90°C.)

From Sections 240.4(B) and 240.6(A):

180 amperes does not correspond to a standard size overcurrent device. The next higher standard size overcurrent device (200 amps) is permitted.

Use 4/0 aluminum SER cable.

**Feeder embedded in insulation**

From Table 310.15(B)(16), 60°C column for aluminum conductors:

Select 300 kcmil conductors with a 60°C ampacity of 195 amperes.

From Sections 240.4(B) and 240.6(A):

195 amperes does not correspond to a standard size overcurrent device. The next higher standard size overcurrent device (200 amps) is permitted.

Use 300 kcmil aluminum SER cable.

## Cable Tray Installation – Marking

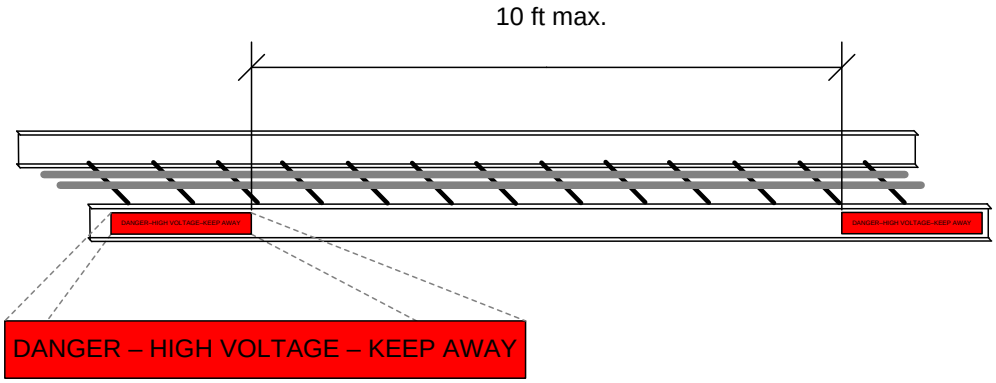
### Significance

Marking of cable trays that contain conductors operating at over 600 volts is required by the 2011 *NEC*.

### Analysis

Cable trays containing conductors rated over 600 volts shall have permanent, legible warning notices or labels containing the words "DANGER – HIGH VOLTAGE – KEEP AWAY" placed in readily visible positions on all cable trays. The warning notices or labels shall be spaced not more than 10 ft apart along the tray. Cables rated over 600 volts and cables rated 600 volts or less are still permitted in the same tray, provided that the over 600-volt cables are Type MC or are separated from cables rated 600 volts or less by a solid fixed barrier. Cable tray support systems are not limited to industrial installations where only qualified persons perform installation and maintenance, but are permitted in locations accessible to unqualified persons. The warning notices will enhance personal safety.

A cable tray marking requirement came into the Code in the 2008 cycle in Section 230.44, requiring field labeling where trays contain both service-entrance conductors and other than service-entrance conductors. This section is revised in the 2011 Code, requiring the labeling on trays containing service-entrance conductors, whether or not the tray also contains other than service-entrance conductors.




### Summary

Cable trays containing conductors rated over 600 volts shall have permanent, legible warning notices or labels containing the words "DANGER – HIGH VOLTAGE – KEEP AWAY" placed in readily visible positions on all cable trays, at intervals not exceeding 10 ft.

### Application Question

**T F** Cable trays containing conductors rated over 600 V and labeled "DANGER – HIGH VOLTAGE – KEEP AWAY" shall not contain conductors rated 600 V or less.

### Answer

False. The marked tray may contain conductors rated over 600 V and 600 V or less.

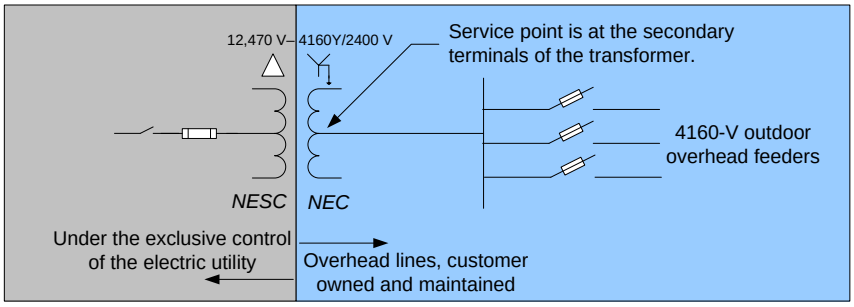
## Outdoor Overhead Conductors over 600 Volts

### Significance

Until now, there has been no guidance in the *NEC* for high-voltage overhead lines installed outdoors. Many of these installations fall under the oversight of the *National Electrical Code*.

### Analysis

For the most part, high-voltage overhead lines fall under the purview of the *National Electrical Safety Code (NESC)* rather than the *NEC*. The *NESC* is the standard used by public utilities for installation of their transmission and distribution equipment. Some overhead high-voltage lines are on the load side of the service point, and thus, constitute part of the premises wiring, rather than being under the exclusive control of the electric utility. A multibuilding industrial complex is an example of where overhead high-voltage lines installed outdoors might not be under the oversight of the serving utility. Rather, the lines might be designed, owned, and maintained by the customer. New Article 399 is introduced into the *NEC* as guidance for the safe installation of customer-owned high-voltage lines. The article contains performance requirements rather than prescriptive requirements. This allows the designer to refer to other documents, such as the *NESC*, since other documents are thorough in their coverage of overhead high-voltage lines. The *NESC* contains rules for the safeguarding of persons during the installation, operation, and maintenance of high-voltage lines and equipment. Article 399 of the *NEC* contains rules for conductor support, support structures, and insulators. Design of support structures and conductor support must be performed by a licensed professional engineer who is engaged primarily in the design of such systems. Documentation of the design shall be made available to the AHJ.




**Point of demarcation between the *NESC* and the *NEC***

There are related Code changes in Article 225 – Outside Branch Circuits and Feeders, Part III, Over 600 Volts. Existing Article 490 covers *equipment* over 600 volts.

### Summary

New Article 399 – Outdoor Overhead Conductors over 600 Volts contains rules for conductor support, support structures, and insulators. Design of support structures and conductor support must be performed by a licensed professional engineer.

**Application Question:** How is the "service point" determined?
**Answer:** The service point is "the point of connection between the facilities of the serving utility and the premises wiring," usually determined by the utility based on the conditions of service. Outdoor wiring on the load side of the service point is part of the premises wiring.

## Switch Connections – Switches Controlling Lighting Loads

### Significance

For some electricians, this new Code rule will affect the layout of cable wiring methods.

### Analysis

Where switches control lighting loads supplied by a grounded general purpose branch circuit, the grounded circuit conductor of the lighting circuit shall be provided at the switch location. The rule is meant to provide the circuitry necessary for the standby current needed for electronic lighting controls such as occupancy sensors. Presently, many devices on the market are designed to use the equipment grounding conductor to complete the circuit supplying standby current. This is due to the fact that designers of lighting controls cannot expect a grounded conductor to be present at all locations where an occupancy sensor or other lighting control might be installed. Occupancy sensors are permitted by UL 773A to have a current of up to 0.5 mA of ground leakage current on the equipment grounding conductor. Code makers anticipate this rule will promote the manufacture of lighting controls that use the grounded conductor for standby currents.

There are exceptions to the requirement. The grounded circuit conductor may be omitted from the switch enclosure where:

1) Conductors for switches controlling lighting loads enter the box through a raceway. The raceway shall have sufficient cross-sectional area to accommodate a grounded conductor installed at a later date, including accommodation for an increased size of conductors in the event that derating for multiple current-carrying conductors becomes necessary.
2) Construction remains unfinished (open) at the back side of the switch box, or where the switch box cavity is sufficiently open at the top or bottom to permit easy access to the box for future wiring.

For cable wiring, electricians that habitually run lighting circuit home runs to switch boxes will not be affected by the change. Some electricians will likely now be using cable with an additional conductor for portions of the wiring system.

### Summary

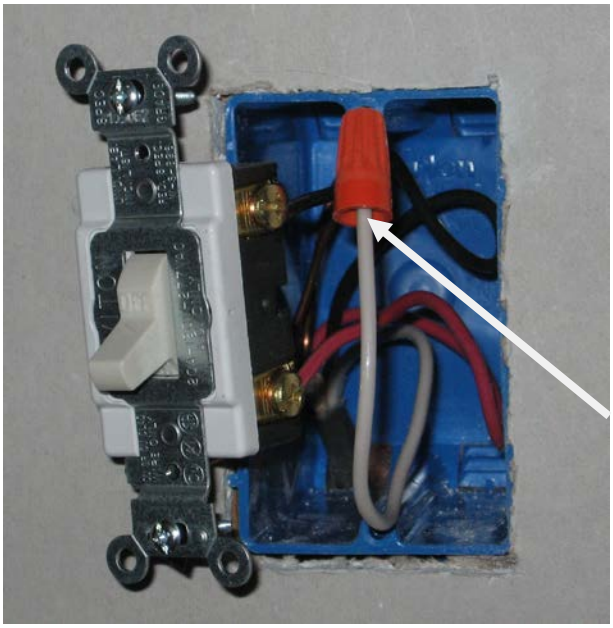
The grounded conductors of lighting circuits shall be available at switch boxes, unless a raceway wiring system is used or the building finish permits easy access to the switch box location for future wiring.

### Application Question

**T F** The new rule in 404.2(C) requiring grounded circuit conductors at switch boxes applies only to one- and two-family dwellings.

### Answer

False. The rule applies to all occupancies.



Grounded (neutral) circuit conductor for the controlled lighting circuit provided for future use

Single-pole switch controlling lighting load supplied from a grounded general purpose branch circuit

## Rating and Use of Snap Switches – Cord-and-Plug-Connected Loads

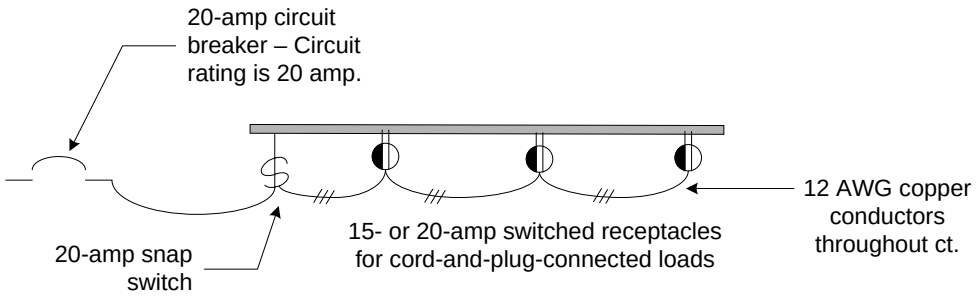
### Significance

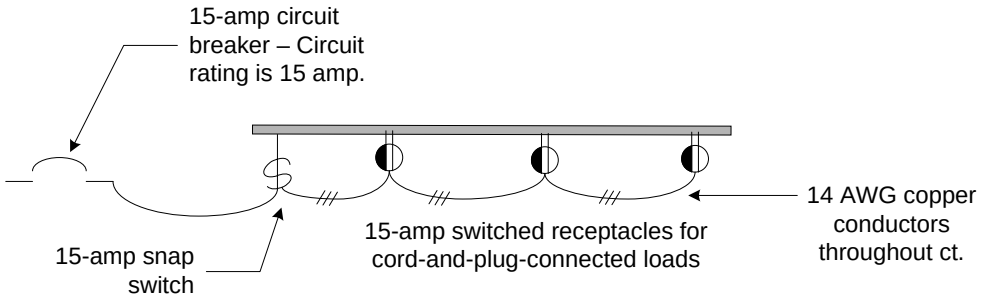
This new subsection affects the rating of snap switches that control cord-and-plug-connected loads.

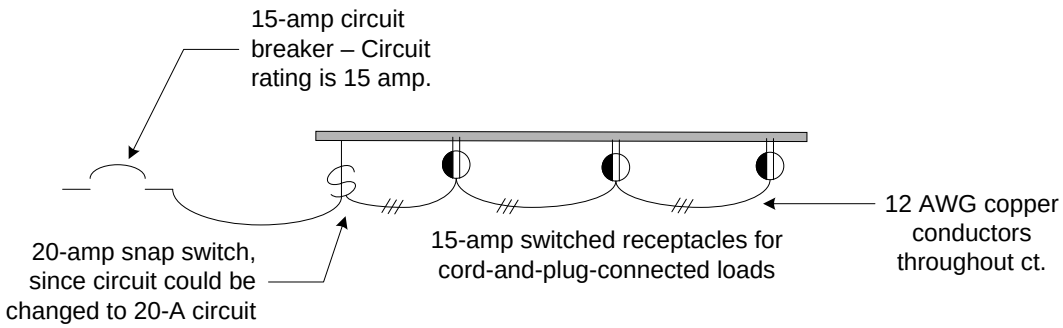
### Analysis

Section 404.14 requires snap switches to be used within their rating. However, the existing Code does not contain switch rating requirements for loads that are not hard-wired, such as variable and interchangeable cord-and-plug-connected loads supplied by receptacles and cord pendants. Section 210.50(A) states that a cord pendant shall be considered a receptacle outlet. Thus, cord pendants are included in the requirement. The new rule requires the rating of the snap switch to be based on the circuit rating when the switch controls cord-and-plug-connected loads on a general-purpose branch circuit. For example, consider the Code-compliant installation of several 15-amp receptacles connected on a general-purpose branch circuit rated at 20 amperes. The rating of a snap switch for switching receptacles on this circuit is not clear in the 2008 *NEC*. This new rule requires a snap switch rating of 20 amps, the rating of the circuit. There is one exception to the rule. When a snap switch controls only one receptacle (a single receptacle, not a duplex), the switch rating must not be less than the rating of the receptacle.

The rule actally goes a bit further. The rating of the snap switch must not be less than the highest rating of overcurrent protective device that could be used on the circuit, in accordance with 210.21(B). If a 15-A overcurrent device is used on a circuit where a 20-A overcurrent device is permitted, the snap switch rating shall be 20 amperes.






**Summary**

The rating of a snap switch that controls multiple receptacles on a general-purpose branch circuit for cord-and-plug-connected loads shall not be less than the *permitted* rating of the branch circuit.

**Application Question**

**T F** The rating of the receptacles connected on a branch circuit determines the rating of the branch circuit.

**Answer**

False. The rating of the circuit is determined by the rating of the overcurrent device protecting the circuit. [210.3]

**Code Refresher**

- ✓ A general-purpose branch circuit is a circuit that supplies two or more receptacles or outlets for lighting and appliances. [Article 100 – Definitions]
- ✓ Where connected to a branch circuit supplying two or more receptacles, a receptacle shall not supply a total cord-and-plug-connected load of more than 12 amps for a 15-amp receptacle, or more than 16 amps for a 20-amp receptacle (not more than 80% of the receptacle rating). [210.21(B)(2)]

## General Installation Requirements – Replacements – Arc-Fault Circuit-Interrupter Protection

### Significance

This very significant revision becomes effective on January 1, 2014. It requires AFCI protection for replacement receptacles on specific circuits in dwelling units.

### Analysis

This new rule is similar to the existing rule requiring GFCI-protected receptacles to be installed where replacements are made at receptacle outlets that are required to be GFCI-protected elsewhere in the Code. Where a receptacle outlet is supplied by a branch circuit that requires arc-fault circuit-interrupter protection elsewhere in the Code, a replacement receptacle at this outlet shall be one of the following:

1) A listed outlet branch-circuit type AFCI receptacle
2) A receptacle protected by a listed outlet branch-circuit type AFCI receptacle
3) A receptacle protected by a listed combination-type AFCI circuit breaker

The options permit the use of AFCI circuit breakers and AFCI receptacles. However, at the time of printing of the 2011 *NEC*, receptacle-type AFCIs were not yet available. It remains to be seen if these devices will function as well as AFCI circuit breakers, without major nuisance tripping problems.

This new requirement is related to a new rule in 210.12(B), Branch Circuit Extensions or Modifications – Dwelling Units. Section 210.12(B) has an effective date of January 1, 2011, or whenever the 2011 *NEC* is adopted, and requires AFCI protection for specific branch circuits that are extended or modified in existing dwellings. Section 406.4(D)(4) requires AFCI-protected replacement receptacles connected to specific branch circuits in existing dwellings.

This new rule will add AFCI protection to certain receptacle circuits, or portions thereof, in exiting dwellings, enhancing the safety of older wiring.

### Summary

Where a receptacle outlet is supplied by a branch circuit that requires arc-fault circuit-interrupter protection, a replacement receptacle at this outlet shall be a listed outlet branch-circuit type AFCI receptacle, a receptacle protected by a listed outlet branch-circuit type AFCI receptacle, or a receptacle protected by a listed combination-type AFCI circuit breaker.

### Application Question

**T F** A branch circuit supplying convenience receptacles in the living room of a 20-year old single-family dwelling can be extended without installing AFCI protection for the receptacles, as long as the installation is completed before January 1, 2014.

### Answer

False. Protection of the *branch circuit* is required after the 2011 *NEC* has been adopted. AFCI protection for *replacement receptacles* is effective on January 1, 2014.

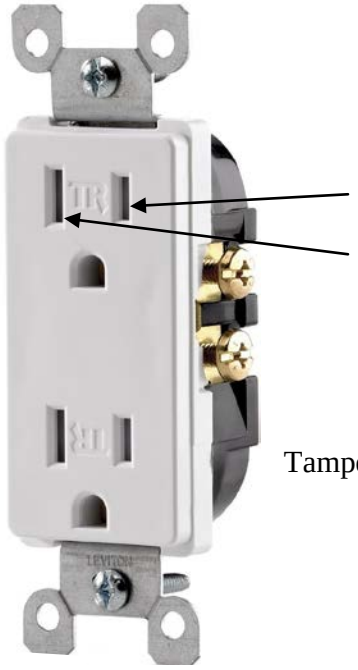
## General Installation Requirements – Replacements – Tamper-Resistant Receptacles

### Significance

While the *National Electrical Code* is not a document with retroactive rules, enhanced safety is obtained by requiring new technology equipment to be installed when replacing older equipment.

### Analysis

Such is the case when replacing receptacle outlets. Listed tamper-resistant receptacles shall be installed when replacing receptacle outlets that are required to be tamper-resistant elsewhere in the *NEC*. When replacing nonlocking-type, 125-volt, 15- and 20- ampere receptacles that are not tamper-resistant in dwelling units, guest rooms and guest suites, and in child care facilities, the replacement receptacles shall be tamper-resistant.




The internal live contacts of a tamper-resistant receptacle are not exposed (or energized) unless simultaneous pressure is imposed on both the hot and neutral slots, as with the blades of a two-wire attachment plug.

Tamper-resistant (TR) receptacle

### Summary

Listed tamper-resistant receptacles shall be installed when replacing receptacle outlets that are required to be tamper-resistant elsewhere in the *NEC*.

### Application Question

When replacing a defective GFCI receptacle in a dwelling unit bathroom, does the replacement receptacle need to be tamper-resistant?

### Answer

Yes. The replacement must be made with a tamper-resistant, GFCI-protected receptacle.

### Code Refresher

- ✓ GFCI-protected receptacles shall be installed where replacements are made at receptacle outlets that are required to be GFCI protected elsewhere in the *NEC*. [406.4(D)(3)]

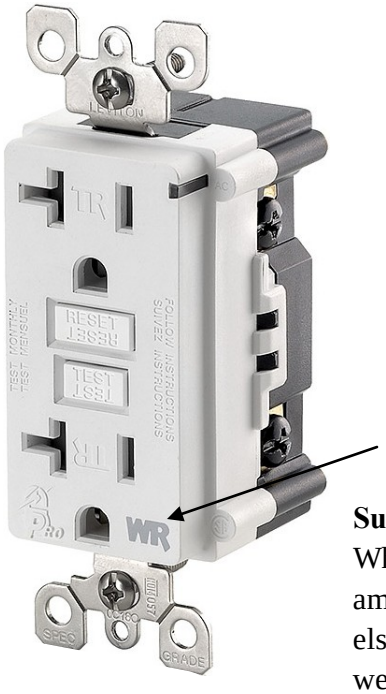
## General Installation Requirements – Replacements – Weather-Resistant Receptacles

### Significance

Studies have shown that GFCI receptacles installed outdoors fail at more than twice the failure rate for GFCI receptacles in any other location. The requirement for weather-resistant receptacles introduced in the 2008 *NEC* to address this problem is expanded in the 2011 Code.

### Analysis

Listed weather-resistant (WR) receptacles shall be installed when replacing receptacle outlets that are required to be weather-resistant elsewhere in the *NEC*. The requirement applies when replacing nonlocking-type, 125- and 250-volt, 15- and 20-ampere receptacles in damp and wet locations, as specified in 406.9. The damp and wet locations in Section 406.9 are not limited to specific occupancies, e.g., dwelling units, but apply broadly to all damp and wet locations.




Listed weather-resistant (WR) receptacle

### Summary

When replacing nonlocking-type, 125- and 250-volt, 15- and 20-ampere receptacles that are required to be weather-resistant elsewhere in the Code, the replacement receptacles shall be listed weather-resistant receptacles.

### Application Question

**T F** An outdoor convenience receptacle at a dwelling unit is required to be a listed weather-resistant, tamper-resistant, GFCI-protected receptacle.

### Answer

True. See Sections 406.9, 210.8(A)(3), and 406.12.

### Code Refresher

- ✓ "Damp locations" are locations protected from the weather and not subject to saturation with water or other liquids but subject to moderate degrees of moisture. Examples of damp locations are partially protected locations under canopies and roofed open porches, and interior locations subject to moderate degrees of moisture, such as some basements, some barns, and some cold-storage warehouses. [Article 100 – Definitions]

## Receptacles in Damp or Wet Locations – Wet Locations – 15- and 20-Ampere Receptacles in a Wet Location

### Significance

Field inspections have determined that a more durable in-use cover is needed for receptacles installed in wet locations on enclosures supported from grade.

### Analysis

Where receptacles are installed in wet locations on enclosures supported from grade, in-use covers are now required to be identified as "extra-duty." "Supported from grade" includes mounting on an independent free-standing post, stanchion, pillar, conduit, or other rigid material. Sections 314.23(B) and 314.23(F) contain requirements for supporting enclosures from grade. The more durable hoods will be beneficial for harsh work environments such as outdoor receptacles at construction sites. Section 590.4(D)(2) applies the same new requirement to temporary installations.

The new rule applies to 15- and 20-ampere, 125- and 250-volt receptacles installed in wet locations on other than one- and two-family dwelling property. Requirements for extra-duty outlet box hoods are found in ANSI/UL 514D-2000, *Cover Plates for Flush-Mounted Wiring Devices.*

An "extra-duty" hood

Courtesy of Midwest Electric Products, Inc.

### Summary

For other than one- and two-family dwellings, an outlet box hood installed on an enclosure supported from grade as described in 314.23(B) or (F) shall be identified as extra-duty. The rule applies to 15- and 20-ampere, 125- and 250-volt receptacles installed in wet locations.

### Application Question

Does the requirement for an extra-duty hood apply for a convenience receptacle installed in a wet location mounted on an exterior wall of a commercial building?

### Answer

No. The rule only applies where the enclosure is supported from grade.

## Tamper-Resistant Receptacles in Dwelling Units

### Significance

A new exception to this section lists four locations where tamper-resistant receptacles are not required for dwelling unit electrical installations.

### Analysis

The general rule from the previous Code requires all 125-volt, 15- and 20-ampere receptacles in dwelling unit areas specified in 210.52 to be listed tamper-resistant receptacles. A change in the 2011 Code is that locking-type receptacles are not required to be tamper-resistant. Another change for this Code cycle is the exemption from the tamper-resistant requirement for receptacles in the following locations:

1. Receptacles located more than 5½ ft above the floor
2. Receptacles that are part of a luminaire or appliance
3. A single receptacle or a duplex receptacle for two appliances located within dedicated space for each appliance that is not normally moved from one place to another, and that is cord-and-plug connected in accordance with 400.7(A)(6), (A)(7), or (A)(8)
4. Nongrounding receptacles used for replacements as permitted in 406.4(D)(2)(a)

The requirement for tamper-resistant receptacles in all areas specified in 210.52 includes not only required receptacles but all receptacles installed in these areas, except for the locations listed in the new exception. Certain receptacle locations are not accessible to small children, such as receptacles behind appliances, receptacles that are integral with a luminaire or appliance, and receptacles located more than 5½ ft above the floor. Locking-type receptacles and nongrounding receptacles are not currently available as tamper-resistant receptacles. Nongrounding receptacles used for replacement of other nongrounding receptacles as permitted in 406.4(D)(2)(a) are not required to be tamper-resistant. A receptacle located behind an appliance, e.g., a refrigerator, shall not be required to be tamper-resistant. Receptacles located more than 5½ ft above the floor and receptacles that are part of a luminaire or appliance are not required to be tamper-resistant.

### Summary

Generally, all nonlocking-type, 125-volt, 15- and 20-ampere receptacles in dwelling unit areas specified in 210.52 shall be listed tamper-resistant receptacles. There are four locations where tamper-resistant receptacles are not required: receptacles located more than 5½ ft above the floor, receptacles that are part of a luminaire or appliance, receptacles located within dedicated space for appliances, and nongrounding receptacles.

### Application Question

**T F** A multioutlet assembly installed at a kitchen countertop in a dwelling unit is not required to have tamper-resistant receptacles.

**Answer**

False. The 125-volt receptacles of a multioutlet assembly, e.g., “plugmold,” are required to be tamper-resistant. They are not included in the list of exceptions to the tamper-resistant requirement. Multioutlet assemblies with tamper-resistant receptacles are available. Multioutlet assemblies are covered in Article 380.

## Tamper-Resistant Receptacles in Guest Rooms and Guest Suites

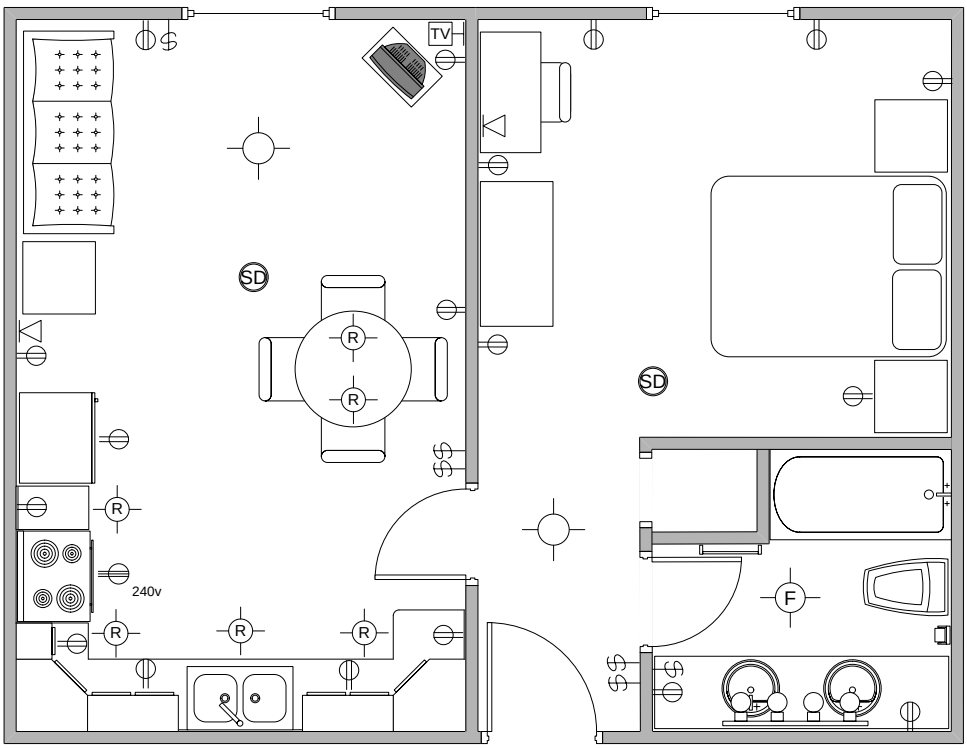
### Significance

The requirement for tamper-resistant receptacles has been expanded to include guest rooms and guest suites. The level of electrical safety and protection in these occupancies should be the same as in dwelling units.

### Analysis

All nonlocking-type, 125-volt, 15- and 20- ampere receptacles installed in guest rooms and guest suites shall be listed tamper-resistant receptacles. There are no exceptions to this new Code section.

By the existing Code, convenience receptacles in guest rooms and guest suites of hotels and motels are installed according to the same rules as receptacles for dwelling units, with some exceptions. For guest rooms and guest suites, the spacing of receptacles can be modified to accommodate the furniture layout. Also, a receptacle located behind a bed shall be located so that an attachment plug will not contact the bed, or a suitable guard shall be placed over the receptacle. According to 210.8(B) or 210.18, bathroom receptacles in guest rooms and guest suites shall be GFCI protected. According to 210.18, guest rooms and guest suites provided with permanent provisions for cooking shall have kitchen receptacles that are GFCI protected.




Guest suite of a hotel

This new Code section does not result in any change for guest rooms and guest suites provided with permanent provisions for cooking. Existing Section 210.18 requires guest rooms and guest suites that are provided with permanent provisions for cooking to have branch circuits installed to meet the rules for dwelling units. Existing Code requires tamper-resistant receptacles for dwelling units.

**Summary**

All nonlocking-type, 125-volt, 15- and 20- ampere receptacles installed in guest rooms and guest suites of hotels and motels shall be listed tamper-resistant receptacles.

**Application Question**

Are there any 125-volt receptacles in the diagram of the guest suite above that are not required to be tamper-resistant?

**Answer**

Yes. All of the 125-volt receptacles in all of the rooms and areas of the guest suite shall be listed tamper-resistant according to 406.13. However, if a single receptacle for the refrigerator is located behind the appliance making the receptacle not accessible to small children, this receptacle would be exempt from the tamper-resistant requirement. Since there are permanent provisions for cooking, 210.18 requires all branch-circuit wiring to comply with all of the applicable rules for dwelling units. A single receptacle behind the refrigerator is exempt from the tamper-resistant requirement by the exception to 406.12, Tamper-Resistant Receptacles for Dwelling Units.

**Code Refresher**

- ✓ Guest rooms and guest suites in hotel and motels, sleeping rooms in dormitories, and similar occupancies are permitted to have the receptacles located conveniently for permanent furniture layout, rather than observe the 12 ft spacing requirement (12 ft maximum between receptacles). However, the number of receptacles cannot be reduced. The minimum number of receptacles shall be the same as if the receptacles were located using the spacing requirements in 210.52(A). [210.60(B)]

- ✓ Guest rooms and guest suites equipped with permanent provisions for cooking shall have branch circuits installed to meet the rules for dwelling units. Branch circuits and outlets must meet all of the provisions in Parts I, II, and III of Article 210 that apply to branch circuits in dwelling units, including GFCI and AFCI requirements. Requirements from other Code articles that pertain to dwelling units also apply, such as the requirement for tamper-resistant receptacles. [210.18]

## Tamper-Resistant Receptacles in Child Care Facilities

### Significance

The requirement for tamper-resistant receptacles has been expanded to include child care facilities. The level of electrical safety and protection in child care facilities should be the same as in dwelling units.

### Analysis

A definition for "child care facility" has been inserted into Section 406.2. A child care facility is, "A building or structure, or portion thereof, for educational, supervisory, or personal care services for more than four children 7 years old or less." In all child care facilities, all nonlocking-type, 125-volt, 15- and 20- ampere receptacles shall be listed tamper-resistant receptacles. There are no exceptions to this new Code section. The requirement applies to all portions of a building or structure that are used as a child care facility.

A *Child Care Center Design Guide* is available from the U.S. General Services Administration that includes design guidelines for electrical safety.


### Summary

In all child care facilities, all nonlocking-type, 125-volt, 15- and 20- ampere receptacles shall be listed tamper-resistant receptacles.

### Application Question

Are tamper-resistant cover plates permitted in lieu of tamper-resistant receptacles in child care facilities?

**Answer:** No. They are not permitted for receptacles in 406.12, 406.13, or 406.14. Tamper-resistant (shuttered) faceplates have been and continue to be permitted in 517.18(C) for pediatric locations in health care facilities. However, shuttered plates are no longer UL Listed due to heat-related safety concerns. Shuttered faceplates add layers of material between the blades of an attachment plug and the receptacle contacts.

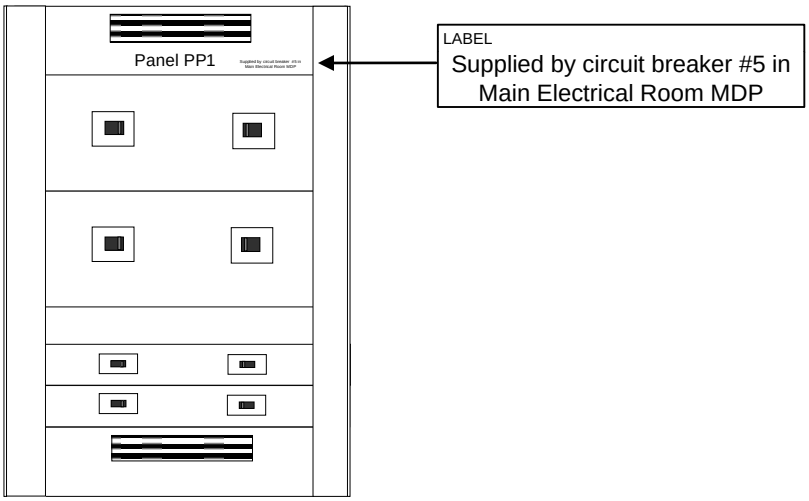
## Field Identification Required – Source of Supply

### Significance

The 2011 *NEC* requires field marking to identify the source and location of the supply for a panelboard or switchboard supplied by a feeder.

### Analysis

Marking a panelboard or switchboard with the location of its supply overcurrent device is a practice in use in some facilities. Now, it is an *NEC* requirement. In other than one- and two-family dwellings, all switchboards and panelboards supplied by a feeder shall be marked to indicate the device or equipment that supplies the panelboard or switchboard, and the location of the supply. This will be helpful in large buildings containing many electrical equipment rooms, panelboards, and switchboards. The marking will be a safety enhancement when quick shutdown is needed and for lockout-tagout procedures.




### Summary

All switchboards and panelboards in other than one- and two-family dwellings shall be marked to indicate the device or equipment that supplies the panelboard or switchboard, and the location of the supply.

### Application Question

**T F** In addition to complying with the new marking requirement in this section, individual overcurrent devices in switchboards and panelboards must be marked to identify their specific function.

### Answer

True. Section 408.4(A) requires that every circuit and circuit modification be identified as to its clear, evident, and specific purpose or use.

**Electric-Discharge Lighting Systems of 1000 Volts or Less – Disconnecting Means**

**Significance**

When a ballast is replaced in an existing luminaire without a local disconnecting means, a disconnecting means shall be installed.

**Analysis**

New in the 2008 Code was a provision that required many newly installed fluorescent luminaires to have an individual disconnecting means either internal or external to the luminaire for the safety of service personnel. The rule applies to fluorescent luminaires installed indoors, in other than dwellings and associated accessory buildings, that utilize double-ended lamps and contain ballast(s) that can be serviced in place. The rule requires an individual disconnecting means within or attached to the luminaire, or within sight of the luminaire. The disconnecting means referred to in this rule is a supplementary disconnecting means and not a wall switch, switch-duty (SWD) circuit breaker, or lighting contactor. However, there are situations where any of these items are permitted to serve as the required disconnecting means (i.e., a supplemental disconnecting means is not required). There are five exceptions to the requirement for a supplemental disconnecting means:

- For luminaires in hazardous locations
- For emergency illumination required in 700.16
- For cord-and-plug-connected luminaires
- In industrial establishments where qualified persons service the installation
- Where the design of an installation with multiple luminaires includes disconnecting means such that the illuminated space cannot be left in total darkness

2-wire luminaire disconnect

Courtesy of Ideal Industries, Inc.

A Code change now applies the rules for a disconnecting means when a ballast in an existing luminaire is replaced. A separable connector that disconnects both the grounded conductor and the ungrounded conductor to the ballast is compliant with this Code section for every situation, for both 2-wire and multiwire supply circuits.

**Summary**

When replacing ballasts in fluorescent luminaires that utilize double-ended lamps and are installed indoors in other than dwellings and associated accessory buildings, an individual disconnecting means shall be installed within or attached to the luminaire, or within sight of the luminaire.

**Application Question**

**T F** One wall switch controls all of the double-ended fluorescent lamps in an office. There is no other type of lighting in the room. The wall switch is within sight of (visible and within 50 ft from) the luminaires. When replacing a ballast in this room, a supplemental disconnecting means is not required.

**Answer**

False. A supplemental disconnecting means is required, since turning the wall switch off will leave the room in total darkness.

## Installation of Cables in Concrete or Poured Masonry Floors – Ground-Fault Circuit-Interrupter Protection

### Significance

GFCI protection for personnel for electric heating cables in concrete or poured masonry floors has been expanded to include kitchen floors.

### Analysis

The 2008 *NEC* requires that ground-fault circuit-interrupter protection for personnel be provided for cables installed in electrically heated floors in bathrooms and in hydromassage bathtub locations. The requirement has been expanded to include electrically heated kitchen floors. The rule will reduce the shock hazard that could exist between the conductive floor (particularly when wet) and grounded objects. The rule still applies, though, if the conductive floor is covered with non-conductive flooring. The requirement is not limited to specific buildings or occupancy types.

Some floor heating cables are intended to be embedded in concrete. Other heating cables are designed to be covered with masonry-like cement for setting ceramic tiles, marble, or stone.

Leads shall be protected where they leave the floor by rigid metal conduit, intermediate metal conduit, rigid nonmetallic conduit, electrical metallic tubing, or by other approved means.

Floor heating cable for tile or stone

Floor heating cable for embedding in concrete

*Courtesy of Tyco Thermal Controls*

### Summary

Ground-fault circuit-interrupter protection for personnel shall be provided for cables installed in electrically heated floors in kitchens. Existing Code requires this protection for electrically heated floors in bathrooms and hydromassage tub locations.

### Application Question

**T F** GFCI protection for personnel for electric heating cables in concrete or poured masonry floors in kitchens, bathrooms, and in hydromassage bathtub locations does not apply to 240-volt circuits.

### Answer

False. Since the Code rule does not mention voltages, GFCI protection is required for both 120- and 240-volt heating circuits.

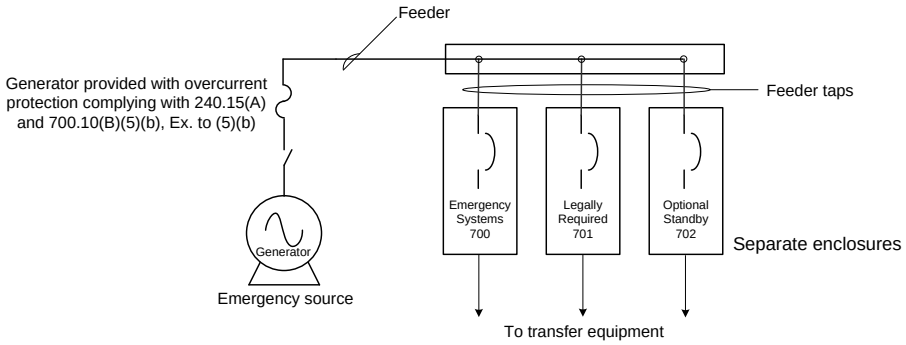
## Generators Supplying Multiple Loads

### Significance

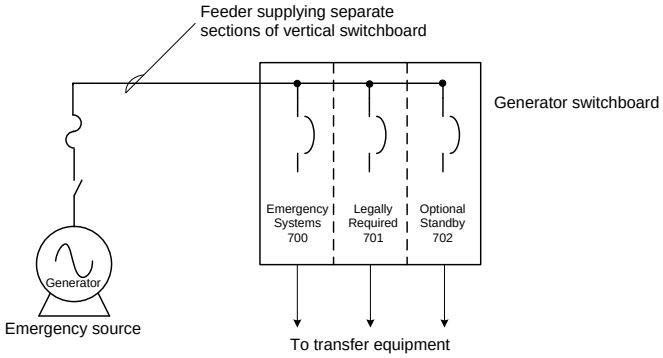
Generators are often used to supply multiple loads. Understanding the applications of feeder tap rules for connecting generator loads is necessary for Code compliance and can provide flexibility in design.

### Analysis

One method for supplying multiple loads from a single generator (or multiple generators connected for parallel operation) is by using feeder taps in accordance with 240.21(B). Part of the reason for the change in 445.19 is to ensure that a tap is not made from a conductor that is itself a tap. Generator windings are protected by an integral overcurrent device. If a generator(s) is provided with overcurrent protection meeting the requirements of 240.15(A), individual enclosures may be supplied by taps from a single feeder as shown in the diagram below. The illustration shows an application of an emergency source connected to supply multiple systems/loads. In this application, generator overcurrent protection must also comply with 700.10(B)(5).




Section 445.19(1) in the 2008 Code, and unchanged in the 2011 Code, permits a generator(s) to supply multiple loads by supplying a switchboard with multiple sections as shown in the diagram below.



There is a related Code change in 700.10(B)(5). This section contains rules for using an emergency source to supply any combination of emergency, legally required, or optional loads. Section 700.10(B)(5) permits the use of single or multiple feeders to supply distribution equipment between an emergency source and the point where the combination of emergency, legally required, or optional loads are separated. Where multiple generators connected for parallel operation connect to a common supply bus, the bus is the source rather than the individual generators.

Where a generator serves as an emergency source, the requirements in both 445.19 and 700.10(B)(5) must be complied with, as well as other applicable sections of these articles.

**Summary**

A single generator supplying more than one load, or multiple generators operating in parallel, shall be permitted to supply a vertical switchboard with separate sections, or individual enclosures with overcurrent protection tapped from a single feeder if a generator(s) is provided with overcurrent protection meeting the requirements of 240.15(A).

**Application Question**

**T F** *Multiple feeders* means the same as feeders in parallel.

**Answer**

False. Conductors in parallel are connected to the same point at the supply end and the same point at the load end. Multiple feeders are not the same as parallel feeders.

**Code Refresher**

- ✓ A “tap conductor” is a conductor, other than a service conductor, that has overcurrent protection ahead of its point of supply that exceeds the value permitted for similar conductors that are protected as described in 240.4. [240.2, Definitions]

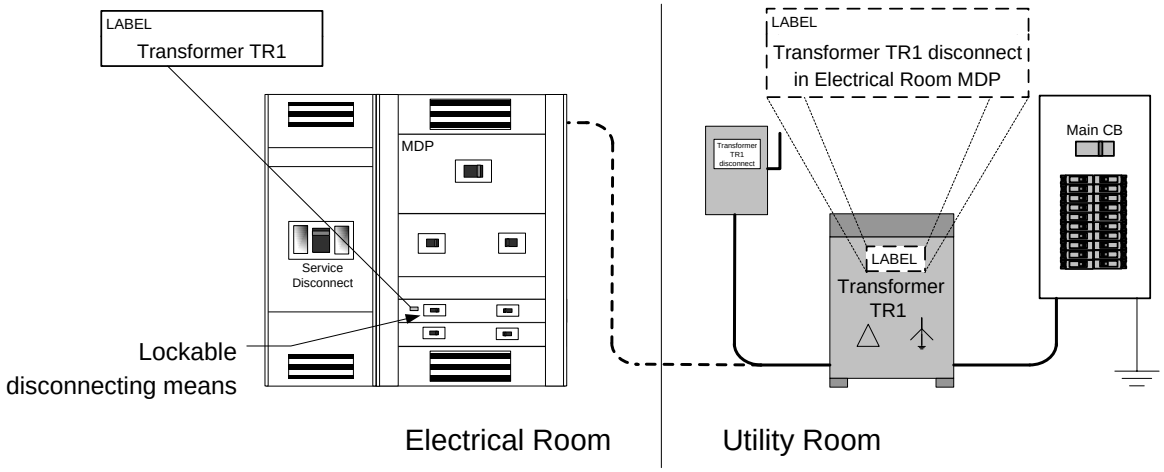
## Transformers – Disconnecting Means

### Significance

New rules require an individual disconnecting means for each power transformer. Application of this new section will result in a safer workplace for maintenance electricians servicing transformers.

### Analysis

The general practice has been to provide a disconnecting means for transformers, but the requirement for a disconnect for each transformer is new. Section 240.21(B)(3) in the existing Code permits multiple transformers supplied by taps to a common feeder to be disconnected by a single feeder disconnect. This arrangement can create an unsafe condition for persons servicing transformer equipment. Also, since a single transformer cannot be isolated, power continuity may be unnecessarily interrupted. The new rule requires a disconnect for each transformer located in sight from the transformer or in a remote location. Where the disconnect is located in a remote location, it shall be capable of being locked open. Also, the location of the remote disconnect shall be field marked on the transformer. The new disconnecting requirements do not apply to Class 2 or Class 3 power supply transformers.




### Summary

Transformers, other than Class 2 or Class 3, shall have a disconnecting means in sight from the transformer, or the disconnect shall be lockable and its location marked on the transformer.

### Application Question

A transformer disconnect is located 65 ft from a transformer and is visible from the transformer location. Does this installation meet the requirement for “in sight from”?

Answer

No. The Article 100 definition for “in sight from” states that one equipment must be visible and not more than 50 ft distant from the other equipment.

## Circuit Disconnects – General

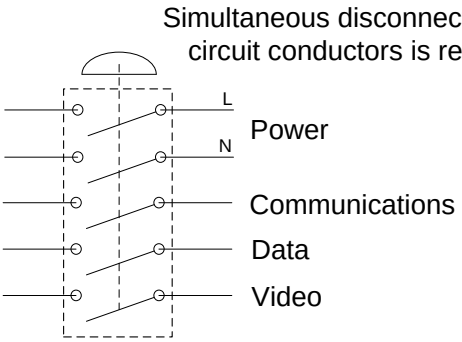
### Significance

This change will enhance the safety of consumers and persons servicing gasoline dispensing equipment by ensuring disconnection of all electric circuits run to dispensers.

### Analysis

The 2008 *NEC* was not clear that circuits in addition to the ac supply for a gasoline dispenser needed to have an emergency disconnecting means. The 2011 *NEC* requires that each circuit leading to or through dispensing equipment, including all associated power, communications, data, and video circuits, and equipment for remote pumping systems, have an emergency disconnecting means located remote from the dispensing devices. The disconnecting means must be clearly identified and readily accessible. It shall simultaneously disconnect all circuit conductors from their source of supply. A similar change in 514.13 requires disconnection of all circuits for maintenance and service, except that simultaneous disconnection is not part of the requirement.


Courtesy of Dresser, Inc.




### Summary

An emergency disconnecting means shall be provided to simultaneously disconnect all electric circuits, including communications, data, and video circuits run to fuel dispensing equipment.

### Application Question

For unattended self-service motor fuel dispensing facilities, the emergency controls specified in 514.11(A) must be located _____ from dispensers.

A. within 20 ft
B. within 50 ft
C. between 20 ft and 100 ft

**Answer:** C [514.11(C)]

## Receptacles with Insulated Grounding Terminals

### Significance

Receptacles with insulated grounding terminals are no longer permitted in patient care areas of health care facilities.

### Analysis

The grounding terminal of an isolated ground (IG) receptacle, as described in 250.146(D), is isolated from the metal yoke of the receptacle. These receptacles are used in circuits intended to reduce noise (electromagnetic interference) on the equipment grounding circuit by employing an insulated equipment grounding conductor from the receptacle grounding terminal all the way back to the service or system equipment grounding conductor terminal. A different grounding means meeting the requirements of 250.118 is used for grounding other metal parts of the circuit, such as the raceway system, metal receptacle yoke, and metal box.

Isolated ground receptacles are sometimes used in circuits supplying sensitive electronic equipment and computers in patient care areas of health care facilities. In order to meet the redundant grounding requirements of 517.13, an IG receptacle used in a patient care area required three grounding conductors: 1) the metal raceway or metal cable armor required by 517.13(A), 2) the insulated grounding conductor required by 517.13(B), and 3) the insulated grounding conductor connected to the isolated grounding terminal as required in 250.146(D). Only one equipment grounding conductor was connected to the isolated terminal of the IG receptacle. Since it is not a Code requirement to connect the equipment grounding terminal of an IG receptacle to a metal box (see 250.148, Exception), the IG receptacle did not have a redundant grounding system as required for patient care areas. A typical receptacle connected on a branch circuit with redundant grounding will have both ground paths available: the grounding conductor, and the metal raceway or cable armor.

Since the redundant grounding provision for safety of persons, and the isolated ground feature for electrical noise reduction cannot be adequately achieved simultaneously, the 2011 Code prohibits the installation of IG receptacles in patient care areas. Patient care areas are not exclusive to hospitals, but can include portions of nursing homes, limited care facilities, clinics, medical and dental offices, and ambulatory care centers.

### Summary

Receptacles with insulated grounding terminals are no longer permitted in patient care areas of health care facilities.

An isolated ground receptacle is identified by an orange triangle.

### Application Question

**T F** The 2011 *NEC* prohibits installation of IG receptacles in a dentist's examining room.

### Answer

True. See the definitions of "health care facilities" and "patient care area" in 517.2.

## Ground-Fault Protection

### Significance

Numerous deaths have been reported from "electric shock drowning." New Section 555.3 will require changes in the way electrical systems are designed for docks, piers, and storage and service areas of marinas and boatyards.

### Analysis

Article 555 applies to public and private docking, storage, repair, and fueling facilities for small craft (not exceeding 300 gross tons). Private, noncommercial docking facilities associated with single-family dwellings are not covered by this article. Docking facilities associated with residential condominiums, yacht clubs, and similar occupancies are within the scope of Article 555.

The goal of the new requirement is to reduce or eliminate currents in the water due to wiring faults at marinas that have been the cause of numerous deaths due to electric shock drowning. Both the marina wiring and the wiring on boats docked at the marina can be the source of the faulty wiring. Faults can result in energized metal equipment, structures, or the metal hull of boats coming in contact with bodies of water. Energized metal in contact with water can introduce currents in the water that can cause muscle paralysis affecting a person's ability to maneuver in the water. The reported deaths and injuries seem to be limited to fresh water. It is thought that because of the better conductivity of salt water, that a voltage gradient in salt water high enough to cause muscle paralysis is not likely.

The new requirement mandates ground-fault protection not exceeding 100 mA for the main overcurrent device feeding a marina. Ground-fault protection for each branch or feeder circuit shall be permitted as an alternative. The designation of a maximum 100 mA trip level is intended to avoid nuisance tripping as much as possible, while providing some level of ground-fault protection for personnel. Since there are many paths for current in the water, it is possible that even this high level of ground-fault protection will provide some protection for someone swimming or floating. A person standing in water and simultaneously contacting an energized part will be protected only if a GFCI device (5 mA trip) is in use. Besides the typical Class A GFCI device, an Equipment Ground-Fault Protective Device (EGFPD) and a device for Ground-Fault Protection of Equipment (GFPE) are available products that could be used to meet the NEC requirement. GFPEs are generally used to comply with 230.95 for service overcurrent protective devices, and are available in trip ratings of 30 mA and higher. EGFPDs are intended for applications such as fixed outdoor electric deicing and snow-melting equipment (426.28), and are available in trip ratings from 6 mA to 50 mA.

There is normal leakage current to ground associated with electronic equipment such as computers, televisions, etc. that could add up to a significant level depending on the number of appliances or equipment connected to a circuit; thus, the prescribed 100 mA setting. Obviously, the lower the trip setting on the protective device, the better the protection.

Since the new ground-fault requirement applies generally to marinas, rather than to specific outlets or circuits, the required protection includes shore power to boats. GFCI protection for personnel is already required for 15- and 20-A, single-phase, 125-V receptacles installed for other than shore power. The AHJ might accept a monitoring system that would operate a shunt-trip breaker upon detection of a pre-set ground fault as meeting the new requirement. This section will need additional work during the 2014 Code cycle.

There is an identical change in Article 553 – Floating Buildings.

Electric power pedestals at a marina

**Summary**

The main overcurrent protective device for a marina shall have ground-fault protection not exceeding 100 mA, or ground-fault protection shall be provided for each feeder or branch circuit.

**Application Question**

**T F** The new ground-fault requirement in 555.3 is intended for the protection of persons rather than equipment, even though a setting of up to 100 mA is permitted for the ground-fault device.

**Answer**

True. Only a GFCI device with a 5 mA trip setting is designed to protect persons. However, the higher trip setting permitted in this section has been chosen in an effort to prevent nuisance tripping, while also providing a level of shock protection.

## Ground-Fault Protection for Personnel – Receptacle Outlets

### Significance

The 2011 *NEC* requires specific receptacles that are a part of portable generators to have GFCI protection for personnel. This change has important implications for the connection of portable generators used to supply standby power to buildings.

### Analysis

Receptacles used to supply temporary power to equipment used by personnel during construction, remodeling, maintenance, repair, or demolition of buildings, structures, equipment, or similar activities are the subject of this Code revision. The provisions apply to receptacles supplied by a utility or an on-site power source, such as a generator. The most significant change involves receptacles integral with portable generators.

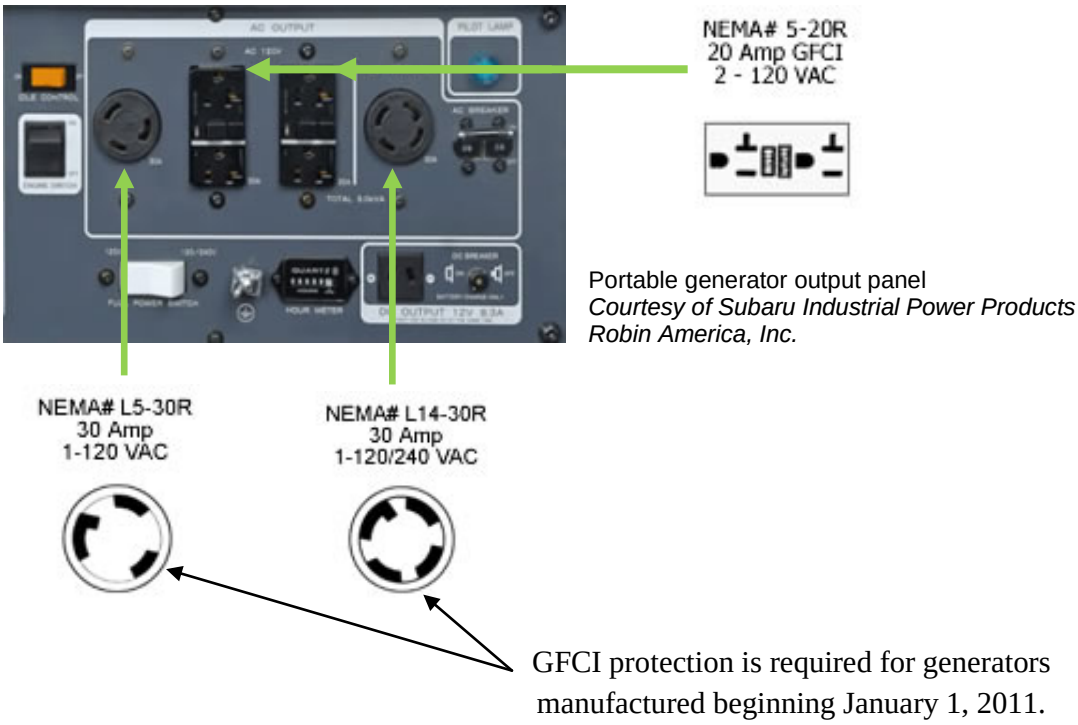
Ground-fault circuit-interrupter protection for personnel is now required for all 125-volt and 125/250-volt, single-phase, 15-, 20-, and 30-ampere receptacle outlets that are a part of a 15 kW or smaller portable generator. Listed cord sets or devices incorporating listed GFCI protection for personnel that are identified for portable use are permitted for use with 15 kW or smaller portable generators manufactured or remanufactured prior to January 1, 2011.

All 15- and 20-ampere, 125- and 250-volt receptacles, including those that are part of a portable generator, used in damp or wet locations shall be a listed weather-resistant type. Also, these receptacles are required to have covers for damp or wet locations as applicable, in accordance with the provisions of 406.9(A) and (B). Where these receptacles are part of a portable generator, the covers shall be weatherproof whether or not the attachment plug cap is inserted.

All 125-volt, single-phase, 15-, 20-, and 30-ampere receptacle outlets that are not part of the permanent wiring of a building or structure and that are in use by personnel shall have GFCI protection for personnel. Where these receptacles are part of the permanent wiring system and are used for temporary power, GFCI protection for personnel is permitted to be provided by GFCI receptacles or by listed cord sets or devices incorporating GFCI protection for personnel.

The rules in Article 590 do not apply for portable generators connected to homes and other buildings to supply standby power. However, the new rules in Article 590 have implications for portable generators used for standby power. Effective January 1, 2011, portable generators rated 15 kW or less must be equipped with GFCI protection for all 125-volt and 125/250-volt, single-phase, 15-, 20-, and 30-ampere receptacles that are part of the generator. It is common practice to patch between a generator's 125/250-volt receptacle and a manual transfer switch to supply backup power to a residence. The GFCI protection for the 125/250-volt receptacle on the generator will not function properly in this arrangement, if the generator frame makes contact with the earth. With the neutral connected to earth both at the generator and at the building being supplied, a parallel neutral current will flow in the earth. The electrician will have to decide whether to operate the generator as a separately derived system or as a nonseparately derived system, and perform the grounding and bonding accordingly. Perhaps the simplest installation

is to install the generator as a nonseparately derived system. The factory bonding jumper between the generator neutral and frame would have to be removed. A ground rod could be driven at a predetermined place where the portable generator will be located when in use, and the generator frame would connect to the ground rod. Lastly, but extremely important, an equipment grounding conductor will need to be included in the cable between the generator and the building service panel. The conductor will connect the generator frame to the building panel neutral. In the event that the generator frame becomes energized, the fault clearing path will be through the equipment grounding conductor to the building panel neutral, and back out to the generator winding.




Portable generator output panel
*Courtesy of Subaru Industrial Power Products Robin America, Inc.*

**Summary**

Ground-fault circuit-interrupter protection for personnel is now required for all 125-volt and 125/250-volt, single-phase, 15-, 20-, and 30-ampere receptacle outlets that are a part of a 15 kW or smaller portable generator.

**Application Question**

**T F** For 15 kW or smaller portable generators at construction sites that are manufactured on or after January 1, 2011, portable GFCI devices can be used in lieu of GFCI protection integral with the generator receptacles.

**Answer**

False. Portable generators rated 15 kW or smaller manufactured on or after January 1, 2011 must be equipped with GFCI-protected receptacles.