

LEVITON®

CAPTAIN CODE®

Guide to the

2017

NEC® Code Changes



**Includes Expert Commentary
on Over 60 Code Changes**

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LEVITON

CAPTAIN CODE®
GUIDE TO THE
2017
NEC® Code Changes



Introduction

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This includes electrical inspectors, electricians, electrical engineers and other similarly qualified professionals. This Pocket Guide is intended to be used with the National Electrical Code and not as a replacement for it. Obtain the 2017 NFPA 70® to ensure compliance.

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Scope, Purpose and Cautions

This Guide was developed to convey the primary changes to the 2017 NEC when compared to the 2014 NEC.

This enables electrical and low-voltage professionals to keep informed and stay in Code compliance from one Code cycle to the next. Articles covered primarily relate to Wiring Devices and Communications Systems with limited discussion of Over-Current Protection, Raceways, Wires, Luminaires, Emerging Markets and other mainstream requirements.

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Text Legend	
Category	Color/Style
Summary of Change	Standard black text
Actual NEC text from NFPA 70	Serif-style font within green box
Expert analysis	Standard black text
New NEC text for 2017	Shaded serif-style font within green box
Previous 2014 NEC text, removed for 2017	Crossed-out text
Leviton commentary	Insights from Leviton Manufacturing are in green text
Leviton Solutions	Leviton solutions which address applicable code articles are in blue text

Vertical Market Legend	
Global (Applies to all applications) 	Healthcare 
Commercial/Industrial 	Hospitality 
Education 	Institutional 
Entertainment 	Recreational 
Sustainability 	Residential 

Vertical market icons appear to help identify and categorize specific code changes

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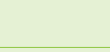







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Revision

100 Accessible, Readily (Readily Accessible)

Change Summary

- The use of a key is not considered taking an action such as the use of a “tool” to gain ready access. Crawling under something is not considered readily accessible.

NEC® Text

Accessible, Readily (Readily Accessible). Capable of being reached quickly for operation, renewal, or inspections without requiring those to whom ready access is requisite to take actions such as to use tools (other than keys), to climb over or under, to remove obstacles, or to resort to portable ladders, and so forth.

Informational Note: Use of keys is a common practice under controlled or supervised conditions and a common alternative to the ready access requirements under such supervised conditions as provided elsewhere in the NEC.

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(See NEC for complete text)

Expert Analysis



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The definition of readily accessible has once again been revised for clarity. The phrase “to actions such as to use tools” was added in the 2014 NEC revision cycle. This added phrase concerning tools was interpreted by some Code users as a prohibition against the use of a key to gain access to an object needing ready access. CMP-1 clarified that locks do not prevent equipment from being readily accessible by adding the phrase

“other than keys” following the word “tools” in this definition for the 2017 NEC. This revision will continue to allow a panelboard cover to be locked with a key while recognizing that the overcurrent devices located behind the panelboard’s operable lid or door are still “readily accessible.”

This definition also described having “to climb over or remove obstacles, or to resort to portable ladders, and so forth” as actions that would prohibit meeting the definition of “readily accessible.” For the 2017 NEC, having to crawl “under” obstacles was added to the definition.

New



110.14(D) Electrical Connections

Change Summary

- New requirements were added for the use of tightening torque tools where torquing is indicated.

NEC® Text

(D) Installation. Where a tightening torque is indicated as a numeric value on equipment or in installation instructions provided by the manufacturer, a calibrated torque tool shall be used to achieve the indicated torque value, unless the equipment manufacturer has provided installation instructions for an alternative method of achieving the required torque.

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Expert Analysis



Use of proper torque tools is essential to verify that terminations are properly made, and the equipment will function properly throughout its expected service life. Without the use of the proper torquing tools, it



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has been shown that even experienced electricians cannot consistently tighten terminations to the recommended torque value. For electrical connections, the adage “hand tight plus a quarter turn” is not sufficient to produce a proper mechanical connection. In articles published by IAEI in the July-August 2010 and January-February 2015 IAEI magazine, research indicated that only about 25% of connections performed without a torque wrench were within +/- 20% of the manufacturer’s recommended torque value. That means 75% of the connections were wrong!

Revision



210.8(A)(7) Ground-Fault Circuit-Interrupter Protection for Personnel

Change Summary

- Measurement criteria at dwelling unit sinks were revised for clarity in determination of which receptacles around these sinks would and would not require GFCI protection.

NEC® Text

210.8 Ground-Fault Circuit-Interrupter Protection for Personnel. Ground-fault circuit-interrupter protection for personnel shall be provided as required in 210.8(A) through (D) (E). The ground-fault circuit-interrupter shall be installed in a readily accessible location.

Informational Note: See 422.5(A) for GFCI requirements for appliances.

For the purposes of this section, when determining distance from receptacles, the distance shall be measured as the shortest path the cord of an appliance connected to the receptacle would follow without piercing a floor, wall, ceiling, or fixed barrier, or passing through a door, doorway, or window.

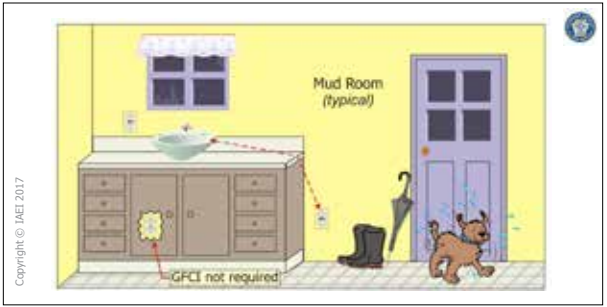
(A) Dwelling Units. All 125-volt, single-phase, 15- and 20-ampere receptacles installed in the locations specified in 210.8(A)(1) through (10) shall have ground-fault circuit-interrupter protection for personnel.

(7) Sinks — where receptacles are installed within 1.8 m (6 ft) of from the outside top inside edge of the sink bowl of the sink.

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Expert Analysis

The 2014 NEC dictated that all 125-volt, single-phase, 15- and 20-ampere receptacles installed within 1.8 m



Note: Same requirement at 210.8(B)(5) for non-dwelling unit sinks

(6 ft) of any dwelling unit sink required GFCI protection. With literal interpretation, this 2014 NEC modification brought about some unintended circumstances such as mandated GFCI protection for a receptacle under the kitchen sink for a garbage/waste disposer.

For the 2017 NEC, revisions to this list item (7), along with an addition to the parent text of 210.8 will eliminate the necessity for GFCI protection for receptacles installed inside a cabinet (such as a receptacle for the garbage disposer) as the measurement to the sink would constitute “penetrating a cabinet door” in order to achieve this required 1.8 m (6 ft) measurement. This revision makes it clear that the measurement from the receptacle to the sink ends or begins at the “top inside edge of the bowl” of the sink rather than the “outside edge” of the sink. The outside edge of a sink is three dimensional and could include the bottom of the bowl, which apparently was an unintended interpretation. In today’s modern dwelling units, it is not difficult to find some unconventional sinks. This would include such things as a free-standing bowl that sits atop a countertop with no recess into the countertop at all. This revised text will help with consistent interpretation as to the method of measurement for these types of sinks.

This same revision occurred at 210.8(B)(5) for GFCI protection and measurements at a non-dwelling unit sink. Nothing previously stated concerning the measurement methodology at a dwelling unit sink would change for a sink at a commercial office break room or any other non-dwelling unit sink location.

The Leviton SmartlockPro® Self-Test GFCI tests itself even if you forget. Designed to meet the latest UL standard for auto-monitoring (self-test) our complete

line of self-test GFCIs periodically conduct an automatic internal test to confirm that it can respond to a ground fault. With the slimmest profile on the market, the device allows for fast and easy installation, while Leviton's patented reset lockout mechanism prevents reset of the GFCI if it is not wired or operating correctly. The SmartlockPro® Self-Test GFCI is the smart choice in ground fault circuit interrupter protection.



Cat. No. GFTR1-W

Revision



210.8(B) Ground-Fault Circuit-Interrupter Protection for Personnel

Change Summary

- The GFCI requirements for receptacles at commercial/ industrial applications have been expanded to recognize ground faults other than 15- and 20-amp 125-volt applications only.

NEC® Text

210.8 Ground-Fault Circuit-Interrupter Protection for Personnel. Ground-fault circuit-interrupter protection for personnel shall be provided as required in 210.8(A) through (D) (E). The ground-fault circuit-interrupter shall be installed in a readily accessible location.

(B) Other Than Dwelling Units. All 125-volt, single-phase, 15- and 20-ampere receptacles rated 150-volts to ground or less, 50-amperes or less; and three-phase receptacles rated 150-volts to ground or less, 100-amperes or less, installed in the following locations specified in 210.8(B) (1) through (8) shall have ground-fault circuit-interrupter protection for personnel.

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Expert Analysis

Revisions in the 2017 NEC at 210.8(B) have resulted in the expansion of GFCI protection for non-dwelling unit receptacles to include all single-phase receptacles rated 150-volts to ground or less, 50-amperes or less; and three-phase receptacles rated 150-volts to ground

or less, 100-amperes or less. These requirements have been expanded in recognition of the fact that shock hazards are not limited to 15- and 20-ampere, 125-volt receptacles alone at commercial/industrial applications. Receptacles of the higher voltage and current ratings in the locations identified in 210.8(B) present similar shock hazards as those of lower voltage and current ratings.

New



210.8(B)(9), 210.8(B)(10) Ground-Fault Circuit-Interrupter Protection for Personnel

Change Summary

- GFCI protection for receptacles in non-dwelling unit crawl spaces and unfinished basement areas has been added.

NEC® Text

210.8 Ground-Fault Circuit-Interrupter Protection for Personnel.

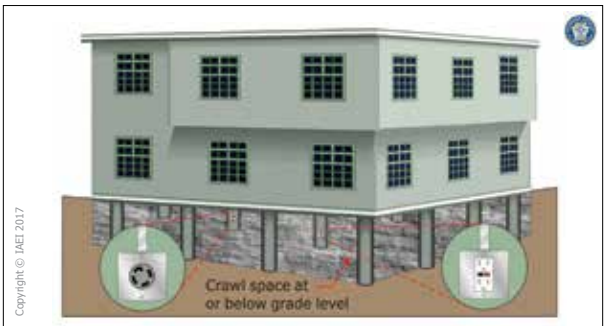
(B) Other Than Dwelling Units. All 125-volt, single-phase, 15- and 20-ampere receptacles rated 150-volts to ground or less, 50-amperes or less; and three-phase receptacles rated 150-volts to ground or less, 100-amperes or less, installed in the following locations specified in 210.8(B) (1) through (8) shall have ground-fault circuit-interrupter protection for personnel.

(9) Crawl spaces — at or below grade level

(10) Unfinished portions or areas of the basement not intended as habitable rooms

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Expert Analysis



The Code has mandated GFCI protection for all 125-volt, single-phase, 15- and 20-ampere receptacles installed in dwelling unit crawl spaces since 1990 and in unfinished basement areas since 1987. From that time until the present, no similar requirement existed for similar receptacles installed in a non-dwelling unit crawl space. That will change for the 2017 NEC with all single-phase receptacles rated 150-volts to ground or less, 50-amperes or less; and three-phase receptacles rated 150-volts to ground or less, 100-amperes or less installed in non-dwelling unit crawl spaces and unfinished basement areas now requiring GFCI protection.

It should be noted that the text at 210.8(A)(5) for GFCI requirement for receptacles in dwelling unit unfinished basements has been revised to match this new text for non-dwelling unit unfinished basements in such a way as to eliminate the need for a definition of an unfinished basement.

Unattended areas like basements and crawlspaces can benefit from Leviton's Audible Alert GFCI Receptacle. A power interruption due to a ground fault provides important protection to people but can shut down freezers, sump pumps and other necessary equipment if left undetected. Often GFCIs in an out-of-the-way place such as a back corner or storage area make daily visual checks for GFCI tripping unlikely. The new SmartlockPro® Slim GFCI with Audible Alert is the smart solution.



When a condition exists causing the SmartlockPro® Slim GFCI with Audible Alert to trip, users will be alerted by the sounding of an audible alarm. This audible alert indicates that power has been disconnected from loads plugged into or fed from the GFCI so users can immediately assess the reason and reset the device.

New

210.8(E) Ground-Fault Circuit-Interrupter Protection for Personnel

Change Summary

- GFCI protection for lighting outlets in crawl spaces has been added.

NEC® Text

210.8 Ground-Fault Circuit-Interrupter Protection for Personnel.

(E) Crawl Space Lighting Outlets. GFCI protection shall be provided for lighting outlets not exceeding 120-volts installed in crawl spaces.

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Expert Analysis

A new requirement was added at 210.8(E) establishing GFCI protection for lighting outlets not exceeding 120-volts installed in crawl spaces where that space is located at or below grade level. This new GFCI requirement for lighting outlets was justified due to the fatality of a worker in a crawl space. The incandescent light bulb of a keyless lampholder was accidentally broken, and the worker was electrocuted upon unintentional contact with the live, exposed parts of the broken light bulb. The number of open-bulb keyless or pull chain lampholders installed in crawl spaces is countless, and they are frequently damaged in this same manner.

Since this new GFCI requirement for crawl space lighting outlets is located at 210.8(E), it will apply to all crawl spaces, dwelling unit and non-dwelling units alike.

New

210.11(C)(4) Garage Branch Circuits

Change Summary

- New requirement added for minimum rated 120-volt, 20-ampere branch circuit for dwelling unit garage receptacles.

NEC® Text

210.11 Branch Circuits Required.

Branch circuits for lighting and for appliances, including motor-operated appliances, shall be provided to supply the loads calculated in accordance with 220.10. In addition, branch circuits shall be provided for specific loads not covered by 220.10 where required elsewhere in this Code and for dwelling unit loads as specified in 210.11(C).

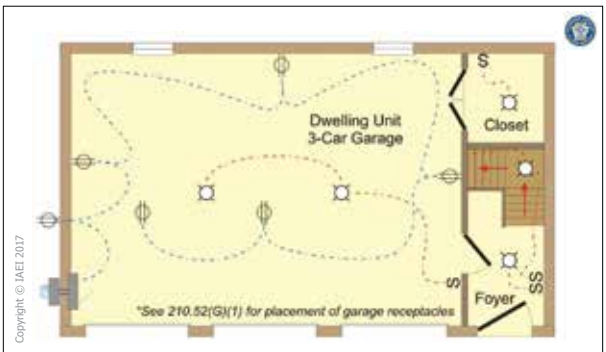
(C) Dwelling Units.

(4) Garage Branch Circuits. In addition to the number of branch circuits required by other parts of this section, at least one 120-volt, 20-ampere branch circuit shall be installed to supply receptacle outlets in attached garages and in detached garages with electric power. This circuit shall have no other outlets.

Exception: This circuit shall be permitted to supply readily accessible outdoor receptacle outlets.

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Expert Analysis



A new requirement, which was added to the required branch circuits for dwelling units, calls for at least one dedicated branch circuit for garage receptacle outlets only. This 120-volt branch circuit must have a minimum rating of 20-amperes. An exception was also added to allow readily accessible outdoor receptacle outlets to be supplied from the branch circuit as well. Many of the appliances and tools used in today's dwelling unit garages are rated at 12- to 16-amperes or higher and demand, at least, a 20-ampere rated branch circuit. A 15-ampere rated branch circuit in the modern dwelling unit garage is typically not sufficient for these loads. This requirement was originally proposed at 210.52(G)

(1) for dwelling unit garage receptacle outlets, not the branch circuit supplying these receptacle outlets. 210.11(C)(4) is a more appropriate location for this requirement as 210.11(C) deals with required branch circuits for dwelling units. Lighting outlets in the dwelling unit garage are still required to be supplied by general lighting circuits and are not allowed to be supplied from this newly required 20-ampere rated receptacle outlet branch circuit. The thought process here is to protect the illumination of the garage area in the event of an outage on the 20-ampere rated receptacle outlet branch circuit. The added exception will allow readily accessible receptacles located outdoors to be supplied from this garage branch circuit.

For areas where more power is required for appliances and tools, Leviton's 20-Amp GFCI is a great solution. The device is rated at 20-Amp, 125-Volt with 20-Amp Feed-Through. It is Tamper-Resistant and offers back and side wiring with self-grounding clip included. Available in non-TR versions and available in several popular colors.



Cat. No. GFTR2-W

New



210.12(C) and 210.12(D) Arc-Fault Circuit-Interrupter Protection

Change Summary

- New provisions added requiring AFCI protection for guest rooms/guest suites of hotels/motels
- Branch circuit extensions or modifications in dormitories must have AFCI Protection

NEC® Text

210.12 Arc-Fault Circuit-Interrupter Protection.

Arc-fault circuit-interrupter protection shall be provided as required in 210.12(A) (B), and (C), and (D). The arc-fault circuit interrupter shall be installed in a readily accessible location.

(C) Guest Rooms and Guest Suites. All 120-volt, single-phase, 15- and 20-ampere branch circuits supplying outlets and devices installed in guest rooms and guest

NEC® Text (continued from previous page)

suites of hotels and motels shall be protected by any of the means described in 210.12(A)(1) through (6).

(D) Branch Circuit Extensions or Modifications – Dwelling Units and Dormitory Units. In any of the areas specified in 210.12(A) or (B) where branch circuit wiring is modified, replaced or extended, the branch circuit shall be protected by one of the following:

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

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Expert Analysis



AFCI technology that can help save lives and avoid property damage from fire-related events has been expanded to include guest rooms and guest suites of hotels and motels. Previous editions of the Code would extend AFCI protection to these guest quarters with a qualifying condition that “permanent provisions for cooking” must be a part of these accommodations (see 210.17, was 210.18). This new AFCI requirement does not depend on cooking provisions in order to be enforceable. The same or similar threats imposed by arcing events exist in hotel or motel guest occupancies as exist in dwelling units. In numerous cases, guest rooms and guest suites are used in the same basic fashion as school dormitories, and dormitories are already afforded the safety measures of AFCI protection.

The 2014 NEC detailed AFCI requirements for branch-circuit extensions, modifications and replacements in dwelling units. These same requirements are now passed along to dormitories. The previous requirements of 210.12 were rearranged to accommodate this

new requirement for guest rooms and guest suites. Requirements at 210.12(C) for AFCI protection for dormitory units were moved to 210.12(B), and the requirements at 210.12(B) for branch circuit extensions and modifications were moved to new 210.12(D).

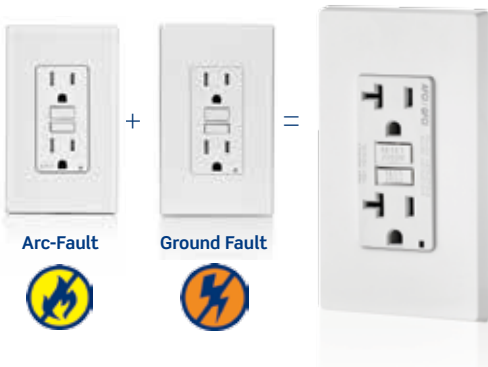
Leviton Comment

Dormitories, Guest Rooms and Guest Suites can present unique challenges for AFCI protection. Quite often people staying in these rooms don't have access to breaker panels to reset the circuit should the AFCI breaker trip. Since receptacles can be reset at point of use, they are a convenient and preferred method of AFCI protection among students, guests and facility personnel.

The NEC specifically calls out AFCI Receptacles as an allowable solution for 210.12(D) above. The NEC allows AFCI Receptacles for 210.12(C) as long as RMC, IMC, EMT, Type MC or steel-armored type AC cables are used on the installation. This is often the case for commercial installations like dormitories and guest rooms and suites. Please reference 210.12 for complete details.

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New! Dual Function SmartlockPro® AFCI/GFCI Receptacles help protect against **BOTH** electrical **fires** and **shocks**:



Leviton offers AFCI receptacles and dual function AFCI/GFCI receptacles. The SmartlockPro® Dual Function AFCI/GFCI Receptacle offers protection both from electrical fires that could result from arc-faults and from electrical shock due to ground faults in one smart device.

Through advanced technology, the SmartlockPro® Dual Function AFCI/GFCI Receptacle helps protect home and family by working to detect arc-fault and ground fault

hazards and, if detected, quickly cuts off power to help avoid a potential fire or shock occurrence.

The SmartlockPro® Dual Function AFCI/GFCI Receptacle offers a National Electrical Code® (NEC®) compliant option for AFCI/GFCI protection in residential kitchens and laundry areas for new construction, modifications/ extensions and replacement receptacles. It is also ideal as a replacement for ungrounded receptacles, satisfying NEC® requirements for both AFCI and GFCI protection. Leviton's AGTR1 is rated at 15-Amp, 125-Volt, 20-Amp Feed-Through. It is Tamper-Resistant, back and side wired and a self-grounding clip is included.

Revision



210.52(A)(2)(1) Dwelling Unit Receptacle Outlets

Change Summary

- Fixed cabinets “that do not have countertops or similar work surfaces” was added as an item that will constitute a break in a wall space for receptacle spacing requirements at dwelling units.

NEC® Text

210.52 Dwelling Unit Receptacle Outlets. This section provides requirements for 125-volt, 15- and 20-ampere receptacle outlets.

(Remainder of text unchanged.)

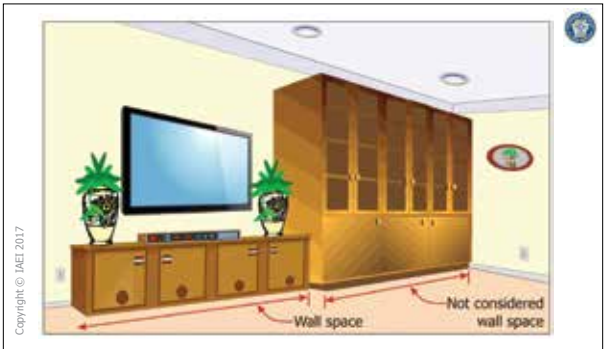
(A) General Provisions. In every kitchen, family room, dining room, living room, parlor, library, den, sunroom, bedroom, recreation room, or similar room or area of dwelling units, receptacle outlets shall be installed in accordance with the general provisions specified in 210.52(A)(1) through (A)(4).

(2) Wall Space. As used in this section, a wall space shall include the following:

- (1) Any space 600 mm (2 ft) or more in width (including space measured around corners) and unbroken along the floor line by doorways and similar openings, fireplaces, and fixed cabinets that do not have countertops or similar work surfaces.
- (2) The space occupied by fixed panels in exterior walls, excluding sliding panels
- (3) The space afforded by fixed room dividers, such as freestanding bar-type counters or railings

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(See NEC for complete text)

Expert Analysis



For spacing of required receptacles, 210.52(A)(1) states that receptacles are to be located so that “no point measured horizontally along the floor line of any wall space is more than 1.8 m (6 ft) from a receptacle outlet.” What is considered “wall space” and what is not? To answer that question, the provisions of 210.52(A)(2) step forward. During the 2011 NEC revision process, 210.52(A)(2)(1) was revised by adding the term “fixed cabinets” to a list of things that actually would break up a “wall space” that was 600 mm (2 ft) or more in width. These items also include doorways and fireplaces. In reading the substantiation for adding the term “fixed cabinets,” it was quite clear that the cabinets referred to were large cabinets, such as kitchen cabinets. Receptacle placement and spacing for kitchen cabinets and countertops have their set of rules at 210.52(C). The term “fixed cabinets” was added to ensure that the requirements for “1.8 m (6 ft) from a receptacle outlet” wall spacing were not applied to large pantry-type cabinets occupying the space from the floor to the ceiling (with no countertop) in a kitchen area.

In a literal reading or interpretation of this 2011 NEC revision, any and all “fixed cabinets” (not just kitchen cabinets) were now subject to having no receptacle outlets required in, on, or above them. This requirement would include any fixed cabinet at any height in any room not counting as “wall space.” This rule presented a problem for enforcement at such things as cabinets in a home office, library, or family room where the cabinets may be only 900 mm (36 in.) tall. In some of these areas, these cabinets are installed around the majority of the room. As previously written, there was

no Code requirement the Authority Having Jurisdiction (AHJ) could fall back on to require any receptacle outlets for the “wall space” these cabinets consumed. This situation resulted in rooms, other than kitchens, with fixed cabinets and cabinet countertops occupying a substantial length of wall space with no required receptacle outlets serving these countertop areas.

This revision for the 2017 NEC at 210.52(A)(2)(1) will eliminate this problem by separating “fixed cabinets,” such as kitchen pantry-type cabinets (but not limited to kitchen cabinets), that do not have countertops or similar work surfaces from short desk-type cabinets with countertops that are clearly intended as work surfaces. This change will ensure that receptacle outlets are required and installed along with these desk-type fixed cabinets that need receptacle outlets for such things as laptop computers, printers, televisions, etc. These fixed desk-type cabinets will be under the same “no point more than 1.8 m (6 ft) from a receptacle outlet” rules as the other walls of that particular room.

For a higher quality receptacle look to Leviton’s Decora Plus™ line. These Heavy-Duty Specification Grade receptacles are designed and manufactured to withstand the most demanding environments. Available in a wide variety of configurations, including isolated ground, tamper-resistant, etc., these Commercial Grade devices are the electrical contractor’s choice for use in hotels, schools, hospitals and commercial office buildings.



Cat. No. 16342-GY

Revision



210.52(G) and 210.52(G)(1) Dwelling Unit Receptacle Outlets

Change Summary

- Receptacle requirements for dwelling unit garages, basements, and accessory buildings expanded to two-family dwellings (not just one-family dwellings). At least one receptacle outlet is required to be installed

“in each vehicle bay” and not more than 1.7 m (5½ ft) above the floor in dwelling unit garages.

NEC® Text

210.52 Dwelling Unit Receptacle Outlets.

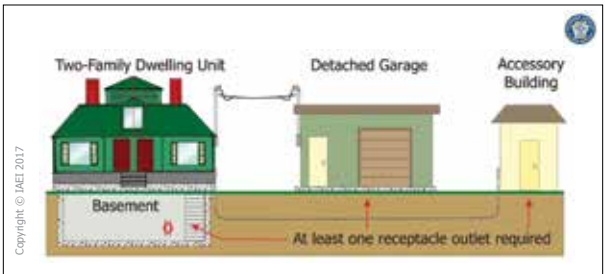
(G) Basements, Garages, and Accessory Buildings.

For a one- and two-family dwellings, at least one receptacle outlet shall be installed in the areas specified in 210.52(G)(1) through (3). These receptacles shall be in addition to receptacles required for specific equipment.

(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 in each car space vehicle bay and not more than 1.7 m (5½ ft) above the floor.

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Expert Analysis

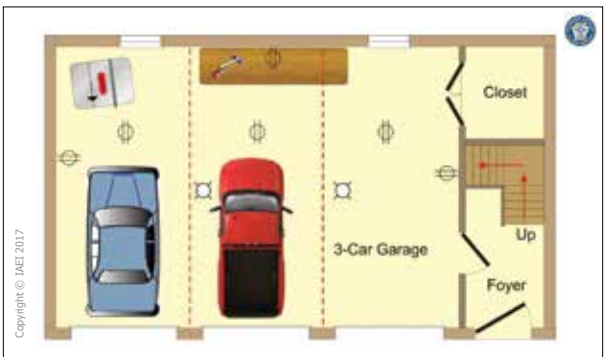


For the 2017 NEC, the level of electrical safety has been extended to two-family dwellings as it has been for one-family dwellings for the past 10 Code cycles. The purpose of this rule is to help prevent the use of extension cords. The 2014 NEC increased the required garage receptacle count to at least one for each car space. This was intended to require a minimum of three receptacle outlets in a three-car garage, four receptacle outlets in a four-car garage, etc.

The 2017 NEC text at 210.52(G)(1) was further revised by changing the requirement for at least one receptacle outlet to be installed “for each car space” to “in each vehicle bay and not more than 1.7 m (5½ ft) above the floor.” The change from “for” to “in” each vehicle bay will eliminate the interpretation of one receptacle outlet being shared by two adjacent spaces. The term “car space” was changed to “vehicle bay” to recognize the

fact that other vehicles such as pickup trucks, sports utility vehicles, tractors, and so forth could be parked in a dwelling unit garage as well as a car. The “not more than 1.7 m (5½ ft) above the floor” requirement removes all doubt concerning the receptacle outlet installed in the ceiling specifically for a garage door opener serving double-duty and also serving as the required receptacle outlet “in each vehicle bay.”

This revision also included the relocation of the requirement that the “branch circuit supplying these receptacle(s) shall not supply outlets outside of the garage” from this section of the Code to the new 210.11(C)(4) which pertains to required branch circuits for dwelling units. 210.11(C)(4) will still find a requirement that this branch circuit serve no other outlets, but with an exception allowing readily accessible receptacles located outdoors to be supplied by this garage branch circuit. As a side note, lighting outlets in the dwelling unit garage are still required to be supplied by general lighting circuits and not allowed to be supplied from this newly required 20 ampere rated receptacle outlet branch circuit of 210.11(C)(4) to protect the illumination of the garage area in the event of an outage on the 20-ampere rated receptacle outlet branch circuit.



Revision

210.64 Electrical Service Areas



Change Summary

- The required receptacle outlets at electrical service equipment must be installed in an



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accessible location within 7.5 m (25 ft) of indoor electrical service equipment.

NEC® Text

210.64 Electrical Service Areas.

At least one 125-volt, single-phase, 15- or 20-ampere-rated receptacle outlet shall be installed in an accessible location within 15 m (50 ft) 7.5 m (25 ft) of the indoor electrical service equipment. The required receptacle outlet shall be located within the same room or area as the service equipment.

Exception No. 1: The receptacle outlet shall not be required to be installed in one-and-two-family dwellings.

Exception No. 2: Where the service voltage is greater than 120-volts to ground, a receptacle outlet shall not be required for services dedicated to equipment covered in Articles 675 and 682.

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Expert Analysis



For the 2014 NEC Code cycle, a new provision was added in Article 210 requiring, at least one 125-volt, single-phase, 15-or 20-ampere receptacle outlet to be installed within 15 m (50 ft) of all electrical service areas (other than one- and two-family dwellings). The substantiation for this change indicated that there is sometimes a need for connecting test equipment for monitoring and servicing electrical equipment in service areas.

The first revision for the 2017 NEC requires this service area receptacle outlet to be installed in an accessible location, within the same room or area as the service equipment. With the previous text at 210.64, the rules for a service area receptacle outlet could be literally accomplished with a receptacle outlet located in the next room, down and across the hallway from the electrical service area by employing an extension cord as long as the receptacle outlet was “installed within 15 m (50 ft) of the electrical service equipment.”

The second revision was to reduce the maximum distance between the required receptacle outlet and the electrical service equipment to 7.5 m (25 ft) rather than the previous 15 m (50 ft). This 7.5 m (25 ft) distance is consistent with 210.63, which is a similar receptacle outlet requirement for heating, air-conditioning, and refrigeration equipment.

The third revision was to limit this service area receptacle outlet requirement to only “indoor” service equipment (other than one- and two-family dwellings).

The final revision to 210.64 added a second exception pertaining to service equipment that is dedicated to equipment covered in Articles 675 (Electrically Driven or Controlled Irrigation Machines) and 682 (Natural and Artificially Made Bodies of Water) where the service voltage is greater than 120 volts to ground.

Surge Protective Devices for Service Equipment

In areas where sensitive electronic equipment is utilized, Leviton recommends the use of a Type 3 Surge Protection Receptacle

Leviton’s surge protection devices can be used individually or as part of a coordinated application strategy to protect sensitive electronic equipment, in industrial, commercial and residential locations. Damaging voltage transients are diverted away from sensitive micro circuitry, providing protection against catastrophic failure, costly downtime and data disruptions. UL 1449 Compliant.

- Available in many colors. Blue pictured here because many tech professionals associate the blue color with clean power



Cat. No. 5280

Revision



210.70(A)(2)(4) and 210.70(C) Lighting Outlets Required

Change Summary

- In dwelling units if a dimmer is used in stairways it must provide full range dimming at all locations.
- Lighting outlet requirements for storage or equipment

spaces added for non-dwelling unit utility rooms and basements.

NEC® Text

210.70 Lighting Outlets Required.

Lighting outlets shall be installed where specified in 210.70(A), (B), and (C).

(A) Dwelling Units. In dwelling units, lighting outlets shall be installed in accordance with 210.70(A)(1), (A)(2) and (A)(3).

(1) Habitable Rooms. *(Text unchanged from 2014 NEC – see NEC for full text)*

(2) Additional Locations. Additional Lighting outlets shall be installed in accordance with ~~(A)(2)(a), (A)(2)(b) and (A)(2)(c)~~ the following:

~~(a)~~ (1) At least one wall switch-controlled lighting outlet shall be installed in hallways, stairways, attached garages, and detached garages with electric power.

~~(b)~~ (2) For dwelling units, attached garages, and detached garages with electric power, at least one wall switch-controlled lighting outlet shall be installed to provide illumination on the exterior side of outdoor entrances or exits with grade-level access. A vehicle door in a garage shall not be considered as an outdoor entrance or exit.

~~(c)~~ (3) Where one or more lighting outlet(s) are installed for interior stairways, there shall be a wall switch at each floor level, and landing level that includes an entryway, to control the lighting outlet(s) where the stairway between floor levels has six risers or more.

Exception to (A)(2)(1), (A)(2)(2), and (A)(2)(3): In hallways, in stairways, and at outdoor entrances, remote, central, or automatic control of lighting shall be permitted.

(4) Lighting outlets controlled in accordance with 210.70(A)(2)(3) shall not be controlled by use of dimmer switches unless they provide the full range of dimming control at each location.

(B) Guest Rooms or Guest Suites. *(Text unchanged from 2014 NEC – see NEC for full text)*

(C) ~~Other Than Dwelling Units~~ All Occupancies. For attics and underfloor spaces, ~~containing equipment requiring servicing, such as heating, air-conditioning, and refrigeration equipment~~ utility rooms, and basements, at least one lighting outlet containing a switch or controlled by a wall switch shall be installed ~~in such~~ where these spaces are used for storage or contain equipment requiring servicing. At least one point of control shall be at the usual point of entry to these spaces. The lighting outlet shall be provided at or near the equipment requiring servicing.

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(See NEC for complete text)



Are You Protected?

- To safeguard emergency systems, Articles 620.51, 645.18, 695.15 and 700.8 of the NEC requires surge protection for emergency system elevators, escalators, data systems, fire pumps and switchboards
- Surge protective devices maximize facility uptime and minimize equipment lifecycle costs
- Leviton offers a complete line of UL 1449 listed SPDs for industrial use

Visit leviton.com/surge to learn how transient voltages can damage your bottom line.

Surge Protective Devices (SPDs)



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Expert Analysis

There were two significant changes to 210.70 for the 2017 NEC. The first change relates to the use of dimmers controlling lighting outlets in dwelling unit interior stairways. Article 210.70(A)(2)(3) requires a switch at each floor level and landing level that includes an entryway. The switch requirement on the landing level is only required if the stairway between floor levels has six or more risers. The switches at these locations can be in the form of a dimmer, but the dimmer(s) at all of the control points must control the full range of dimming. Thus NEC is prohibiting the use of basic 3-way dimming where if one of the dimmers is set at a low light level and someone turns on the light at the other dimmer location, the light will only come-on at the low light level and the person can't increase the brightness. This could create an unsafe condition in stairwells. To avoid this the NEC is calling for more advanced multi location dimmers that can control the light levels at all dimmer locations.

The second change to article 210.70 relates to 210.70(C). The title of 210.70(C) was changed from "Other Than Dwelling Units" to "All Occupancies" and the text at this provision was revised to mirror the Code text at 210.70(A)(3) for dwelling units. This lighting outlet requirement for storage or equipment spaces now applies to dwelling units as well as non-dwelling unit attics, underfloor spaces, utility rooms, and basements. The same types of hazards that can exist due to the lack of illumination exist in all attics, underfloor spaces, utility rooms, and basements whether these areas are located in a dwelling unit or other than a dwelling unit. The revised wording at 210.70(C) for all occupancies is the same as the text found in 210.70(A)(3) for dwelling units.

In the revised text in the First Draft of 2017 NEC, 210.70(C) contained language calling for a lighting outlet installed in a crawl space to be protected from physical damage or be provided with GFCI protection. This requirement for GFCI protection was more appropriate for the GFCI requirements found at 210.8 and was moved to new 210.8(E). This location at 210.70 is for required lighting outlets and, therefore, addresses the luminaire itself or GFCI protection. The option of protection from physical damage was removed from 210.8(E) since physical protection does not provide the appropriate shock protection.

To comply with 210.70(A)(2)(4) Leviton offers many options in digital multi location dimmers. Among them the Bluetooth Decora® Digital Dimmer with matching dimmer remote for up to 5 dimming locations.

The Bluetooth capability also allows control from your Smartphone and has advanced programming features. The dimmer is also available with timer capabilities and astronomical clock.



Cat. No.
DDL06-1LZ



Cat. No.
DD00R-DLZ

To comply with 210.70(C) Leviton's line of compact lampholders offer the ideal lighting source for closets, closed spaces, basements, attics and other utility areas. They are available in several configurations: with and without pull-chain and optional motion sensor (motor sensor unit will not comply with 210.70(C)). Pigtail leads provide easy installation and multiple mounting holes are provided for multiple box configurations.



Cat. No.
9860-BL



Cat. No.
9852-LED



Cat. No.
9862-PCH



Cat. No.
9850-LED

Revision



210.71 Meeting Rooms

Change Summary

- Receptacle outlet requirements were added for non-dwelling unit meeting rooms.

NEC® Text

210.71 Meeting Rooms.

(A) General. Each meeting room of not more than 93 m² (1000 ft²) in other than dwelling units shall have outlets

NEC® Text (continued from previous page)

for nonlocking-type, 125-volt, 15- or 20-ampere receptacles. The outlets shall be installed in accordance with 210.71(B). Where a room or space is provided with movable partition(s), each room size shall be determined with the partition in the position that results in the smallest size meeting room.

Informational Note No. 1: For the purposes of this section, meeting rooms are typically designed or intended for the gathering of seated occupants for such purposes as conferences, deliberations, or similar purposes, where portable electronic equipment such as computers, projectors, or similar equipment is likely to be used.

Informational Note No. 2: Examples of rooms that are not meeting rooms include auditoriums, schoolrooms, and coffee shops.

(B) Receptacle Outlets Required. The total number of receptacle outlets, including floor outlets and receptacle outlets in fixed furniture, shall not be less than as determined in (1) and (2). These receptacle outlets shall be permitted to be located as determined by the designer or building owner.

(1) Receptacle Outlets in Fixed Walls. Receptacle outlets shall be installed in accordance with 210.52(A)(1) through (A)(4).

(2) Floor Receptacle Outlets. A meeting room that is at least 3.7 m (12 ft) wide and that has a floor area of at least 20 m² (215 ft²) shall have at least one receptacle outlet located in the floor at a distance not less than 1.8 m (6 ft) from any fixed wall for each 20 m² (215 ft²) or major portion of floor space.

Informational Note No. 1: See Section 314.27(B) for floor boxes used for receptacles located in the floor.

Informational Note No. 2: See Article 518 for assembly occupancies designed for 100 or more persons.

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(See NEC for complete text)

Expert Analysis

For certain sized non-dwelling unit meeting rooms, receptacle outlets will be required to be provided and spaced apart similar to a dwelling unit and the wall spacing rules of 210.52(A)(1) through (A)(4) [see complete Code text at 210.71 for specifics]. Meeting rooms with a floor area greater than 93 m² (1000 ft²) will not be subject to these rules, unless they can be partitioned into smaller rooms meeting that threshold.

In some cases, floor receptacles will be required to be installed to meet the needs of the present and future meeting room occupants. A meeting room that is at least 3.7 m (12 ft) wide and has a floor area of 20 m² (215 ft²) must be provided with one floor receptacle



outlet located not less than 1.8 m (6 ft) from any fixed wall for each 20 m² (215 ft²) or major portion of floor space. These required floor receptacle outlet(s), located away from fixed walls, will minimize the need for extension cords and multi-outlet devices to facilitate the use of equipment (such as a projector) in the middle of the meeting room. Without this new requirement, there was previously no Code requirement to provide receptacle outlets in meeting rooms of commercial or non-dwelling occupancies.

It should be noted that in a meeting room or space provided with movable partition(s), each room size will be determined by the partition in the position that results in the “smallest size meeting room.” If a meeting area were equipped with a movable partition and that partition (when opened or in place) would divide the space into two equal spaces, this would result in two separate meeting rooms. If each side of these two spaces is each at least 3.7 m (12 ft) wide and have a floor area of at least 20 m² (215 ft²), this would require at least one floor-receptacle outlet located on both sides of this partition.

For low profile, in-floor receptacle installations, Leviton Floor Boxes are the perfect fit. Available in both single and 2-gang, 15- and 20-Amp and quick port configurations. These Commercial Grade devices are suitable for wood frame construction with carpet and wood finished flooring. Common applications include a variety of uses from hotel meeting rooms, home office workstations to high-end stages and entertainment venues.



Cat. No. 25249-FBA



New

250.52(B)(3) Grounding Electrodes

Change Summary

- In-ground swimming pool structures are not permitted to be used as a grounding electrode.

NEC® Text

250.52 Grounding Electrodes.

(B) Not Permitted for Use as Grounding Electrodes.

The following systems and materials shall not be used as grounding electrodes:

- (1) Metal underground gas piping systems
- (2) Aluminum
- (3) The structures and structural reinforcing steel described in 680.26(B)(1) and (B)(2)

Informational Note: See 250.104(B) for bonding requirements of gas piping.

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Expert Analysis



Detached buildings or structures with electrical power from a feeder — such as detached garages, workshops, etc. — require that a grounding electrode system be established and installed in accordance with the requirements of 250.32(A). Occasionally, these detached structures are located near in-ground permanently installed swimming pools. When this situation occurs, it has been documented that the electrical installer will sometimes run a grounding electrode conductor from the electrical subpanel at the detached structure to the reinforcing steel of the conductive pool shell (belly steel) or to the structural steel of the perimeter surfaces (deck steel) with the intent to identify the pool

reinforcing steel as an “other local metal underground system or structure” as described at 250.52(A)(8). Unfortunately, this action is sometimes at the request of the local AHJ. This action would make the swimming pool in question (and its inhabitants) a “super-target” for any stray currents or ground-fault current introduced on this grounding electrode system, and could potentially introduce safety hazards to the occupants of the pool during events such as lightning-induced stray currents.

For the 2017 NEC, language was added at 250.52(B) to prohibit the use of the structures and structural reinforcing steel of an in-ground swimming pool as described in 680.26(B)(1) and (B)(2) from being used as a grounding electrode in the manner described above. CMP-5 determined that it was never the intent of the NEC to use a pool bonding grid as a grounding electrode. Adding the additional requirement to prohibit the use of the metal components of an in-ground swimming pool is an important clarification to point out the difference between grounding and bonding. The equipotential bonding requirements of 680.26 are to reduce voltage gradients (difference of voltage potential between two conducting objects), and not to create a grounding electrode system for a building or structure.

This point is further illustrated in the current language at 680.26(B), which states in part that “an 8 AWG or larger solid copper bonding conductor provided to reduce voltage gradients in the pool area shall not be required to be extended or attached to remote panelboards, service equipment, or electrodes.”

Revision and New



250.94(A) and (B) Bonding for Communication Systems

Change Summary

- The title of this section was renamed “Bonding for Communication Systems” and a new 250.94(B) was added titled “Other Means” allowing an alternate connection option to be made on a common bus bar. A new exception was added for 250.94(A) and (B) offering relief from an intersystem bonding connection means “where communications systems are not likely to be used.”

NEC® Text (continued from previous page)

250.94 Bonding for Other Communication Systems.

Communications system bonding terminations shall be connected in accordance with (A) or (B).

(A) The Intersystem Bonding Termination Device.

An intersystem bonding termination (IBT) for connecting intersystem bonding conductors required for other systems shall be provided external to enclosures at the service equipment or metering equipment enclosure and at the disconnecting means for any additional buildings or structures. ~~The intersystem bonding termination~~ If an IBT is used, it shall comply with the following:

(Remainder of 250.94(A) unchanged. See NEC for complete text.)

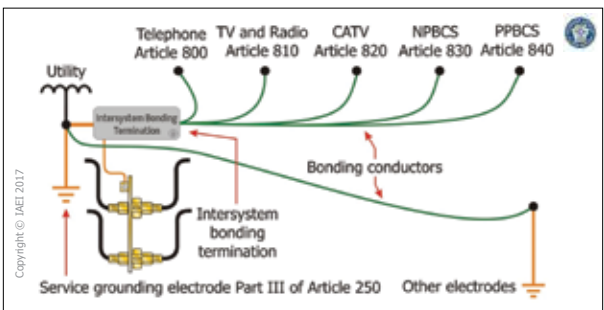
(B) Other Means. Connections to an aluminum or copper busbar not less than 6 mm thick × 50 mm wide (¼ in. thick × 2 in. wide) and of sufficient length to accommodate at least three terminations for communication systems in addition to other connections. The busbar shall be securely fastened and shall be installed in an accessible location. Connections shall be made by a listed connector. If aluminum busbars are used, the installation shall also comply with 250.64(A).

Exception to (A) and (B): Means for connecting intersystem bonding conductors are not required where communications systems are not likely to be used.

Informational Note: The use of an IBT can reduce electrical noise on communication systems.

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(See NEC for complete text)

Expert Analysis



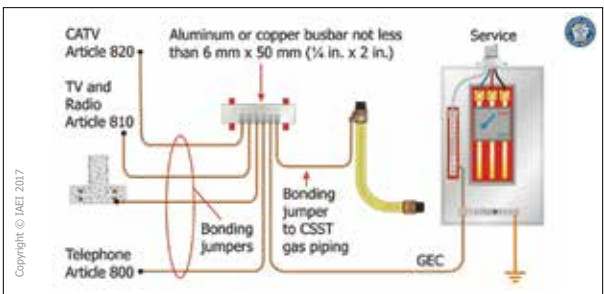
Bonding for Other Communications Systems

The title of the section was changed to “Bonding for Communication Systems.” The existing text for the intersystem bonding termination was placed under List Item (A) and titled, “The Intersystem Bonding Termination Device.” The six conditions that must be met to qualify as an intersystem bonding termination have not changed, and the one exception for existing

buildings or structures remains the same. Intersystem bonding — which is accomplished by connection of a communication grounding conductor to the power system grounding electrode system — is an important safety measure to prevent differing voltage potential between the communication system and the power system. The intersystem bonding termination is for bonding of intersystem bonding conductors only.

A new 250.94(B) was added titled, “Other Means,” which permits intersystem bonding connections to an aluminum or copper busbar that will accommodate at least three terminations for communication systems as well as “other connections.” This method is often used in commercial or multifamily mixed-use buildings. Even though the previous language was not restricted to just dwelling units and worked well for a dwelling unit, it did not take into account how a commercial or industrial building may bond the communication systems and other systems. Many commercial buildings commonly utilize a common grounding terminal bar for the connection of multiple electrodes and bonding of other systems, such as water piping systems, building steel, and internal antenna systems — to name a few. This new “other means” of terminating other systems allows the installer to terminate other bonding conductors for bonding all systems, including such things as corrugated stainless steel tubing (CSST) gas piping, which is still prohibited to be terminated on the intersystem bonding termination device.

A new exception to 250.94(A) and (B) was also added to give relief from providing a means for connecting intersystem bonding conductors where communications systems are not likely to be used. This exception would include such things as outhouses, chicken coops or garden sheds.



Bonding for Other Communications Systems
250.94(B) Other Means

Revision



250.148 Continuity and Attachment of Equipment Grounding Conductors to Boxes

Change Summary

- Revision to clarify that all equipment grounding conductors associated with any and all circuits in the box must be connected together and to the box and not just each equipment grounding conductors of each associated circuit.

NEC® Text

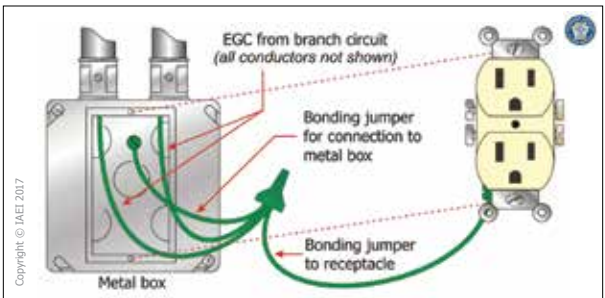
250.148 Continuity and Attachment of Equipment Grounding Conductors to Boxes.

Where If circuit conductors are spliced within a box, or terminated on equipment within or supported by a box, any all equipment grounding conductor(s) associated with any of those circuit conductors shall be connected within the box or to the box with devices suitable for the use in accordance with 250.8 and 250.148(A) through (E).

Exception: The equipment grounding conductor permitted in 250.146(D) shall not be required to be connected to the other equipment grounding conductors or to the box.

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Expert Analysis



See exception for Isolated Ground Receptacles at 250.146(D)

Clear directions in 250.148 specify that all of the equipment grounding conductors present in a box or enclosure are required to be connected, regardless of the circuit with which they are associated. The existing exception to 250.148 still applies, giving relief to the equipment grounding conductor of an isolated ground circuit for an isolated ground receptacle not being required to be connected to the other equipment

grounding conductors or the box. An equipment bonding jumper is typically required to connect the grounding terminal of a grounding-type receptacle to both a grounded metal box and the supply equipment grounding conductor(s) (EGC). Where one or more EGCs enters a box, they are typically required to be spliced or joined inside the box with suitable devices (listed grounding screws, listed grounding clips, etc.) to bond the box and to connect to the device with a bonding jumper [see 250.146(A) through (D) for exceptions to this general rule].

The removal of a receptacle or other devices or equipment installed in or on the metal box is not permitted to interrupt or break the continuity of the EGC connections to other equipment or devices that are supplied from the same box where EGCs are connected, or to interrupt or break the continuity of the EGC connections downstream. EGCs installed in nonmetallic boxes are required to provide a means of connecting EGCs to receptacles, switches, luminaires, and other equipment installed in or supplied from the nonmetallic box.

A reference to 250.8 was also added to provide guidance on terminating an EGC or bonding jumper to a metal box or enclosure. Section 250.8 is titled, “Connection of Grounding and Bonding Equipment” and gives eight specific list items on permitted methods to properly connect grounding and bonding conductors to metal enclosures.

New



312.8(B) Switch and Overcurrent Device

Change Summary

- Power monitoring equipment is now required to be listed for the application when installed in free spaces of cabinets and cutout boxes.

NEC® Text

312.8 Switch and Overcurrent Device Enclosures with ~~Splices, Taps, and Feed-Through Conductors.~~

The wiring space within enclosures for switches and

NEC® Text (continued from previous page)

overcurrent devices shall be permitted for other wiring and equipment subject to limitations for specific equipment as provided in (A) and (B).

(A) Splices, Taps, and Feed-Through Conductors.

The wiring space of enclosures for switches or overcurrent devices shall be permitted for conductors feeding through, spliced, or tapping off to other enclosures, switches, or overcurrent devices where all of the following conditions are met:

- (1) The total of all conductors installed at any cross section of the wiring space does not exceed 40 percent of the cross-sectional area of that space.
- (2) The total area of all conductors, splices, and taps installed at any cross section of the wiring space does not exceed 75 percent of the cross-sectional area of that space.
- (3) A warning label complying with 110.21(B) is applied to the enclosure that identifies the closest disconnecting means for any feed-through conductors.

(B) Power Monitoring Equipment. The wiring space of enclosures for switches or overcurrent devices shall be permitted to contain power monitoring equipment where all of the following conditions are met:

- (1) The power monitoring equipment is identified as a field-installable accessory as part of the listed equipment, or is a listed kit evaluated for field installation in switch or overcurrent device enclosures.
- (2) The total area of all conductors, splices, taps, and equipment at any cross section of the wiring space does not exceed 75 percent of the cross-sectional area of that space.

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(See NEC for complete text)

Expert Analysis

The wiring space within enclosures, such as a panelboard cabinet for switches or overcurrent devices, has been permitted to contain “other wiring and equipment” for a limited percentage (40% and 75%) of the cross-sectional area of the space as far back as the 1971 NEC. To answer the demand for such equipment being installed in a cabinet containing switches or overcurrent devices, the 2017 NEC adopted new text at 312.8(B) to allow power monitoring equipment with specific conditions. This additional text limits the inclusion of devices and equipment in a wiring space to power monitoring equipment that is identified as field-installable accessories as part of the listed equipment, or as a listed kit evaluated for field installation in the

specific equipment. This new wording also retains the limit on the amount of space occupied by all conductors, splices, taps, devices, and equipment to the same 75 percent fill requirement previously located at 312.8(2) [now 312.8(A)(2)].

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Revision



404.2(C) Switch Connections

Change Summary

- Revisions clarified that a grounded conductor of the lighting circuit at switch locations shall be connected to the electronic device.

NEC® Text

404.2 Switch Connections.

(C) Switches Controlling Lighting Loads.

The grounded circuit conductor for the controlled lighting circuit shall be provided installed at the location where switches control lighting loads that are supplied by a grounded general-purpose branch circuit serving bathrooms, hallways, stairways, or rooms suitable for human habitation or occupancy as defined in the applicable building code. Where multiple switch locations control the same lighting

NEC® Text (continued from previous page)

load such that the entire floor area of the room or space is visible from the single or combined switch locations, the grounded circuit conductor shall only be required at one location. ~~for other than the following~~ A grounded conductor shall not be required to be installed at lighting switch locations under any of the following conditions:

- (1) Where conductors enter the box enclosing the switch through a raceway, provided that the raceway is large enough for all contained conductors, including a grounded conductor
- (2) Where the box enclosing the switch is accessible for the installation of an additional or replacement cable without removing finish materials
- (3) Where snap switches with integral enclosures comply with 300.15(E)
- ~~(4) Where a switch does not serve a habitable room or bathroom [moved to parent text of 404.2(C)]~~
- ~~(5) Where multiple switch locations control the same lighting load such that the entire floor area of the room or space is visible from the single or combined switch locations [moved to parent text of 404.2(C)]~~
- ~~(6)~~ (4) Where lighting in the area is controlled by automatic means
- ~~(7)~~ (5) Where a switch controls a receptacle load

The grounded conductor shall be extended to any switch location as necessary and shall be connected to switching devices that require line-to-neutral voltage to operate the electronics of the switch in the standby mode and shall meet the requirements of 404.22.

Exception: The connection requirement shall become effective on January 1, 2020. It shall not apply to replacement or retrofit switches installed in locations prior to local adoption of 404.2(C) and where the grounded conductor cannot be extended without removing finish materials. The number of electronic lighting control switches on a branch circuit shall not exceed five, and the number connected to any feeder on the load side of a system or main bonding jumper shall not exceed 25. For the purpose of this exception, a neutral busbar, in compliance with 200.2(B) and to which a main or system bonding jumper is connected shall not be limited as to the number of electronic lighting control switches connected.

Informational Note: The provision for a (future) grounded conductor is to complete a circuit path for electronic lighting control devices.

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(See NEC for complete text)

Expert Analysis

The concept from the beginning for requiring the presence and use of the grounded conductor at switch locations was due primarily to the increased demand for electronic lighting control devices (such as an occupancy sensor) which require standby current to

maintain a ready state of detection, even in the “off” position. When the grounded conductor is not present, installers have been known to employ the equipment grounding conductor for the standby current of these control devices.

The latest attempt to eliminate this intentionally introduced current onto the equipment grounding conductor resulted in further revisions to 404.2(C). One of the first changes was in response to the indication that 404.2(C) required a grounding conductor to be “present” at switch locations, but did not demand that the supplied grounded conductor be used or “connected” to the switching device. To that end, the first sentence at 404.2(C) was revised to state that the grounded circuit conductor be “installed” at the switch locations rather than simply “provided.” New more direct text was added further down in the requirement to state, “the grounded conductor shall be extended to any switch location as necessary and shall be connected to switching devices that require line-to-neutral voltage to operate the electronics of the switch in the standby mode.”

This requirement references 404.22, which is a new section under Part II of Article 404 for the “Construction Specifications” for a switching device. This is largely a manufacturer’s requirement and is covered in the next article in this Pocket Guide.

The previously discussed grounded conductor connection requirement has an added exception that will delay enforcement until January 1, 2020. This exception further relieves this connection requirement from “replacement or retrofit switches installed in locations prior to local adoption of 404.2(C) and where the grounded conductor cannot be extended without removing finish materials.” This exception will allow some continuation of older designs, which is warranted for replacement or retrofit installations in existing or previous applications.

This new exception goes on to limit the actual number of electronic lighting control switches on a branch circuit to “not exceed 5,” and the number connected to any feeder on the load side of a system or main bonding jumper to “not exceed 25.” This limitation is a result of simple mathematics- as more devices are added to the branch

circuit leaking current to the neutral, it will start to add up and become a hazard.

Leviton offers a wide selection of occupancy and vacancy sensors, commonly referred to as “motion sensors” or “motion light sensors” for commercial and residential applications. Neutral required and non-neutral required devices are available to meet this Code requirement. These state-of-the-art devices use passive infrared, ultrasonic or a combined multi-sensing technology. From wall and ceiling mount to wall switch and wireless, Leviton motion sensors enhance convenience, security and provide smart energy saving solutions for both indoor and outdoor use. Leviton Occupancy Sensors and Vacancy Sensors meet requirements for Title 24, ASHRAE 90.1 and IECC.



Cat. No. OSSMT-MD

New



404.22 Electronic Lighting Control Switches

Change Summary

- New provisions were added for “Electronic Lighting Controlled Switches” prohibiting current on the equipment grounding conductor with a future effective date.

NEC® Text

404.22 Electronic Lighting Control Switches.

Electronic lighting control switches shall be listed. Electronic lighting control switches shall not introduce current on the equipment grounding conductor during normal operation. The requirement to not introduce current on the equipment grounding conductor shall take effect on January 1, 2020.

***Exception:** Electronic lighting control switches that introduce current on the equipment grounding conductor shall be permitted for applications covered by 404.2(C), Exception. Electronic lighting control switches that introduce current on the equipment grounding conductor shall be listed and marked for use in replacement or retrofit applications only.*

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(See NEC for complete text)

Leviton Comment

Leviton manufactures electronic lighting control devices (like occupancy sensors) available with two wiring methods: 1- neutral required, 2- no neutral required. The no neutral solution does require an equipment grounding conductor and the device does push a very small amount of energy to the ground. As of Jan. 1 2020 these will only be allowed for retrofit or replacement applications. In Wiring Method #1, contractors should never use a device that requires a neutral in an application without a neutral. Using the ground as a neutral with these devices is dangerous as it pushes a higher amount of current to the ground. This could create a dangerous condition for personnel and potentially damage other equipment within the electrical system. For these reasons this practice is prohibited in this Code article.

Expert Analysis

This new section at 404.22 addresses the fact that electronic lighting control switches must be listed and “shall not introduce current on the equipment grounding conductor during normal operation.” This requirement has a future effective date of January 1, 2020, as well. When CMP-9 initiated 404.2(C) in the 2011 NEC, the intent was to begin a process that would ultimately result in no current being introduced intentionally onto the equipment grounding system as a result of the installation of electronic switching devices such as an occupancy sensor.

The new exception will recognize a retrofit installation or replacement situation in an existing situation where the grounded conductor is not installed. Electronic control switching devices that utilize the equipment grounding conductor for powering the device would still be permitted, but only in these retrofit applications. These products have been listed and in use for years. The product standard for these devices controls the amount of current permitted to be introduced on the equipment grounding conductor to no more than 0.5 mA. This exception will require devices that permit the use of the equipment grounding conductor for powering the electronics of the device to be listed and labeled for use in retrofit installations only where the grounded conductor is not provided in the switch device box or enclosure.

Revision



406.3(E) Receptacle Rating and Type

Change Summary

- Receptacles that are controlled by an automatic control device must be permanently marked with the symbol shown in Figure 406.3(E) and the word “Controlled.” Required marking must be on the receptacle face (not the cover plate) and be visible after installation.

NEC® Text

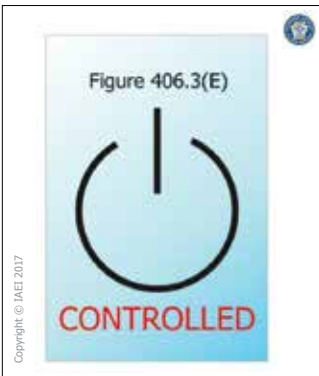
406.3 Receptacle Rating and Type. (E) Controlled Receptacle Marking.

All non-locking-type, 125-volt, 15- and 20-ampere receptacles that are controlled by an automatic control device, or that incorporate control features that remove power from the receptacle outlet for the purpose of energy management or building automation, shall be permanently marked with the symbol shown in Figure 406.3(E) and the word “controlled.” For receptacles controlled by an automatic control device, the marking shall be located on the controlled receptacle outlet face where and visible after installation. In both cases where a multiple receptacle device is used, the required marking of the word “controlled” and symbol shall denote which contact device(s) are automatically controlled.

Figure 406.3(E). Controlled Receptacle Marking Symbol.
(see below for symbol)

Exception: The marking shall not be required for receptacles controlled by a wall switch that provide the required room lighting outlets as permitted by 210.70.

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Expert Analysis

For the 2017 NEC, 406.3(E) was revised to provide additional requirements that will help people identify controlled receptacles that are part of an energy management system. One of these revisions requires that the word “Controlled”

be placed on the controlled receptacle along with the previous symbol. The word “Controlled” was also added to Figure 406.3(E). Marking the receptacle with the word “Controlled” will help the end user better understand which receptacle is controlled, even if the end user is not familiar with electrical symbols.

Another change that occurred at 406.3(E) deals with the exact location where the marking of the controlled receptacle is to be placed. For the 2017 NEC, the symbol and the word “Controlled” are to be placed on the face of the controlled receptacle and be visible after installation. The 2014 NEC provisions allowed the symbol to be placed on the receptacle face or the faceplate. If the controlled receptacle marking only appeared on the faceplate, the controlled receptacle itself and its original intended faceplate could be easily separated. An example of this is when the walls are repainted.

To meet the requirements for identifying receptacles that will be automatically de-energized by a mechanical switch or as part of an overall plug load control program, Leviton offers a complete line of receptacles with the “Controlled Receptacle Marking Symbol” Ⓞ and the word “CONTROLLED” on the receptacle face. Available in 15- and 20-Amp ratings and in many colors for both standard duplex and Decora® configurations.



Leviton 'Controlled' Receptacles

New

406.3(F) Receptacle Rating and Type

Change Summary

- New requirements were added for receptacle outlets with USB charger(s).

NEC® Text

406.3 Receptacle Rating and Type.

(F) Receptacle with USB Charger. A 125-volt 15- or 20-ampere receptacle that additionally provides Class 2 power shall be listed and constructed such that the Class 2 circuitry is integral with the receptacle.

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(See NEC for complete text)

Expert Analysis



A new requirement has been added to Article 406 at 406.3(F) pertaining to 125-volt 15- or 20-ampere receptacle that additionally provides Class 2 power in the form of an USB charger. These new provisions require these devices to be listed and constructed such that the Class 2 circuitry is integral with the receptacle. Outlet devices consisting of a Class 2 power supply and Class 2 output connector(s) are presently readily available to the public. Some of these assemblies are intended to be secured and directly connected to a duplex receptacle. The combination of the Class 2 assembly and duplex receptacle has not been investigated to national standards. The product standard for receptacles, ANSI/UL 498 (Attachment Plugs and



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Receptacles), contains requirements that correspond to the required construction as well as the performance requirements to evaluate the suitability of a receptacle with integral power supply with Class 2 output connectors. Requiring the use of a listed receptacle with integral power supply with Class 2 output connectors will confirm that the installed device complies with the appropriate product standard.

Leviton Comment

Leviton's USB devices comply with 406.3 and incorporate "Smart Chip technology" which detects what type of device is connected (phone, tablet, Apple, Android) and provides the exact amount of power that the device requires.



Leviton USB Charging Devices

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Plug, Power and Play.

Leviton's USB Charger Devices provide smart solutions for charging electronic devices such as tablets, smart phones, gaming devices, e-readers, digital cameras and more. Adapter-free charging means quick, convenient power without counter-top clutter. With Leviton USB Charger Devices, you'll spend less time charging devices and more time enjoying them.

USB Charger Devices



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New



406.4(D)(4), Ex. No. 1 and Ex. No. 2 General Installation

Change Summary

- Two new exceptions were added for AFCI requirements for replacement of existing receptacles.

NEC® Text

406.4 General Installation Requirements.

Receptacle outlets shall be located in branch circuits in accordance with Part III of Article 210. General installation requirements shall be in accordance with 406.4(A) through (F).

(D) Replacements. Replacement of receptacles shall comply with 406.4(D)(1) through (D)(6), as applicable. Arc-fault circuit-interrupter type and ground-fault circuit-interrupter type receptacles shall be installed in a readily accessible location.

(4) Arc-Fault Circuit-Interrupter Protection. Where a receptacle outlet is supplied by a branch circuit that requires arc-fault circuit-interrupter protection as specified elsewhere in this Code located in any areas specified in 210.12(A) or (B), a replacement receptacle at this outlet shall be one of the following:

- (1) A listed outlet branch-circuit type arc-fault circuit-interrupter receptacle
- (2) A receptacle protected by a listed outlet branch-circuit type arc-fault circuit-interrupter type receptacle
- (3) A receptacle protected by a listed combination type arc-fault circuit-interrupter type circuit breaker

Exception No. 1: Arc-fault circuit-interrupter protection shall not be required where all of the following apply:

- (1) The replacement complies with 406.4(D)(2)(b).
- (2) It is impracticable to provide an equipment grounding conductor as provided by 250.130(C).
- (3) A listed combination type arc-fault circuit-interrupter circuit breaker is not commercially available.
- (4) GFCI/AFCI dual function receptacles are not commercially available.

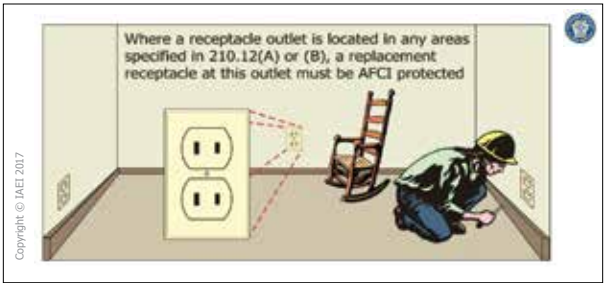
Exception No. 2: Section 210.12(B), Exception shall not apply to replacement of receptacles. This requirement becomes effective January 1, 2014.

Leviton Comment: We believe the NEC made a minor error here and the above referenced Exception is really found in 210.12(D), not 210.12(B).

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Expert Analysis

The parent text of 406.4(D)(4) was revised by removing text concerning the branch circuit providing power to the replaced receptacle, and replacing that text



with a reference to 210.12(A) or (B). This revision will clarify where AFCI protection is required, which is at the receptacle outlet being replaced and not at receptacles located downstream of the replaced receptacle. If a receptacle is being replaced in a bedroom and that branch circuit serves not only that bedroom but a receptacle located outdoors at the front porch, this outdoor receptacle need not be AFCI-protected simply because a bedroom receptacle was being replaced. A literal reading of the previous text could have been interpreted in that way.

Two new exceptions were added for the 2017 NEC following this main rule that requires AFCI protection for replacement of existing receptacles.

In the first exception the installation must meet ALL 4 conditions called-out: Numbers (1) and (2) recognize applications where an existing two-wire receptacle (no equipment grounding conductor) is replaced and no equipment grounding conductor can be installed. Number (3) references a scenario where no listed combination type AFCI breaker is available and Number (4) references a scenario where no GFCI/AFCI dual function receptacle is available. This exception is really meaningless since combination type AFCI breakers and GFCI/AFCI dual function receptacles are both readily commercially available.

The second exception clarifies that the exception to 210.12(D) does not apply when replacing existing receptacles. The requirements of 210.12(D) concern AFCI protection for branch-circuit wiring in areas specified at 210.12(A) when said wiring is modified, replaced, or extended at existing dwelling units. The exception to 210.12(D) permits existing branch-circuit conductors to be modified or extended up to 1.8 m (6 ft) without AFCI protection where no additional outlets or devices are installed.

The Leviton SmartlockPro® Dual Function AFCI/GFCI Outlet offers a National Electrical Code (NEC) compliant option for AFCI/GFCI protection in residential kitchens and laundry areas for new construction, modifications/extensions and replacement receptacles. They are also ideal as a replacement for ungrounded outlets, satisfying NEC requirements for both AFCI and GFCI protection. The Dual Function AFCI/GFCI is available in 15- and 20-Amp with 20-Amp Feed-Through. They are Tamper-Resistant, are back and side wired and include a self-grounding clip included. Available in several colors.



Cat. No. AGTR2-W

Revision



406.9(B)(1) Receptacles in Damp or Wet Locations

Change Summary

- New provisions allowing “other listed products,” enclosures, or assemblies providing weatherproof protection that do not utilize an outlet box hood need not be marked “extra duty” as required for the outlet box hoods.

NEC® Text

406.9 Receptacles in Damp or Wet Locations.

(B) Wet Locations.

(1) Receptacles of 15 and 20 Amperes in a Wet Location.

Receptacles of 15- and 20-amperes, 125- and 250-volts installed in a wet location shall have an enclosure that is weatherproof whether or not the attachment plug cap is inserted. An outlet box hood installed for this purpose shall be listed and shall be identified as “extra duty.” Other listed products, enclosures, or assemblies providing weatherproof protection that do not utilize an outlet box hood need not be marked “extra duty.”

Informational Note No. 1: Requirements for extra-duty outlet box hoods are found in ANSI/UL 514D-2000 2013, Cover Plates for Flush-Mounted Wiring Devices. “Extra duty” identification and requirements are not applicable to listed receptacles, faceplates, outlet boxes, enclosures, or assemblies that are identified as

NEC® Text (continued from previous page)

either being suitable for wet locations or rated as one of the outdoor enclosure-type numbers of Table 110.28 that does not utilize an outlet box hood.

Exception: 15- and 20-ampere, 125- through 250-volt receptacles installed in a wet location and subject to routine high-pressure spray washing shall be permitted to have an enclosure that is weatherproof when the attachment plug is removed.

All 15- and 20-ampere, 125- and 250-volt nonlocking-type receptacles shall be listed and so identified as the weather-resistant type.

Informational Note No. 2: The types configuration of weather-resistant receptacles covered by this requirement are identified as 5-15, 5-20, 6-15, and 6-20 in ANSI/NEMA WD 6-2002 6-2012, Standard for Dimensions of Attachment Plugs and Receptacles Wiring Devices — Dimensional Specifications.

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Expert Analysis



Must be marked “Extra Duty”



“Extra Duty” not required

For the 2017 NEC, in an effort to remedy confusion or misapplication, 406.9(B)(1) was once again revised by adding an extra sentence to indicate that other listed products, enclosures, or assemblies providing weatherproof protection that do not utilize an outlet box hood need not be marked “extra duty.” Language was also added to a 406.9(B)(1) informational note that further stresses the fact that “extra duty” identification and requirements are not applicable to listed receptacles, faceplates, outlet boxes, enclosures, or assemblies that are identified as either being suitable for wet locations or rated as one of the outdoor enclosure-type numbers of Table 110.28 (Enclosure Selection) that does not utilize an outlet box hood. Table 110.28 is used for selecting enclosures for use in specific locations (such as a damp or wet location) other than hazardous (classified) locations.

Other housekeeping revisions occurred with 406.9(B)(1) to make sure the informational notes and exception

“immediately follow the main rule to which they apply” for compliance with the NEC Style Manual.

Leviton Extra Duty While-in-Use Covers

Built to withstand the elements and tough enough to comply with 406.9(B)(1) for “Extra-Duty”

- Accommodates Decora® GFCI devices. Adapter plates are included for duplex and single receptacles
- Heavy-duty gasket protects from moisture and adds to ease of installation
- Includes two inserts to cover cord openings to prevent insects and debris from entering the cover
- Safety lock feature



Leviton Extra Duty covers

Revision and New



406.12 Tamper-Resistant Receptacles

Change Summary

- Requirements for tamper-resistant receptacles were expanded to mobile homes, preschools and elementary education facilities, as well as other locations where small children are likely to congregate.
- TR requirements were expanded to 250-volt receptacles as well as 125-volt receptacles.

NEC® Text

406.12 Tamper-Resistant Receptacles. Tamper-resistant receptacles shall be installed as All 15- and 20-ampere, 125- and 250-volt nonlocking-type receptacles in the areas specified in 406.12(A) through (C) 406.12(1) through (7)

NEC® Text (continued from previous page)

shall be listed tamper-resistant receptacles.

- (1) Dwelling units in all areas specified in 210.52 and 550.13
- (2) Guest rooms and guest suites of hotels and motels
- (3) Child care facilities
- (4) Preschools and elementary education facilities
- (5) Business offices, corridors, waiting rooms and the like in clinics, medical and dental offices and outpatient facilities
- (6) Subset of assembly occupancies described in Article 518.2 to include places of waiting transportation, gymnasiums, skating rinks, and auditoriums
- (7) Dormitories

Informational Note: This requirement would include receptacles identified as 5-15, 5-20, 6-15, and 6-20 in ANSI/NEMA WD 6-2016, *Wiring Devices — Dimensional Specifications*.

Exception to (A), (B), and (C) (1), (2), (3), (4), (5), (6), and (7): Receptacles in the following locations shall not be required to be tamper-resistant:

- (1) Receptacles located more than 1.7 m (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 the dedicated space for each appliance that, in normal use, is not easily moved from one place to another and that is cord-and-plug-connected in accordance with 400.10(A)(6), (A)(7), or (A)(8)
- (4) Nongrounding receptacles used for replacements as permitted in 406.4(D)(2)(a)

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Expert Analysis



One of the first changes involved an expansion of the voltage rating to 250-volts for nonlocking-type receptacles in certain locations that will be required to be of the tamper-resistant type. Receptacles rated at 250-volts are commonly used for air-conditioning and heating units in dwelling units, guest rooms and guest suites of hotels and motels as well as other locations. Expanding the TR receptacle requirements to 250-volts for the same locations as required by 125-volt rated receptacles will enhance and further reduce the number of shock and burn injuries to small children.

For dwelling units, all 15- and 20-ampere, 125- and 250-volt nonlocking-type receptacles in the areas specified at 550.13 were added to receptacles requiring tamper-resistant protection. This requirement was expanded to include areas specified at 550.13, along with areas specified at 210.52, to bring TR receptacle requirements to mobile and manufactured homes.

Finally, the areas and locations where TR receptacles are now required was expanded to include areas such as preschools and elementary education facilities, dormitories, business offices, corridors, waiting rooms, and the like, in clinics, medical and dental offices and outpatient facilities. The areas now requiring TR receptacles would also include assembly occupancies including places of awaiting transportation, gymnasiums, skating rinks, and auditoriums.

A new informational note was also added providing information from the National Electrical Manufacturers Association (NEMA) concerning dimensional requirements for receptacles rated up to 60 amperes and 600 volts as well as dimensions for wall plates. The informational note identifies certain receptacles that would be included in this expanded TR receptacle requirements (see NEMA Standards Publication ANSI/NEMA WD 6-2016). The TR receptacle requirements are aimed at common receptacles found in the locations specified in 406.12 and are not intended to apply to special configurations of receptacles that may be required for specific dedicated equipment where tamper-resistant receptacles are not produced or available.

Leviton tamper-resistant receptacles, have proven effective in preventing electrical injuries resulting from foreign objects being inserted into receptacles. Available residential and commercial grade in 15- and 20-Amp, 125-Volt, Duplex and Decora® in several colors.



Cat. No. T6525



Cat. No. TR5320



Cat. No. GFNT1-W



Deletion

406.15 Dimmer-Controlled Receptacles

Change Summary

- Dimmer-controlled receptacle provisions have been deleted.

NEC® Text

~~406.15 Dimmer-Controlled Receptacles:~~

~~A receptacle supplying lighting loads shall not be connected to a dimmer unless the plug/receptacle combination is a nonstandard configuration type that is specifically listed and identified for each such unique combination.~~

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Expert Analysis

During the 2014 Code revision cycle, new rules were added at 406.15 permitting certain receptacles to be controlled by a dimmer under specific conditions. In conjunction with 404.15(E), dimmer switches are not permitted to control receptacle outlets. Dimmer switches are to be used only to control permanently installed incandescent luminaires, unless listed for the control of other loads and installed accordingly. This 2014 NEC addition at 406.15 allowed a receptacle supplying lighting loads to be connected to a dimmer if the plug/receptacle combination is a nonstandard configuration type and specifically listed and identified for each such unique combination.

This requirement was directed at 120-volt cord- and plug-connected lighting, such as LED-type rope lighting. According to the substantiation for this 2014 NEC addition, some of the manufacturers of these lighting sources provide a dimming feature that is listed with their product. Clear, concise Code language was needed to ensure standard grade receptacles were not being controlled from any dimming or voltage dropping device. For the 2017 NEC, 406.15 was deleted in its entirety. The substantiation for the deletion of 406.15 stated that this issue was better handled by the listing and product standards for these unique and specific products. Perhaps the rules were too broad in nature in specifying

an undefined type of plug/receptacle connector pairing related to cord-and-plug connected load and dimmer incompatibility.

The creation of 406.15 was an attempt to solve a specific problem associated with emerging and evolving new technology, such as LED. As noble as the concept might have been, the addition of 406.15 did not solve this problem. Once again, the solution is better found with the listing and product standards for these unique and specific products.

Leviton Comment

Although 406.15 was deleted in the 2017 NEC, 404.14(E) remains and it dictates that “General use dimmer switches shall be used only to control permanently installed incandescent luminaires unless listed for the control of other loads and installed accordingly.”

Revision and New



422.5 Ground-Fault Circuit-Interrupter (GFCI) Protection for Personnel

Change Summary

- GFCI requirements from 210.8 and throughout Article 422 are related to personnel hazards from specific equipment (contact with equipment with excessive leakage current) and provide those requirements in a single location in Article 422.

NEC® Text

422.5 Ground-Fault Circuit-Interrupter (GFCI) Protection for Personnel. The device providing GFCI protection required in this article shall be readily accessible.

(A) General. Appliances identified in 422.5(A)(1) through (5) rated 250 volts or less and 60 amperes or less, single- or 3-phase, shall be provided with GFCI protection for personnel. Multiple GFCI protective devices shall be permitted but shall not be required.

- (1) Automotive vacuum machines provided for public use
- (2) Drinking fountains water coolers
- (3) High-pressure spray washing machines — cord-and plug-connected
- (4) Tire inflation machines provided for public use
- (5) Vending machines

NEC® Text (continued from previous page)

(B) Type. The GFCI shall be readily accessible, listed, and located in one or more of the following locations:

- (1) Within the branch circuit overcurrent device
- (2) A device or outlet within the supply circuit
- (3) An integral part of the attachment plug
- (4) Within the supply cord not more than 300 mm (12 in.) from the attachment plug
- (5) Factory installed within the appliance

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Expert Analysis



The requirements to have specific appliances provided with GFCI protection have been gathered into one location within Article 422. This relocation has resulted in the expansion and revision of existing 422.5. Based on the voltage limitation of the product standard for GFCIs (UL 943), the “250 volts or less” value was included in 422.5. While UL 943 does not limit applications to 60 amperes or less, that ampere rating was chosen for the ampacity value at 422.5 because 60 amperes or less covers the appliance applications addressed at 422.5 where GFCI protection is commercially available.

A new 422.5(B) gives five options for the location and type of GFCI protective device to deliver GFCI protection to the specific appliances listed at 422.5(A). These options permit the GFCI protection to be provided by any GFCI protective device listed and identified from UL 943. The options also provide owners, designers, and installers the ability to select the location most suitable for the conditions involved. Where the appliances specified at 422.5(A) include built-in GFCI protection in the supply cord, the text at 422.5(A) does not require additional GFCI protection but recognizes that multiple

levels of GFCI protection are compatible and do not cause any safety or operational concerns.

Finally, revisions to 422.5(A) changed the previous 422.52 term of electric drinking fountain to drinking water cooler. This decision was based on the specific identified term used in the applicable product standard for drinking water coolers (UL 399).

Revision



422.16(B)(2) Flexible Cords. (Appliances)

Change Summary

- Maximum length of flexible cord for built-in dishwashers increased from 1.2 m (4 ft) to 2.0 m (6.5 ft) while the receptacle outlet for a built-in dishwasher can only be located in the space adjacent to the dishwasher.

NEC® Text

422.16 Flexible Cords.

(B) Special Appliances.

(2) Built-in Dishwashers and Trash Compactors.

Built-in dishwashers and trash compactors shall be permitted to be cord-and-plug-connected with a flexible cord identified as suitable for the purpose in the installation instructions of the appliance manufacturer where all of the following conditions are met:

- (1) The flexible cord shall be terminated with a grounding-type attachment plug.

Exception: A listed dishwasher or trash compactor distinctly marked to identify it as protected by a system of double insulation, or its equivalent, shall not be required to be terminated with a grounding-type attachment plug.

- (2) For a trash compactor, the length of the cord shall be 0.9 m to 1.2 m (3 ft to 4 ft) measured from the face of the attachment plug to the plane of the rear of the appliance.

- (3) For a built-in dishwasher, the length of the cord shall be 0.9 m to 2.0 m (3 ft to 6.5 ft) measured from the face of the attachment plug to the plane of the rear of the appliance.

- (4) Receptacles shall be located to avoid protect against physical damage to the flexible cord.

- (5) The receptacle for a trash compactor shall be located in the space occupied by the appliance or adjacent thereto.

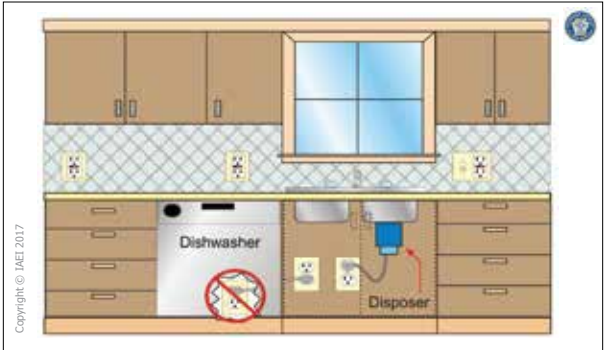
- (6) The receptacle for a built-in dishwasher shall be located in the space adjacent to the space occupied by the dishwasher.

NEC® Text (continued from previous page)

(7) The receptacle shall be accessible.

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Expert Analysis



Changes occurred for the 2017 NEC at 422.16(B)(2) which will only permit the receptacle outlet for a cord-and-plug-connected built-in dishwasher to be located “in the space adjacent to the space occupied by the dishwasher.” In previous editions of the Code, the receptacle outlet for a trash compactor or a built-in dishwasher could be located “in the space occupied by the appliance or adjacent thereto” (directly behind the dishwasher). This change corresponds with provisions in the product standard for household dishwashers, UL 749.

This change brings the NEC in agreement with Section 8.3.3(a) of UL 749 which states in part, “the power-supply receptacle for the appliance (dishwasher) shall be installed in a cabinet or on a wall adjacent to the under counter space in which the appliance is to be installed.

To accommodate this potentially extended length of the cord for connection to a receptacle outlet in the adjacent cabinet space, the maximum length of a cord for a built-in dishwasher was extended from the previous length of 1.2 m (4 ft) to 2.0 m (6.5 ft), measured from the face of the attachment plug to the plane of the rear of the appliance.

New



424.45 Installation of Cables Under Floor Coverings

Change Summary

- New requirements were added for the installation of heating cables installed under floor coverings.

NEC® Text

424.45 Installation of Cables Under Floor Coverings.

(A) Identification. Heating cables for installation under floor covering shall be identified as suitable for installation under floor covering.

(B) Expansion Joints. Heating cables shall not be installed where they bridge expansion joints unless provided with expansion and contraction fittings applicable to the manufacture of the cable.

(C) Connection to Conductors. Heating cables shall be connected to branch-circuit and supply wiring by wiring methods described in the installation instructions or as recognized in Chapter 3.

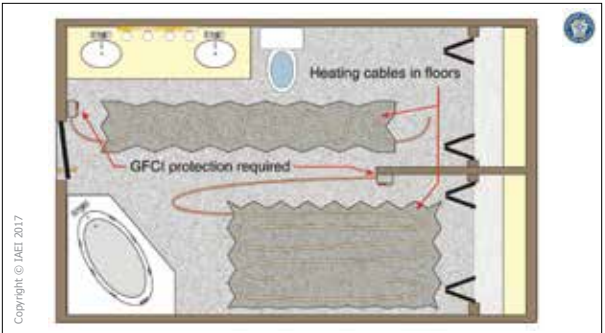
(D) Anchoring. Heating cables shall be positioned or secured in place under the floor covering, per the manufacturer's instructions.

(E) Ground-Fault Circuit-Interrupter Protection. Ground-fault circuit-interrupter protection for personnel shall be provided.

(F) Grounding Braid or Sheath. Grounding means, such as copper braid, metal sheath, or other approved means, shall be provided as part of the heated length.

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Expert Analysis



A new 424.45 with prescriptive language for the installation of heating cables under floor coverings

was added. This practice is not new to the electrical industry, but installation requirements for these under flooring heating cables is new for Article 424. These types of heating cables are required to be GFCI protected.

Heating panels, as well as heating cables, are being installed under floor coverings such as ceramic tile in bathroom and showers, under laminate flooring, and sometimes even under carpet. It is critical that these installations comply with the listing, product standard, and the manufacturer's instructions. Before the 2017 NEC, Part V of Article 424, which deals with electric space-heating cables, did not specifically mention under floor coverings for heating cables. According to some users of the Code, this left it unclear whether or not heating cables installed under a floor covering was permitted. To clear up this confusion and to make it clear that this type of installation is permitted by the NEC, the new text of 424.45 has been added, which is similar to the text of 424.99 for electric radiant heating panels and heating panel sets.

Revision and New



445.18 Disconnecting Means and Shutdown of Prime Mover

Change Summary

- Generator disconnecting means have been reorganized. Provisions for disconnecting means, shut down of the prime mover, and provisions for generators installed in parallel have been added.

NEC® Text

445.18 Disconnecting Means Required for Generators and Shutdown of Prime Mover.

~~Generators shall be equipped with a disconnect(s), lockable in the open position by means of which the generator and all protective devices and control apparatus are able to be disconnected entirely from the circuits supplied by the generator except where the following conditions apply: (1) Portable generators are cord- and plug-connected, or (2) Both of the following conditions apply: a. The driving means for the generator can be readily shut down, is rendered incapable of restarting, and is lockable in the OFF position in accordance with 110.25.~~

NEC® Text (continued from previous page)

b. ~~The generator is not arranged to operate in parallel with another generator or other source of voltage.~~

Informational Note: See UL 2200-2012, Standard for Safety of Stationary Engine Generator Assemblies.

(A) Disconnecting Means. Generators other than cord- and plug-connected portable shall have one or more disconnecting means. Each disconnecting means shall simultaneously open all associated ungrounded conductors. Each disconnecting means shall be lockable in the open position in accordance with 110.25.

(B) Shutdown of Prime Mover. Generators shall have provisions to shut down the prime mover. The means of shutdown shall comply with all of the following:

- (1) Be equipped with provisions to disable all prime mover start control circuits to render the prime mover incapable of starting
- (2) Initiate a shutdown mechanism that requires a mechanical reset

The provisions to shut down the prime mover shall be permitted to satisfy the requirements of 445.18(A) where it is capable of being locked in the open position in accordance with 110.25.

Generators with greater than 15 kW rating shall be provided with an additional requirement to shut down the prime mover. This additional shutdown means shall be located outside the equipment room or generator enclosure and shall also meet the requirements of 445.18(B)(1) and (B)(2).

(C) Generators Installed in Parallel. Where a generator is installed in parallel with other generators, the provisions of 445.18(A) shall be capable of isolating the generator output terminals from the paralleling equipment. The disconnecting means shall not be required to be located at the generator.

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Expert Analysis

Generators are generally required to be equipped with an appropriate disconnecting means (445.18). Historically, Article 445 has not listed requirements for the shutdown of the prime mover for a generator. Typically, a generator is the combination of an electrical generator and an engine (prime mover) mounted together to form a single piece of equipment. This combination is called a generator set or a “gen-set.”

This lack of information and regulations for a “prime mover” is addressed for the 2017 NEC with the addition

of 445.18(B), Shutdown of Prime Mover. This new requirement was added to require shutdown of the prime mover for generators and, in particular, generators rated greater than 15kW. A new sentence was also added to 445.18(B) to clarify that the general provisions to shut down the prime mover may also satisfy the requirements in 445.18(A) for a disconnecting means for the generator (or generator set) under specific conditions. This additional requirement was necessary to provide a remote shutdown means in the event of an emergency. This shutdown means for the prime mover is needed to prevent the generator set from unexpectedly starting and running while the generator is shut down for such things as undergoing service.

A new 445.18(C), Generators Installed in Parallel, clarifies that where generators are installed in parallel, it is not necessary to provide a disconnecting means at each generator and the paralleling equipment as long as the generator is capable of isolating the generator output terminals from the paralleling equipment. Arranging generators to operate in parallel is becoming usual practice for hospitals, data centers, and large buildings requiring onsite backup power. Generators installed in parallel are not exempt from requiring a disconnecting means to disconnect the control circuit, the fuel supply, and to render the generator incapable of restarting. This requirement does not remove the requirement for identified overload protection at the generator, per the requirements of 445.12(A).

Safety Disconnect Switches

Leviton offers a full line of Enclosed Safety Disconnect Switches for every application, including the PowerSwitch Enclosed Safety Disconnect Switch Product Line: DS and EDSR Series

- The DS Series of 30-Amp to 100-Amp, fused and non-fused enclosed switches
- The EDSR Series which brings a 30-Amp, non-fused safety disconnect switch and NEMA locking receptacle into the same enclosure for easier installation and maintenance
- The MDS30-AX, our 30-Amp, non-fused stainless steel enclosed disconnect switch

Heavy Duty Enclosed Safety Disconnect Switches cut power to the circuit for equipment servicing and are

designed to withstand higher short circuit currents than manual motor controllers. Watertight and dust-tight, PowerSwitch Safety Disconnect Switches are the ideal choice for process environments with particulate laden air, outdoor exposure, or requiring water washdowns.



Revision and New



445.20 Ground-Fault Circuit-Interrupter Protection for Receptacles on 15-kW or Smaller Portable Generators

Change Summary

- Listed cord sets incorporating GFCI protection for portable generators manufactured or rebuilt prior to January 1, 2015, are now permitted. GFCI requirements have been separated into unbonded (floating neutral) generators versus bonded neutral generators.

NEC® Text

445.20 Ground-Fault Circuit-Interrupter Protection for Receptacles on 15-kW or Smaller Portable Generators.

All 125-volt, single-phase, 15- and 20-ampere receptacle outlets that are a part of a 15-kW or smaller portable generator either shall have listed ground-fault circuit-interrupter protection (GFCI) for personnel integral to the generator or receptacle or shall not be available for use when the 125/250-volt locking-type receptacle is in use. If the generator does not have a 125/250-volt locking-type receptacle, this requirement shall not apply, as indicated in either (A) or (B):

(A) Unbonded (Floating Neutral) Generators. Unbonded generators with both 125-volt and 125/250-volt receptacle outlets shall have listed GFCI protection for personnel

NEC® Text (continued from previous page)

integral to the generator or receptacle on all 125-volt and 15- and 20-ampere receptacle outlets.

Exception: *GFCI protection shall not be required where the 125-volt receptacle outlet(s) is interlocked such that it is not available for use when any 125/250-volt receptacle(s) is in use.*

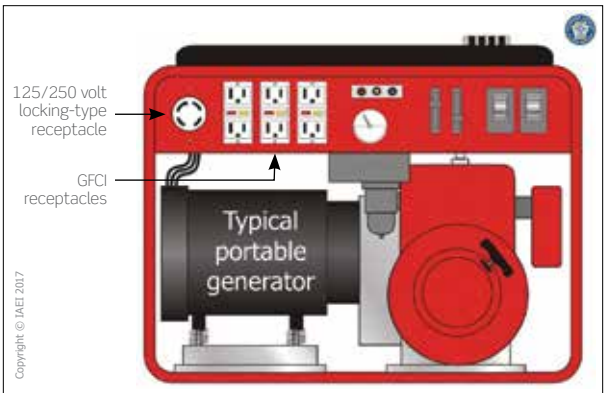
(B) Bonded Neutral Generators. Bonded generators shall be provided with GFCI protection on all 125-volt and 15- and 20-ampere receptacle outlets.

Informational Note: Refer to 590.6(A)(3) for GFCI requirements for 15-kW or smaller portable generators used for temporary electric power and lighting.

Exception to (A) and (B): *If the generator was manufactured or remanufactured prior to January 1, 2015, listed cord sets or devices incorporating listed GFCI protection for personnel identified for portable use shall be permitted.*

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Expert Analysis



The requirements of 445.20 were revised to separate GFCI requirements for unbonded (floating neutral) generators at 445.20(A) and bonded neutral generators at 445.20(B). Unbonded (floating neutral) generators requires GFCI protection at all 125-volt, 15- and 20-ampere receptacles, but only where both 125-volt and 125/250-volt receptacles exist on the generator. An exception to 445.20(A) eliminates GFCI protection where the 125-volt receptacle outlet(s) is interlocked such that it is not available for use when any 125/250-volt receptacle(s) is in use.

New 445.20(B) requires all 125-volt, 15- and 20-ampere receptacles on bonded neutral generators to be provided with GFCI protection. An exception to 445.20(A) and (B) permits GFCI protection in the form of listed cord

sets or devices incorporating listed GFCI protection if the generator was manufactured or remanufactured prior to January 1, 2015.

Leviton Comment

This code article relates to the construction of the Generator. Contractors exposure here is limited as inspectors typically look for your installation work, not your generator. This may be more of an OSHA concern on larger job sites. Compliance makes sense to address safety and liability concerns on the job site.

To comply with the exception to (A) and (B) above, Leviton offers a full line of GFCI Cord Sets. Leviton's GFCI Cord Sets and User-attachable plugs are sleeker and more rugged than ever. And, while these devices are fully NEC and OSHA compliant for use on job sites, they are also perfect for use in a variety of temporary power applications, such as electric gardening equipment, electric power tools, recreation vehicles, marine vehicles, portable pools, portable generators, submersible pumps, vending machines and more.



Leviton GFCI Cord Sets

New



517.16 Use of Isolated Ground Receptacles. (Health Care Facilities)

Change Summary

- Revisions to 517.16 were divided into two subdivisions for prohibition of isolated ground receptacles inside a patient care vicinity and allowance of isolated ground receptacles installed outside a patient care vicinity.

NEC® Text

517.16 Use of Isolated Ground Receptacles.

(A) Inside of a Patient Care Vicinity. An isolated ground receptacle shall not be installed within a patient care vicinity. [99:6.3.2.2.7.1(B)]

(B) Outside of a Patient Care Vicinity. Isolated ground receptacle(s) installed in patient care spaces outside of a patient care vicinity(s) shall comply with 517.16(B)(1) and (2).

(1) The grounding terminals of isolated ground receptacles installed in branch circuits for patient care spaces shall be connected to an insulated equipment grounding conductor in accordance with 250.146(D) in addition to the equipment grounding conductor path required in 517.13(A).

The equipment grounding conductor connected to the grounding terminals of isolated ground receptacles in patient care spaces shall be clearly identified along the equipment grounding conductor's entire length by green insulation with one or more yellow stripes.

(2) The insulated equipment grounding conductor required in 517.13(B)(1) shall be clearly identified along its entire length by green insulation, with no yellow stripes, and shall not be connected to the grounding terminals of isolated ground receptacles but shall be connected to the box or enclosure indicated in 517.13(B)(1)(2) and to non-current-carrying conductive surfaces of fixed electrical equipment indicated in 517.13(B)(1)(3).

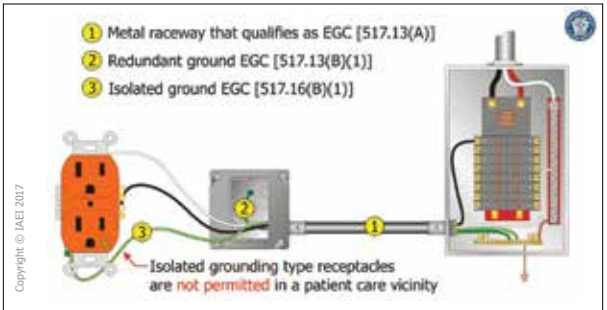
Informational Note No. 1: This type of installation is typically used where a reduction of electrical noise (electromagnetic interference) is necessary, and parallel grounding paths are to be avoided.

Informational Note No. 2: Care should be taken in specifying a system containing isolated ground receptacles, because the grounding impedance is controlled only by the grounding wires and does not benefit from any conduit or building structure in parallel with the grounding path. [99: A.6.3.2.2.7.1]

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Expert Analysis

Isolated ground receptacles are permitted to have their grounding terminal purposely insulated from the receptacle mounting means for the reduction of electrical noise (electromagnetic interference) on the grounding circuit [see 250.146(D)]. The isolated ground receptacle grounding terminal is to be connected to an insulated equipment grounding conductor run with the circuit conductors. This isolated ground equipment grounding conductor is permitted to pass through



one or more panelboards without a connection to the panelboard grounding terminal bar as well as pass through boxes, wireways, or other enclosures without being connected to such enclosures. The requirements of 406.3(D) calls for isolated ground receptacles to be identified by an orange triangle located on the face of the receptacle.

Changes were made to 517.16 for the 2014 NEC to make it clear that isolated ground receptacles were not permitted to be installed within a patient care vicinity of a health care facility. The concern is the assurance of the equipment grounding conductor redundancy requirement of 517.13(A) and (B) for wiring methods at a patient care vicinity. This redundant grounding provision in a patient care space requires two equipment grounding paths to always ensure one is functioning at all times. This redundant grounding provision cannot and should not be accomplished with an isolated ground receptacle equipment grounding conductor as this conductor should not be connected to the metal enclosure. Therefore, such a connection would negate the isolated grounding of an isolated ground receptacle established by 250.146(D).

Apparently, confusion still existed regarding the number of equipment grounding conductors that must be installed for isolated ground receptacles installed outside the patient care vicinity. To meet the requirements of 517.13(A) and (B) for redundant grounding provisions, it is not uncommon to find a wiring method of electrical metallic tubing (EMT) with a separate 12 AWG copper insulated equipment grounding conductor in spaces outside of a patient care vicinity. The problem comes in when this redundant grounding equipment grounding conductor is incorrectly utilized to serve double-duty as the isolated ground equipment

grounding conductor where isolated ground receptacles are installed outside of a patient care vicinity. This type of installation is in violation of 250.146(D) and 517.13.

The new provisions of 517.16(B) will clearly identify the requirement of three grounding paths when isolated ground receptacles are required [metal raceway or cable armor equipment grounding path, green wire type equipment grounding conductor for the 517.13 redundant grounding requirements, and a separate isolated ground equipment grounding conductor to comply with 250.146(D)]. The new provisions of 517.16(B)(1) will demand a color designation of green with one or more yellow stripes for the isolated ground equipment grounding conductor. This color designation was chosen to provide a color pattern typically used as an industry standard for isolated ground equipment grounding conductors.

Leviton offers Isolated Ground Receptacles in Industrial Grade and Hospital Grade with standard Duplex and Decora® styling. Offered with back and side wiring terminals as well as with 6" wire leads. Modular Lev-Lock® wiring system also available. Several colors available.



Cat. No. M8300-IGR

Revision and New



517.30 Sources of Power. (Health Care Facilities)

Change Summary

- Requirements for two independent sources of power and an alternate source of power for the essential electrical system for hospitals and other health care facilities were revised and relocated to 517.30. Fuel cell systems will now be permitted to serve as the alternate source for all or part of an essential electrical system.

NEC® Text

517.35 517.30 Sources of Power.
(A) Two Independent Power Sources.

NEC® Text (continued from previous page)

Essential electrical systems shall have a minimum of the following two independent sources of power: a normal source generally supplying the entire electrical system and one or more alternate source(s) for use when the normal source is interrupted. [99: 6.4.1.1.4]

(B) Alternate Source Types of Power Sources.

The alternate source of power shall be one of the following:

- (1) **Generating Units.** Generator(s) driven by some form of prime mover(s) and located on the premises. Where the normal source consists of generating units on the premises, the alternate source shall be either another generating set or an external utility service. [99:6.4.1.1.5]
- (2) Another generating unit(s) where the normal source consists of a generating unit(s) located on the premises
- (3) An external utility service when the normal source consists of a generating unit(s) located on the premises
- (4) A battery system located on the premises [99:6.4.1.2]

(2) Fuel Cell Systems. Fuel cell systems shall be permitted to serve as the alternate source for all or part of an essential electrical system, provided the following conditions apply:

- (1) Installation of fuel cells shall comply with the requirements in Parts I through VII of Article 692 for 1000 volts or less and Part VIII for over 1000 volts.

Informational Note: For information on installation of stationary fuel cells, see NFPA 853-2015, Standard for Installation of Stationary Fuel Cell Power Systems. [99:6.4.1.1.7]

- (2) N + 1 units shall be provided where N units have sufficient capacity to supply the demand loads of the portion of the system served. [99:6.4.1.7.2]
- (3) System shall be able to assume loads within 10 seconds of loss of normal power source.
- (4) System shall have a continuing source of fuel supply, together with sufficient on-site fuel storage for the essential system type.
- (5) A connection shall be provided for a portable diesel generator to supply life safety and critical portions of the distribution system. [99: 6.4.1.1.7.5(1) through (5)]
- (6) Fuel cell systems shall be listed for emergency system use.

(C) Location of Essential Electrical System Components.

Careful consideration shall be given to the location of the spaces housing the components of the Essential electrical system components shall be located to minimize interruptions caused by natural forces common to the area (e.g., storms, floods, earthquakes, or hazards created by adjoining structures or activities). Consideration shall also be given to the Installations of electrical services shall be located to reduce possible interruption of normal electrical

NEC® Text (continued from previous page)

services resulting from similar causes as well as possible disruption of normal electrical service due to internal wiring and equipment failures. ~~Consideration shall be given to the~~ **Feeders shall be located to provide** physical separation of the **main** feeders of the alternate source from the **main** feeders of the normal electrical source to prevent possible simultaneous interruption.

Informational Note: Facilities in which the normal source of power is supplied by two or more separate central station-fed services experience greater than normal electrical service reliability than those with only a single feed. Such a dual source of normal power consists of two or more electrical services fed from separate generator sets or a utility distribution network that has multiple power input sources and is arranged to provide mechanical and electrical separation so that a fault between the facility and the generating sources is not likely to cause an interruption of more than one of the facility service feeders.

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Expert Analysis

When reviewing the requirements of 517.35 from the 2014 NEC, the electrical power sources for the essential electrical system of a health care facility must be supplied by a minimum of two independent sources; a normal power source and one or more alternate power sources for use when the normal power source is interrupted. The normal power source is generally made up of a source supplied by the local electric utility power company and an on-site power generator(s), which can be a private on-site power generator unit(s) or another electric utility-supplied source. The alternate power source was permitted to be one of several options.

Typically, the alternate sources of power are supplied to the loads through a series of automatic and/or manual transfer switches. The transfer switches can be non-delayed automatic, delayed automatic, or manual transfer depending on the requirements of the specific branch of the essential electrical system that they are feeding. It is permissible to feed multiple branches or systems of the essential electrical system from a single automatic transfer switch provided that the maximum demand on the essential electrical system not exceed 150 kVA.

One of the most noticeable changes to the requirements for the types of allowed power sources for these essential electrical systems was the added language

at 517.30(B)(2) for fuel cell systems. Fuel cell systems will now be permitted to serve as the alternate source for all or part of an essential electrical system, with six specific conditions involved [see 517.30(B)(2)(1) through (6)]. Fuel cells provide a high level of reliability and have a proven reliability track record in data centers and other mission-critical facilities. Other advantages to fuel cells include the fact that a failed fuel cell can be isolated and replaced without shutting down the entire string, and they have fuel flexibility from natural gas to diesel.

New



525.23(D) Ground-Fault Circuit-Interrupter (GFCI) Protection. (Carnivals, Circuses, Fairs, and Similar Events)

Change Summary

- New requirement for listed, labeled, and identification of portable GFCI protection for branch circuits fed by flexible cords.

NEC® Text

525.23 Ground-Fault Circuit-Interrupter (GFCI) Protection.

(A) Where GFCI Protection Is Required. GFCI protection for personnel shall be provided for the following:

(1) All 125-volt, single-phase, 15- and 20-ampere non-locking-type receptacles used for disassembly and reassembly or readily accessible to the general public

(2) Equipment that is readily accessible to the general public and supplied from a 125-volt, single-phase, 15- or 20-ampere branch circuit

The ~~ground-fault circuit-interrupter~~ **GFCI** shall be permitted to be an integral part of the attachment plug or located in the power-supply cord within 300 mm (12 in.) of the attachment plug. Listed cord sets incorporating ~~ground-fault circuit-interrupter~~ **GFCI** for personnel shall be permitted.

(B) Where GFCI Protection Is Not Required.

Receptacles that are not accessible from grade level and that only facilitate quick disconnecting and reconnecting of electrical equipment shall not be required to be provided with GFCI protection. These receptacles shall be of the locking type.



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NEC® Text (continued from previous page)

(C) Where GFCI Protection Is Not Permitted.

Egress lighting shall not be protected by a GFCI.

(D) Receptacles Supplied by Portable Cords. Where GFCI protection is provided through the use of GFCI receptacles, and the branch circuits supplying receptacles utilize flexible cord, the GFCI protection shall be listed, labeled, and identified for portable use.

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Expert Analysis

For wiring at carnivals, circuses, fairs, and similar events, ground-fault circuit-interrupter (GFCI) protection is required at all 125-volt, single-phase, 15- and 20-ampere non-locking-type receptacles used for disassembly and reassembly of rides and equipment and at all 125-volt, single-phase, 15- and 20-ampere non-locking-type receptacles that are readily accessible to the general public. GFCI protection is also required at equipment that is readily accessible to the general public and supplied from 125-volt, single-phase, 15- or 20-ampere branch circuits.

Frequently, this required GFCI protection is delivered through a standard GFCI receptacle device installed at the end of a flexible cord. This installation can result in a potential hazard as an open neutral situation can easily develop in the field due to wear-and-tear on the cord and plug connections. When this happens, the GFCI device does not and cannot function properly because this GFCI device no longer sees 120 volts needed to function properly, and fails to open (trip) properly. Under the UL product category (KCXS), standard GFCI receptacles are described as “flush receptacles and are intended to be installed in an outlet box for fixed installation on a branch circuit similar to a conventional receptacle.” To combat this situation, a new 525.23(D) was incorporated into the 2017 NEC calling for GFCI protection to be listed, labeled, and identified for portable use when any GFCI protection is provided through the use of GFCI receptacles, with the branch circuits supplying these receptacles utilizing flexible cords. Portable GFCIs are plug-in type GFCIs provided with male blades or an integral power-supply cord for connection to a receptacle outlet. Portable GFCIs are also provided with one or more receptacle

outlets located on the GFCI or a cord-connector body at the end of a length of flexible cord. These portable GFCI devices also interrupt power to the load when any single supply conductor (including the neutral conductor) is opened.

It is important to point out that this new portable GFCI requirement at 525.23(D) incorporates a requirement for identified portable GFCI receptacles, but only on branch circuits fed by flexible cords. This provision does not apply to GFCI protection for portable structures or rides even though such structures and rides may be fed by flexible cord feeders.

Leviton's Automatic and Manual Reset GFCI Cord Sets feature ultrasonically welded bodies that provide excellent resistance to harsh weather and long service life. They are perfect for carnivals, circuses, fairs and other temporary outdoor events.

All of our GFCI cord sets have Open-Neutral Protection — immediately trips the GFCI if the neutral conductor on the line side is opened, eliminating the possibility of the Cord Set having a live hot leg. Plus, they fully comply with NEC and OSHA regulations for construction sites.



Cat. No. GFM15-3C

Automatic Reset Cord Sets will automatically reset ON when plugged in or power is restored after a power interruption, while Manual Reset Cord Sets will not automatically reset ON when power is restored after a power interruption — the reset button must be pushed in.

Revision



550.13(B) Receptacle Outlets. (Mobile Homes, Manufactured Homes, and Mobile Home Parks)

Change Summary

- GFCI protection for mobile homes was revised to reflect GFCI coverage for all sinks, dishwashers, and other locations similarly found at 210.8(A).

NEC® Text

550.13 Receptacle Outlets.

(B) Ground-Fault Circuit Interrupters (GFCI).

All 125-volt, single-phase, 15- and 20-ampere receptacle outlets installed outdoors, in compartments accessible from outside the unit, or in bathrooms, including receptacles in luminaires, in the locations specified in 550.13(B)(1) through (5) shall have GFCI protection for personnel. GFCI protection shall be provided for receptacle outlets serving countertops in kitchens and receptacle outlets located within 1.8 m (6 ft) of a wet bar sink. The exceptions in 210.8(A) shall be permitted.

- (1) Outdoors, including in compartments accessible from outside the unit
- (2) Bathrooms, including receptacles in luminaires
- (3) Kitchens, where receptacles are installed to serve countertop surfaces
- (4) Sinks, where receptacles are installed within 1.8 m (6 ft) of the outer edge of the a wet bar sink
- (5) Dishwashers

Feeders supplying branch circuits shall be permitted to be protected by a ground-fault circuit interrupter in lieu of the provision for such interrupters specified herein.

Informational Note: For information on protection of dishwashers, see 422.5.

Note to Reader: The GFCI requirements for dwelling unit dishwashers remained at 210.8(D) and not at 422.5 as indicated in the added informational note above.

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Expert Analysis



Unfortunately, the GFCI requirements for mobile and manufactured homes have not always kept pace with the same GFCI requirements for conventional dwelling units. With that in mind, revisions and updates were made to 550.13(B) for the 2017 NEC related to GFCI requirements for mobile and manufactured homes.



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Along with the previous GFCI requirements, GFCI requirements for all sinks (not just wet bar sinks), dishwashers and other locations similarly found at 210.8(A) were incorporated into 550.13(B).

Clarification was added to the GFCI provisions for outdoor receptacle outlets to include all outdoor receptacle outlets including (but not limited to) outdoor receptacle outlets located in compartments accessible from outside the unit.

The option of delivering the required GFCI protection through a feeder that supplied the branch circuits associated with the receptacle outlets requiring GFCI protection was eliminated with the revisions of 550.13(B) for the 2017 NEC. No explanation was given for this feeder option being deleted.

The GFCI requirements for mobile and manufactured homes at 550.13(B) were reformatted into a list format for usability. These revisions and formatting will add enforceability and clarity while bringing needed consistency between mobile and manufactured homes and conventional dwelling units concerning GFCI requirements.

Revision/Deletion



550.25(B) Arc-Fault Circuit-Interrupter Protection. (Mobile Homes, Manufactured Homes, and Mobile Home Parks)

Change Summary

- AFCI requirements for mobile homes were expanded to reference AFCI requirements of 210.12.

NEC® Text

550.25 Arc-Fault Circuit-Interrupter Protection.

(A) Definition. Arc-fault circuit interrupters are defined in Article 100.

(B) Mobile Homes and Manufactured Homes. All 120-volt branch circuits that supply 15- and 20-ampere outlets installed in family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, or similar rooms or areas of mobile homes and manufactured homes shall comply with 210.12.

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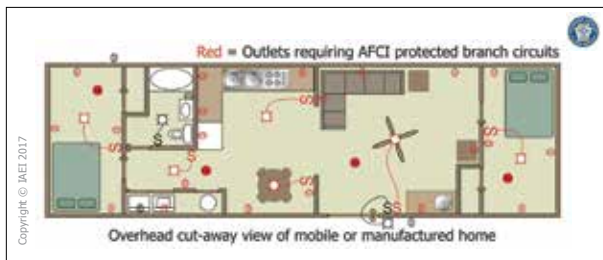
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Expert Analysis



Similar to GFCI requirements, AFCI protection at mobile and manufactured homes has not kept pace with the expansion of AFCI protection at conventional dwelling units. Equal AFCI protection is warranted at all dwelling unit locations regardless of the type of dwelling unit that is involved.

To that end, the provisions for AFCI protection at mobile and manufactured homes were revised at 550.25(B) by eliminating the “laundry list” of rooms and locations requiring AFCI protection at mobile and manufactured homes and simply requiring “all 120-volt branch circuits that supply 15- and 20-ampere outlets to comply with 210.12.”

Revision



551.71 Type Receptacles Provided. (Recreational Vehicle Parks)

Change Summary

- The number of RV sites required to be equipped with 50-ampere, 125/250-volt receptacles has increased from 20 percent to 40 percent for all new recreational vehicle sites
- GFCI devices used in RV site electrical equipment are not required to be weather- or tamper-resistant in accordance with 406.9 and 406.12

NEC® Text

551.71 Type Receptacles Provided.

(A) 20-Ampere. Every recreational vehicle site with electrical supply shall be equipped with recreational vehicle site supply equipment with at least one 20-ampere, 125-volt receptacle.

(B) 30-Ampere. A minimum of 70 percent of all recreational vehicle sites with electrical supply shall each be equipped

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Five improvements to the NEC include Single-Phase Dwelling Services & Feeders, 310.15(B)(7); GFCI Protection for Non-Dwelling Units, 210.8(B); Reconditioned Equipment, ID & Traceability, 110.21(A)(2); Short-Circuit Current Documentation, 9 locations throughout; and Limited Access Working Space Requirement, 110.26(A)(4).

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NEC® Text (continued from previous page)

with a 30-ampere, 125-volt receptacle conforming to Figure 551.46(C)(1). This supply shall be permitted to include additional receptacle configurations conforming to 551.81.

(C) 50-Ampere. A minimum of 20 percent of existing and 40 percent of all new recreational vehicle sites, with electrical supply, shall each be equipped with a 50-ampere, 125/250-volt receptacle conforming to the configuration as identified in Figure 551.46(C)(1). Every recreational vehicle site equipped with a 50-ampere receptacle shall also be equipped with a 30-ampere, 125-volt receptacle conforming to Figure 551.46(C)(1). These electrical supplies shall be permitted to include additional receptacles that have configurations in accordance with 551.81.

(D) Tent Sites. Dedicated tent sites with a 15- or 20-ampere electrical supply shall be permitted to be excluded when determining the percentage of recreational vehicle sites with 30- or 50-ampere receptacles.

(E) Additional Receptacles. Additional receptacles shall be permitted for the connection of electrical equipment outside the recreational vehicle within the recreational vehicle park.

(F) GFCI Protection. All 125-volt, single-phase, 15- and 20-ampere receptacles shall have listed ground-fault circuit-interrupter protection for personnel. The GFCI devices used in RV site electrical equipment shall not be required to be weather or tamper resistant in accordance with 406.9 and 406.12.

Informational Note: The percentage of 50 ampere sites required by 551.71 may could be inadequate for seasonal recreational vehicle sites serving a higher percentage of recreational vehicles with 50 ampere electrical systems. In that type of recreational vehicle park, the percentage of 50 ampere sites could approach 100 percent.

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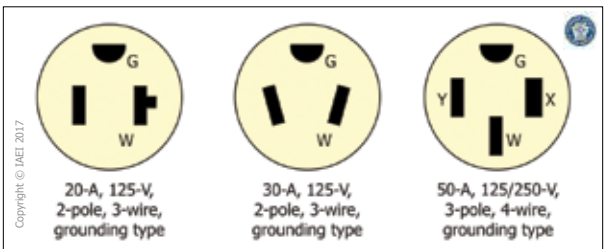


Illustration of Figure 551.46(C)(1)



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Expert Analysis

The demands for the type and rating of receptacles provided at recreational vehicle (RV) parks continue to grow and expand. A 30-ampere rated system is the most common type of electrical system provided on RVs. In the last Code cycle, a new requirement was added at 551.71 requiring every RV site equipped with a 50-ampere receptacle to also be equipped with a 30-ampere, 125-volt receptacle. This requirement was an attempt to stop or slow down the increasing use of a “cheater cord” at RV sites supplied with only a 50-ampere receptacle. These “cheater cords” are a 50-ampere to 30-ampere short cord being sold to connect a 30-ampere RV supply cord to a 50-ampere receptacle. Proper connection of the grounding and bonding connections is only one concern with these “cheater cords” being employed along with improper overcurrent protection for the RV itself.

For the 2017 NEC, the number of RV sites required to be equipped with 50-ampere, 125/250-volt receptacles at RV parks has increased from 20 percent to 40 percent of all new recreational vehicle sites. A minimum of 20 percent of existing RV sites equipped with a 50-ampere, 125/250-volt receptacle remains sufficient. As the industry increases the number of RVs equipped with 50-ampere supply cords, it is important to ensure that RV parks and campgrounds can safely accommodate these power supplies so that “cheater cord” adapters are not a viable option.

Another change initiated at 551.71 was the use of the term recreational vehicle site supply equipment. This term is defined at 551.2 (necessary equipment intended to constitute the disconnecting means for the supply to that site) but is not mentioned in previous editions of the Code at 551.71.

Lastly, a new sentence was added at 551.71(F) specifying that “GFCI devices used in RV site electrical equipment shall not be required to be weather- or tamper-resistant in accordance with 406.9 and 406.12.” In their Committee Statement, CMP-19 indicated that RV site electrical equipment listed for use in RV parks is NEMA 3R rated, weather-resistant rated equipment and the weather-resistant receptacle requirements of 406.9 are not needed. This statement went on to say that RV

site electric equipment is not for use in a dwelling, so the tamper-resistant receptacle requirements of 406.12 is not necessary.

For RV connection, Leviton offers receptacles to comply with requirements of Article 551.71

RV Receptacles



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Cat. No. 279

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Revision



555.3 Ground-Fault Protection. (Marinas, Boatyards and Commercial and Noncommercial Docking Facilities)

Change Summary

- The ground-fault protection required for overcurrent protective devices for marinas, boatyards, and commercial and noncommercial docking facilities cannot exceed 30 mA (rather than 100 mA).

NEC® Text

555.3 Ground-Fault Protection.

The main overcurrent protective devices that feeds supply the marina, boatyards, and commercial and noncommercial docking facilities shall have ground fault protection not exceeding 100 mA 30 mA. Ground-fault protection of each individual branch or feeder circuit shall be permitted as a suitable alternative.

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Expert Analysis

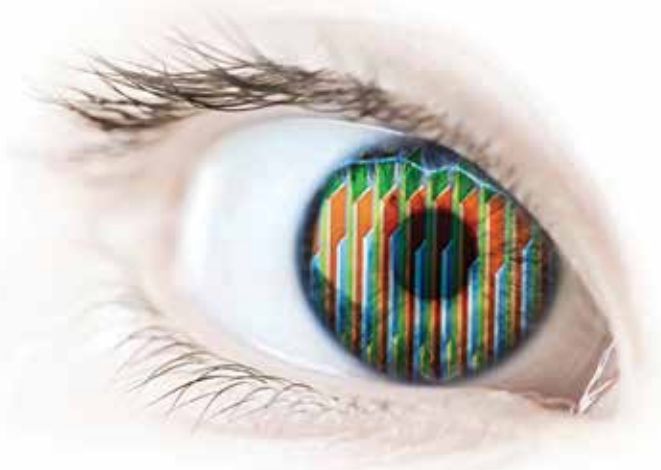


A new 555.3 was added to Article 555 for the 2011 NEC calling for “ground-fault protection” of a maximum 100 milliamperes (mA) capacity on the main overcurrent protective device serving a marina or boatyard. In lieu of this ground-fault protection on the main, individual GFCI protection on each branch circuit or feeder was permitted.

For the 2017 NEC, this maximum 100 mA capacity has been reduced to a maximum of 30 mA. This 30 mA ground-fault limit is recommended in a report commissioned by NFPA’s Fire Protection Research Foundation. This report stated in part: “While 30 mA through the body is more than enough to kill a swimmer (above the “let-go” threshold established for a Class A GFCI device), it is not sufficient to assume that all of the 30 mA leaking into the water will actually go through the swimmer. 30 mA represents an acceptable level to prevent a majority of electric shock drowning (ESD) incidents while remaining practical enough to minimize unnecessary tripping.”

Some users of the Code will argue that true protection for personnel (people) is only be achieved with Class A GFCI protection (maximum 4 to 6 mA current levels). This let-go level of protection would prove to be too sensitive for the wet environments encountered at marinas and docking facilities, resulting in continual “nuisance” tripping.

It should be noted that a related change occurred at 555.24 that calls for posting of signage to alert personnel coming into the vicinity of marinas and boatyards of the potential for shock hazards. See Article 555.24 in this publication for more information.



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Deletion



**555.19(B)(1) Receptacles.
(Marinas, Boatyards, and Commercial
and Noncommercial Docking Facilities)**

Change Summary

- GFCI protection for personnel is required for all 125-volt, single-phase, 15- and 20-ampere receptacles installed outdoors, in boathouses, and in buildings or structures used for storage, maintenance, or repair, without consideration of whether “electrical diagnostic equipment, electrical hand tools, or portable lighting equipment” is being used.

NEC® Text

555.19 Receptacles.

Receptacles shall be mounted not less than 305 mm (12 in.) above the deck surface of the pier and not below the electrical datum plane on a fixed pier.

(B) Other Than Shore Power.

(1) Ground-Fault Circuit-Interrupter (GFCI) Protection for Personnel. Fifteen- and 20-ampere, single-phase, 125-volt receptacles installed outdoors, in boathouses, in buildings or structures used for storage, maintenance, or repair ~~where portable electrical hand tools, electrical diagnostic equipment, or portable lighting equipment are to be used~~ shall be provided with GFCI protection for personnel. Receptacles in other locations shall be protected in accordance with 210.8(B).

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Expert Analysis



The previous language at 555.19(B) required ground-fault circuit-interrupter (GFCI) protection for personnel at all 15- and 20-ampere, single-phase, 125-volt receptacles “where portable electrical hand tools, electrical diagnostic equipment, or portable lighting equipment was to be used”.



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For the enforcement community, it is extremely difficult for the AHJ to determine which receptacles will employ “portable electrical hand tools, electrical diagnostic equipment, or portable lighting equipment” and which receptacles will not. This determination is made even more difficult for the AHJ since this determination is typically required to be made on the final inspection with the marinas, docking facilities, buildings or structures, etc., unoccupied.

To this end, the 2017 NEC deleted the condition that the receptacles involved must supply “portable electrical hand tools, electrical diagnostic equipment, or portable lighting equipment” in order for GFCI protection to be required.

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Cat. No. G5362-WTI

New



555.24 Signage. (Marinas, Boatyards and Commercial and Noncommercial Docking Facilities)

Change Summary

- New signage requirement at 555.24 for precautionary signage related to electric shock hazard in water around marinas and boatyards.

NEC® Text

555.24 Signage.

Permanent safety signs shall be installed to give notice of

NEC® Text (continued from previous page)

electrical shock hazard risks to persons using or swimming near a boat dock or marina and shall comply with all of the following:

- (1) The signage shall comply with 110.21(B)(1) and be of sufficient durability to withstand the environment.
- (2) The signs shall be clearly visible from all approaches to a marina or boatyard facility.
- (3) The signs shall state “WARNING — POTENTIAL SHOCK HAZARD — ELECTRICAL CURRENTS MAY BE PRESENT IN THE WATER.”

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Expert Analysis



A new 555.24 was added to the 2017 NEC requiring the posting of signage to alert personnel coming into the vicinity of marinas and boatyards of the potential for shock hazards in the water in and around these nautical areas. Numerous ESD deaths and injuries (including electrocution in the water) at marinas and boatyards have been documented and investigated over the last decade.

The signage must comply with 110.21(B)(1) and be clearly visible from all approaches to a marina or boatyard facility. The signs shall state:

“WARNING — POTENTIAL SHOCK HAZARD — ELECTRICAL CURRENTS MAY BE PRESENT IN THE WATER.”

It is recognized that inspection and regular maintenance activities which often require personnel entering the water will still be required in these marinas and boatyards. Preventative actions such as disconnecting shore connections to boats at and near the work location, securing power to docks or sections of docks, and wearing protective equipment (such as

wet suits) can be used to provide adequate protection for maintenance personnel. The general public does not have an understanding of the potential electrical dangers present within the confines of marinas and boatyards. Marina and boatyard operators clearly have a responsibility to provide protection from electrical hazards as is stated in NFPA 303 (Fire Protection Standard for Marinas and Boatyards).

New



600.4(B) Signs with a Retrofitted Illumination System

Change Summary

- New requirement calls for electric signs that have been retrofitted to be marked to indicate that it is a retrofit kit.

NEC® Text

600.4 Markings.

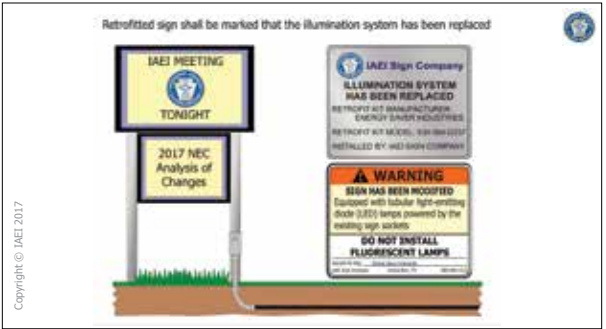
(B) Signs with a Retrofitted Illumination System.

- (1) The retrofitted sign shall be marked that the illumination system has been replaced.
- (2) The marking shall include the kit providers and installer's name, logo, or unique identifier.
- (3) Signs equipped with tubular light-emitting diode lamps powered by the existing sign sockets shall include a label alerting the service personnel that the sign has been modified. The label shall meet the requirements of 110.21(B). The label shall also include a warning not to install fluorescent lamps and shall also be visible during relamping.

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Expert Analysis

The sign and lighting industries have experienced an extensive movement toward the use of retrofit kits to achieve greater energy efficiency in signs and luminaires. To ensure that the parts are compatible with the field modification, a qualified nationally recognized testing laboratory (NRTL), such as UL, requires all the parts for luminaire and sign conversions to be assembled into a kit that the NRTL evaluates and labels as "Classified." To that end, existing electric signs that have been retrofitted need to be marked, and the authority having



jurisdiction (AHJ) will inspect the retrofit based on the installation instructions provided as part of the kits' listing. The installer and/or serving company needs to be notified that the sign has a retrofitted lighting system as a safety measure for future maintenance activities involving the sign. To greatly assist with these activities, a new marking requirement was added to 600.4 for the 2017 NEC.

This new marking requirement for retrofit kits will clarify that replacement of such things as fluorescent lamps is prohibited after a retrofit kit with tubular LEDs has been installed. A reference to 110.21(B) will require the label to address the hazard involved with words and/or symbols. It also addresses the location of the required label. These markings must include the kit providers and installer's name, logo, or unique identifier. The installer of the kit needs to be identified since the installation company may not be the manufacturer of the retrofit kit or the original sign. This marking provides the AHJ with a means of identifying the installer of the field conversion.

New

**600.6(A)(1),
Ex. No. 2 Disconnects.
(Electric Signs and Outline Lighting)**



Change Summary

- A new exception was added permitting energized conductors (with warning label) in a Chapter 3 raceway or metal-jacketed cable identified for the location to be run through a sign body or enclosure to a feeder panelboard(s) located within the sign body or enclosure.

NEC® Text

600.6 Disconnects.

Each sign and outline lighting system, feeder circuit conductor(s), or branch circuit(s) supplying a sign, outline lighting system, or skeleton tubing shall be controlled by an externally operable switch or circuit breaker that opens all ungrounded conductors and controls no other load.

The switch or circuit breaker shall open all ungrounded conductors simultaneously on multi-wire branch circuits in accordance with 210.4(B). Signs and outline lighting systems located within fountains shall have the disconnect located in accordance with ~~680.12~~ 680.13.

Exception No. 1: A disconnecting means shall not be required for an exit directional sign located within a building.

Exception No. 2: A disconnecting means shall not be required for cord-connected signs with an attachment plug.

Informational Note: The location of the disconnect is intended to allow service or maintenance personnel complete and local control of the disconnecting means.

(A) Location.

(1) At Point of Entry to a Sign Enclosure. The disconnect shall be located at the point the feeder circuit or branch circuit(s) supplying a sign or outline lighting system enters a sign enclosure, a sign body, or a pole in accordance with 600.5(C)(3) and: The disconnect shall disconnect open all wiring ungrounded conductors where it enters the enclosure of the sign or pole.

Exception No. 1: A disconnect shall not be required for branch circuit(s) or feeder circuits conductor(s) passing through the sign where enclosed in a Chapter 3 listed raceway or metal-jacketed cable identified for the location.

Exception No. 2: A disconnect shall not be required at the point of entry to a sign enclosure or sign body for branch circuit(s) or feeder conductor(s) that supply an internal panelboard(s) in a sign enclosure or sign body. The conductors shall be enclosed in a Chapter 3 listed raceway or metal-jacketed cable identified for the location. A field-applied permanent warning label that is visible during servicing shall be applied to the raceway at or near the point of entry into the sign enclosure or sign body. The warning label shall comply with 110.21(B) and state the following: "Danger. This raceway contains energized conductors." The marking shall include the location of the disconnecting means for the energized conductor(s). The disconnecting means shall be capable of being locked in the open position in accordance with 110.25.

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Expert Analysis

For the 2014 NEC, a new 600.6(A)(1) titled, "At Point of Entry to a Sign Enclosure," was added requiring the sign disconnect to be located at the point the feeder(s) or branch circuit(s) supplying a sign or outline lighting system enters a sign enclosure or pole. An exception to this rule was also added allowing a branch circuit or feeder to pass through a sign where enclosed in a NEC Chapter 3 listed raceway allowing the disconnecting

feeder panelboards within the sign. For example, each of these feeders could be rated as much as 800- or 1,200-amperes. Due to the size and location of these signs, it is desirable and/or necessary to control multiple lighting loads from within the sign body or enclosure to facilitate servicing of the sign. These feeder panelboards can be located on different levels and sections within the sign. Service personnel use the circuit breakers in the feeder panelboard(s) as a disconnecting means for branch circuits on the different levels (stories) where they are working.

Electrical safety dictates that these raceways be identified to prevent accidental or deliberate exposure to energized conductors. OSHA 1910.335(b)(1) requires the use of safety signs, safety symbols or accident-prevention tags to warn about potential electrical hazards. Warning labels and markings with similar warning of energized conductors are found in other places in the Code, such as 404.6(C) Ex.; 620.52(B); 690.5(C), etc. Equally as important, in the event of an emergency requiring de-energizing the live feeders or branch circuits passing through the sign body, the location of the disconnecting means, which is out of the line of sight and at a location other than the sign, must be known and accessible to service personnel or emergency responders. Providing a field-applied label with the location of the disconnecting means will contribute to electrical safety for service personnel as well as emergency first responders.

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plates and covers to 15-Amp, 20-Amp and 30-Amp single receptacles

- Easily operated with wet and/or gloved hands, and provides OSHA compliant lockout/tagout capabilities



New

600.34, 600.2 Photovoltaic (PV) Powered Sign



Change Summary

- A new definition for Photovoltaic (PV Powered) Sign was added to 600.2 and new provisions for PV powered signs were added to Article 600 at 600.34.

NEC® Text

600.2 Definitions.

Photovoltaic (PV) Powered Sign. A complete sign powered by solar energy consisting of all components and subassemblies for installation either as an off-grid stand-alone, on-grid interactive, or non-grid interactive system.

600.34 Photovoltaic (PV) Powered Sign. All field wiring of components and subassemblies for an off-grid stand-alone, on-grid interactive, or non-grid interactive PV installation shall be installed in accordance with Article 690, as applicable, 600.34, and the PV powered sign installation instructions.

(A) Equipment. Inverters, motor generators, PV modules, PV panels, ac PV modules, dc combiners, dc-ac converters, and charge controllers intended for use in PV powered sign systems shall be listed for PV application.

(B) Wiring. Wiring from a photovoltaic panel or wiring external to the PV sign body shall be:

- (1) Listed, labeled, and suitable for photovoltaic applications
- (2) Routed to closely follow the sign body or enclosure
- (3) As short as possible and secured at intervals not exceeding 0.91 m (3 ft)
- (4) Protected where subject to physical damage

(C) Flexible Cords and Cables. Flexible cords and

NEC® Text (continued from previous page)

cables shall comply with Article 400 and be identified as extra hard usage, rated for outdoor use, and water and sunlight resistant.

(D) Grounding. Grounding a PV powered sign shall comply with Article 690, Part V and 600.7.

(E) Disconnecting Means. The disconnecting means for a PV powered sign shall comply with Article 690, Part III and 600.6.

(F) Battery Compartments. Battery compartments shall require a tool to open.

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Expert Analysis

The installation rules for a PV system are found in Article 690. Requirements for these PV powered signs located in Article 600, a new 600.34 was added for the 2017 NEC pertaining to field wiring and installations of PV powered signs. A new definition for a Photovoltaic (PV Powered) Sign was added to 600.2 in Article 600. Signs powered by a PV system will require special installation instructions and a new 600.34 will provide these installation instructions in addition to the appropriate application rules of Article 690.

The rules in 600.34 are intended to harmonize with Article 600, Article 690, and the end use of PV powered signs constructed in accordance with UL 48. Self-contained, stand-alone PV powered signs operating at or below Class 2 voltages are considered safe from electrical shock the same as any other Class 2 circuits (see 725.2 for a definition of Class 2 circuits). UL 48 does not require bonding or grounding for self-contained off-grid PV powered signs operating within the limits of Class 2 voltages. A self-contained off-grid PV powered sign having the photovoltaic panel as part of the sign housing and having all circuits operating at 30-volt dc or less is not required to be grounded or to comply with the bonding requirements [see 600.7(B)(1) Exception and UL 48. 4.4.12.19].

New



620.51(E) Elevators, Dumbwaiters, Escalators, Moving Walks, Platform Lifts, and Stairway Chairlifts

Change Summary

- Surge protection is required for all emergency system disconnects covered under 620.51.

NEC® Text

620.51 Disconnecting Means.

A single means for disconnecting all ungrounded main power supply conductors for each elevator, dumbwaiter, escalator, moving walk, platform lift or stairway chairlift, shall be provided and be designed so that no pole can be operated independently.

620.51 (E) Surge Protection

Where any of the disconnecting means in 620.51 has been designated as supplying an emergency system load, surge protection shall be provided.

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(See NEC for complete text)

Expert Analysis

The 2014 NEC added a new Code article 700.8 which requires surge protection on emergency systems. This new Code language in 620.51(E) expands requirements for surge protection for emergency systems to include disconnects for emergency systems as called out in 620.51. These disconnects include loads for elevators, escalators, moving walkways, platform lifts and others. If any of these loads are designated as part of the facilities emergency system, it would have to be surge protected.

Leviton Comment

Article 620.51(E) calls for Surge Protection Devices (SPDs). Type 2 SPDs would typically be the type of device associated with this Code article.

Here we have provided an explanation of the different levels of surge protection and their applications:

Type 1 SPD for the supply side of service



Cat. No.
50240-MSA

Cat. No.
55240-ASA

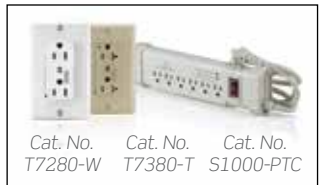
entrance. Leviton offers several options including the 55240-ASA and 50240-MSA secondary surge arrestors.

Type 2 SPDs SPDs are typically service entrance SPD panels or branch circuit SPD panels that are connected on the load side of the service disconnect overcurrent device (main service panel).

Leviton offers several options including the 52120-7CS.



Type 3 SPD's are typically surge receptacles or cord connected point-of use devices. Leviton offers a complete assortment in duplex, quad and 6-plex in many styles and colors.



Type 4 SPDs are component assemblies consisting of one or more Type 5 components together with a disconnect (integral or external) or a means of complying with the limited current tests in UL 1449.



Type 5 SPDs: Discrete component surge suppressors connected by its leads or provided with an enclosure with mounting means and wiring terminations.

Type 1 and Type 2 SPDs shunt external surges that originate from utilities or disturbances outside the home or facility. Type 2 SPDs can protect for both internal and external surges when located at the branch. Type 3 SPDs can shunt surges that originated internally within the home or facility. So a comprehensive strategy for surge protection typically involves a Type 1 or Type 2 SPD and also a Type 3 SPD at point of use.

New

645.18 Surge Protection for Critical Operations Data Systems. (Information Technology Equipment)

Change Summary

- A new requirement was added for surge protection for critical operations data systems.

NEC® Text

645.18 Surge Protection for Critical Operations Data Systems.

Surge protection shall be provided for critical operations data systems.

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(See NEC for complete text)

Expert Analysis

A Critical Operations Data System is defined at 645.2 as “an information technology equipment system that requires continuous operation for reasons of public safety, emergency management, national security, or business continuity.” A new section was added at 645.18 demanding that surge protection be provided for critical operations data systems. Type 1 and Type 2 surge-protective devices (SPD) are typically the devices installed to a particular element of the electrical system to achieve the desired surge protection and ensure reliable electrical power.

This new surge protection requirement in Article 645 correlates with 708.20(D) for Critical Operations Power Systems. Section 708.20(D) calls for surge protection devices to be provided at all facility distribution voltage levels of a critical operations power system. This requirement often results in localized surge protection as part of the manufactured equipment. This requirement at 645.18 addresses an additional level of surge protection that is needed as close as possible to the incoming supply for the critical operations data system. For surge protection to be effective, multiple levels of surge protection typically must be provided. Type 2 and Type 3 SPDs would typically be the type of device associated with this Code article.

Surge protection at utilization equipment is only one piece of the total surge protection package that is necessary to be effective. The definition of Critical

Operations Data System substantiates the need for a complete and effective surge protection system. The purpose of the NEC as stated at 90.1(A) is “the practical safeguarding of persons and property from hazards that arise from the use of electricity.” This new requirement at 645.18 for surge protection provisions for critical operation data systems supports this overall purpose. Critical operation data systems are essential in weather-related events, loss of utility power, or other catastrophic conditions.

This surge protection is not meant solely for protection against weather-related events such as lightning. This surge protection also addresses internal surges caused by localized switching within the power distribution system as well as utility switching which is a common occurrence.

Servers, storage and networking equipment can only perform as well as the power that drives it. Leviton Power Distribution Units (PDUs) provide robust, reliable power to rack and cabinet applications. Choose from a wide variety of horizontal and vertical models in switched, metered or unmetered configurations, or rack-mounted units with surge protection.



Leviton Power Distribution Units (PDUs)

New

670.6 Surge Protection. (Industrial Machinery)



Change Summary

- A new requirement was added for surge protection of industrial machinery with safety interlocking circuits.

NEC® Text

670.6 Surge Protection.
Industrial machinery with safety interlock circuits shall have surge protection installed.

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(See NEC for complete text)

Expert Analysis

Industrial machinery is defined at 670.2 as “a power-driven machine (or a group of machines working together in a coordinated manner), not portable by hand while working, that is used to process material by cutting; forming; pressure; electrical, thermal, or optical techniques; lamination; or a combination of these processes.” Industrial machinery can include associated equipment used to transfer material or tooling, including fixtures, to assemble/disassemble, to inspect or test, or to package. The associated electrical equipment, including the logic controller(s) and associated software or logic together with the machine actuators and sensors, are considered as part of the industrial machinery as well.

A new requirement has been added to Article 670 applying to Industrial machinery with safety interlock circuits. These industrial machinery applications will now be required to be provided with surge protection. Type 2 SPDs would typically be the type of device associated with this Code article. By definition, a safety interlock is “a device or means that places a machine or machine component into a zero, or substantially reduced, danger-mode upon intent to access; or a device or means that will actively prevent access to a hazard upon intended access.” A very simplistic example of a safety interlock is found on a household clothes dryer. Upon opening the clothes dryer door, the high-speed rotation of the dryer’s drum will stop, and the drum will not operate with the dryer door open.

Protecting workers by protecting the industrial machinery safety interlocking systems from damage due to surges is a step forward in electrical safety.

New



680.2 and Part VIII of Article 680 Definitions, Swimming Pools, Fountains, and Similar Installations

Change Summary

- A new definition for Electrically Powered Pool Lift was added to 680.2 and a new Part VIII entitled, “Electrically Powered Pool Lifts,” was added to Article 680.

NEC® Text

680.2 Definitions.

Electrically Powered Pool Lift. An electrically powered lift that provides accessibility to and from a pool or spa for people with disabilities.

Part VIII. Electrically Powered Pool Lifts

680.80 General. Electrically powered pool lifts as defined in 680.2 shall comply with Part VIII of this article. They shall not be required to comply with other parts of this article.

680.81 Equipment Approval. Lifts shall be listed and identified for swimming pool and spa use.

Exception No. 1: Lifts where the battery is removed for charging at another location and the battery is rated less than or equal to the low-voltage contact limit shall not be required to be listed or labeled.

Exception No. 2: Solar-operated or -recharged lifts where the solar panel is attached to the lift and the battery is rated less than or equal to 24 volts shall not be required to be listed or labeled.

Exception No. 3: Lifts that are supplied from a source not exceeding the low-voltage contact limit and supplied by listed transformers or power supplies that comply with 680.23(A)(2) shall not be required to be listed.

680.82 Protection. Pool lifts connected to premises wiring and operated above the low-voltage contact limit shall be provided with GFCI protection for personnel.

680.83 Bonding. Lifts shall be bonded in accordance with 680.26(B)(5) and (B)(7).

680.84 Switching Devices. Switches and switching devices that are operated above the low-voltage contact limit shall comply with 680.22(C).

680.85 Nameplate Marking. Electrically powered pool lifts shall be provided with a nameplate giving the identifying name and model and rating in volts and amperes, or in volts and watts. If the lift is to be used on a specific frequency or frequencies, it shall be so marked. Battery-powered pool lifts shall indicate the type reference of the battery or battery pack to be used. Batteries and battery packs shall be provided with a battery type reference and voltage rating.

Exception: Nameplate ratings for battery-powered pool lifts shall only need to provide a rating in volts in addition to the identifying name and model.

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(See NEC for complete text)

Expert Analysis





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A new definition for an Electrically Powered Pool Lift at 680.2 along with a new Part VIII (680.80 through 680.85) were incorporated into Article 680 for the 2017 NEC. These lifts are defined as “an electrically powered lift that provides accessibility to and from a pool or spa for people with disabilities.” Before the 2017 NEC, installation of these mandated powered pool lifts has been without compliance to any NEC requirements, in particular, requirements in Article 680.

This new definition is a companion to a new term now found in a new Part VIII of Article 680 pertaining to electrically powered pool lifts. Part VIII to Article 680 puts into place prescribed rules for the installation of these mandatory pool lifts with adequate safety requirements for all pool users. These new rules for electrically powered pool lifts include general requirements at 680.80, equipment approval (listing requirements) at 680.81, GFCI protection requirements at 680.82, bonding requirements at 680.83, switching device requirements at 680.84, and nameplate marking requirements at 680.85.

Weather-Resistant GFCI Receptacles

Swimming pool areas are among the harshest environments that wiring devices are subject to. Leviton's SmartlockPro® Weather-Resistant (WR) GFCI receptacles are up to the challenge.

Our large selection includes outdoor grade versions that are also tamper-resistant. All are UL Listed weather-resistant to comply with Section 406.9(B)(1) of the National Electrical Code®. Constructed with UV stabilized engineering thermoplastic for high cold impact resistance, the devices feature stainless steel straps and mounting screws. Rain or shine, Leviton offers products to meet all your outdoor needs.



Cat. No.
GFWT1-KW

Important: Covers must be used with WR GFCI receptacles in damp or wet locations per NEC Section 406.9(B)(1).

Revision and New

680.12 and 680.14 Equipment Rooms and Pits. (Swimming Pools, Fountains, and Similar Installations) and 680.14 Corrosive Environment

Change Summary

- A new requirement for protection against a corrosive environment for electrical equipment installed in equipment rooms and pits was added at 680.12 and 680.14.

NEC® Text**680.12 Equipment Rooms and Pits.**

Electrical equipment shall not be installed in rooms or pits that do not have drainage that prevents water accumulation during normal operation or filter maintenance. Equipment shall be suitable for the environment in accordance with 300.6.

Informational Note: Chemicals such as chlorine cause severe corrosive and deteriorating effects on electrical connections, equipment, and enclosures when stored and kept in the same vicinity. Adequate ventilation of indoor spaces such as equipment and storage rooms is addressed by ANSI/APSP-11, *Standard for Water Quality in Public Pools and Spas*, and can reduce the likelihood of the accumulation of corrosive vapors.

680.14 Corrosive Environment.

(A) General. Areas where pool sanitation chemicals are stored, as well as areas with circulation pumps, automatic chlorinators, filters, open areas under decks adjacent to or abutting the pool structure, and similar locations shall be considered to be a corrosive environment. The air in such areas shall be considered to be laden with acid, chlorine, and bromine vapors, or any combination of acid, chlorine, or bromine vapors, and any liquids or condensation in those areas shall be considered to be laden with acids, chlorine, and bromine vapors, or any combination of acid, chlorine, or bromine vapors.

(B) Wiring Methods. Wiring methods in the areas described in 680.14(A) shall be listed and identified for use in such areas. Rigid metal conduit, intermediate metal conduit, rigid polyvinyl chloride conduit, and reinforced thermosetting resin conduit shall be considered to be resistant to the corrosive environment specified in 680.14(A).

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(See NEC for complete text)

Expert Analysis

When installing electrical equipment in a room or pit, it is important to make sure that proper drainage and corrosion protection is provided.

Quite a few places in Article 680 discuss things like metal conduits needing to be corrosion resistant and suitable for the location, but corrosion protection was not addressed in previous editions of the Code in Article 680 for electrical equipment in designated rooms or pits. This situation was rectified for the 2017 NEC with the revision of 680.12, which was 680.11 in the 2014 NEC, and the creation of new 680.14. Code language was added at 680.12 and 680.14 requiring electrical equipment located in equipment rooms or pits or areas where pool sanitation chemicals are stored to be suitable for the environment in accordance with 300.6. A look at 300.6 reveals that “raceways, cable trays, cable bus, auxiliary gutters, cable armor, boxes, cable sheathing, cabinets, elbows, couplings, fittings, supports, and support hardware shall be of materials suitable for the environment in which they are to be installed.”

The new provisions at 680.14 identify areas where pool sanitation chemicals are stored, as well as areas with circulation pumps, automatic chlorinators, filters, open areas under decks adjacent to or abutting the pool structure, and similar locations as being considered to be a corrosive environment. The air in such areas is also considered to be laden with acid, chlorine, and bromine vapors, or any combination of acid, chlorine, or bromine vapors. This new section also requires wiring methods in these areas to be listed and identified for use in such areas.

This new corrosion-resistance requirement at 680.12 addresses the suitability of the equipment for these locations and will allow the to address these issues from a Code standpoint.

Leviton Wetguard® devices are designed for applications where electrical connections are exposed to wet and corrosive locations. They have IEC and NEMA watertight and dust-tight enclosure ratings and offer many significant advantages over competitive brands. A patented multi-point sealing system forms a barrier against dirt and moisture providing the ultimate protection that you should expect from a watertight device. The Wetguard® line features corrosion-resistant electroless nickel-coated brass blades, contacts, terminal screws and wiring clamps, and stainless steel assembly screws. They are resistant

to water, acids, alkalis, and many automotive and industrial lubricants and solvents. The plug and connector husk is molded to a bondable nylon body, providing a device that withstands physical abuse as well. In addition, the patented compression nut strain relief system ensures the integrity of the electrical connection and watertight seal.



Leviton Wetguard® Devices

Revision/Deletion



680.22(A)(2) Lighting, Receptacles, and Equipment. (Swimming Pools, Fountains, and Similar Installations)

Change Summary

- Requirements for the pool pump motor receptacle were revised with the single receptacle requirement removed and the minimum distance from the pool of 3.0 m (10 ft) being reduced to 1.83 m (6 ft).

NEC® Text

680.22 Lighting, Receptacles, and Equipment. (A) Receptacles.

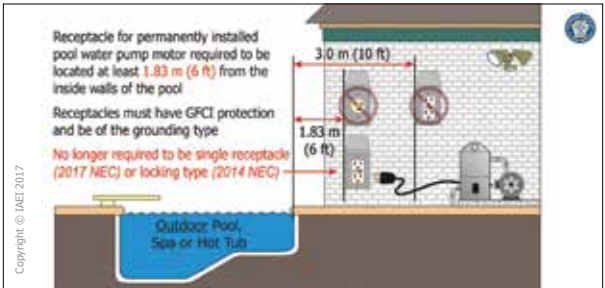
(2) Circulation and Sanitation System, Location.

Receptacles that provide power for water-pump motors or for other loads directly related to the circulation and sanitation system shall be located at least ~~3.0 m (10 ft)~~ **1.83 m (6 ft)** from the inside walls of the pool, ~~or not less than 1.83 m (6 ft) from the inside walls of the pool if they meet all of the following conditions:~~ **These receptacles shall have GFCI protection and be of the grounding type.**

- ~~(1) Consist of single receptacles~~
- ~~(2) Are of the grounding type~~
- ~~(3) Have GFCI protection~~

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(See NEC for complete text)

Expert Analysis



In the last Code cycle, 680.22(A)(2) [previously 680.22(A)(1)] eliminated the need for a locking-type receptacle configuration for the circulation and sanitation receptacle.

For the 2017 NEC, 680.22(A)(2) reduced the minimum distance of “3.0 m (10 ft) from the inside walls of the pool” for the pool pump receptacle outlet to “not less than 1.83 m (6 ft) from the inside walls of the pool.” The requirement for the pool pump motor receptacle outlet to consist of a single receptacle configuration was also eliminated. Why would the pool pump motor receptacle outlet need to be located 3.0 m (10 ft) from the inside walls of the pool or be a single receptacle configuration if any convenience receptacle outlet cannot be located less than 1.83 m (6 ft) from the inside walls of the pool and be of the duplex type configuration?

Pool pump motor receptacle outlets are still required to be GFCI-protected. GFCI receptacle devices commonly consist of the duplex configuration.

When it comes to outdoor GFCI protection, it's smart to choose SmartlockPro® GFCIs. Our large selection includes outdoor grade Weather-Resistant versions that are also tamper-resistant. Constructed with UV stabilized engineering thermoplastic for high cold impact resistance, the devices feature stainless steel straps and mounting screws. For the increased power that pool pumps can demand, Leviton's 20-Amp GFCI's are up to the test.



Cat. No.
GFWT2-KW

Important: Covers must be used with WR GFCI receptacles in damp or wet locations per NEC Section 406.9(B)(1).



Jump start a new level of comfort.

Leviton and Samsung SmartThings have teamed up to offer the perfect home automation starter kit.

Get your next smart home project off on the right foot. The bundled kit includes the Samsung SmartThings Hub, and a wireless Leviton Z-Wave universal dimmer and light switch. Expand from there with other easy plug-ins like thermostats, sensors and extra lighting controls.

Visit www.leviton.com/smartthings for more information.

Leviton and Samsung SmartThings



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New

680.28 Gas-Fired Water Heater. (Swimming Pools, Fountains, and Similar Installations)

Change Summary

- New requirements were added for GFCI protection for swimming pool and spa gas-fired water heaters.

NEC® Text

680.28 Gas-Fired Water Heater.

Circuits serving gas-fired swimming pool and spa water heaters operating at voltages above the low-voltage contact limit shall be provided with ground-fault circuit-interrupter protection for personnel.

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(See NEC for complete text)

Expert Analysis

GFCI protection for personnel is not required for electric water heater installations as the risk of electric shock is considered adequately mitigated through the use of proper grounding provisions [see 680.6(3)] and the listing installation requirement for the use of current collectors on the input and output side of the heater. These current collectors have proven reliable to prevent unacceptable levels of current in the pool in the event of corrosion of the immersed heating elements of an electric pool heater. However, these current collectors are not present with a gas-fired swimming pool heater. The 125-volt branch circuit to a gas-fired water heater is susceptible to a loss of current and a ground-fault condition as much as any other piece of electrical equipment.

To address this issue, branch circuits serving gas-fired swimming pool and spa water heaters operating at voltages above the low-voltage contact limit are required to provide GFCI protection for personnel beginning with the 2017 NEC. This requirement adds a measure of safety to the end user of the swimming pool in future installations.

Some within the electrical industry, including some enforcers of the Code, have relied on the requirements of 680.22(A)(2) to enforce GFCI protection for receptacle outlets that provide power to pool heaters

of permanently installed pools. This particular provision required GFCI protection for “receptacles that provide power for water-pump motors or other loads directly related to the circulation and sanitation system.” The argument being that a pool heater would fall into this category of “other loads directly related to the circulation and sanitation system.” Regardless if this is a legitimate Code interpretation or not, this new GFCI requirement for gas-fired water heaters will give users of the Code a strong, direct requirement for GFCI protection for this one heating aspect of the aquatic environment moving forward.

Revision



682.15 Ground-Fault Circuit-Interrupter (GFCI) Protection. (Natural and Artificially Made Bodies of Water)

Change Summary

- Section 682.15 now requires that all receptacles installed outdoors and in or on floating buildings or structures within the electrical datum plane area are to be provided with GFCI protection for personnel (not just in areas used for storage, maintenance, or repair where portable electric hand tools, electrical diagnostic equipment, or portable lighting equipment are to be used).

NEC® Text

682.15 Ground-Fault Circuit-Interrupter (GFCI) Protection.

Fifteen- and 20-ampere single-phase, 125-volt through 250-volt receptacles installed outdoors and in or on floating buildings or structures within the electrical datum plane area ~~that are used for storage, maintenance, or repair where portable electric hand tools, electrical diagnostic equipment, or portable lighting equipment are to be used~~ shall be provided with GFCI protection **for personnel**. The GFCI protection device shall be located not less than 300 mm (12 in.) above the established electrical datum plane.

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(See NEC for complete text)

Expert Analysis

For the 2017 NEC, the description, “areas that are used for storage, maintenance, or repair where portable electric hand tools, electrical diagnostic equipment, or portable lighting equipment are to be used” was deleted. GFCI protection for personnel is now required for all 15- and 20-ampere, single-phase, 125-volt through 250-volt receptacles installed outdoors and in or on floating buildings or structures within the electrical datum plane area without having to determine if portable electric hand tools, etc., will be used or not. The GFCI protection device must be located not less than 300 mm (12 in.) above the established electrical datum plane.

By removing the qualifying language, it will be clear that GFCI protection for personnel is required under all situations encountered within the electrical datum plane area. This change will help eliminate the debate between installers and enforcers in these areas concerning whether portable tools, portable lighting, and the like, are being used or not.

New



695.15 Surge Protection. (Fire Pumps)

Change Summary

- A listed surge protection device (SPD) is now required to be installed in or on fire pump controllers.

NEC® Text

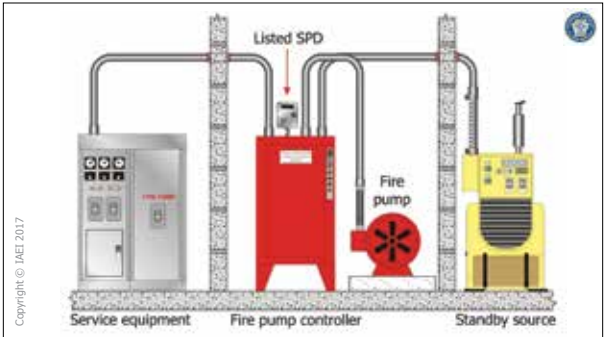
695.15 Surge Protection.

A listed surge protection device shall be installed in or on the fire pump controller.

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Expert Analysis

For the 2017 NEC, SPD protection is being added for items such as critical operations data systems and industrial machinery. Joining these crucial operations needing SPD protection for the 2017 NEC will be fire pump controllers. The location and type of SPD is a design issue and remains with the designer and/or installer.



The SPDs for fire pump controllers are required to be listed devices as already required by former 285.5 (now 285.6). Type 2 SPDs would typically be the type of device associated with this Code article.

A study titled, “Data Assessment for Electrical Surge Protective Devices,” commissioned by the National Fire Protection Research Foundation, provided results of a 2013 and 2014 survey of facility managers concerning surge damage. This study shows that twelve percent of the fire pumps involved had damage due to voltage surges. Much of this damage could have been prevented with properly sized and listed surge protective devices. The new requirement for listed SPD for fire pump controllers is vitally important as fire pumps are so critical for life-safety.

Surge Protection Required For Emergency Fire Pump Controllers



Leviton Type 2 Surge Devices

To satisfy NEC 695.15 Leviton offers several Surge protection options from a comprehensive suite of Type 2 Surge Protective Panels that provide the required surge protection and additional noise filtering to improve

power quality. The line includes models appropriate for both 3-phase and single-phase electrical systems up to 600-Volts AC, with maximum surge current ratings up to 640kA per phase. Surge panels with modular platforms incorporate easy-to-replace surge modules — eliminating the need to change out the entire surge panel following a damaging surge event. All Leviton surge protective panels are listed to UL 1449 3rd edition standards, and are backed by a limited lifetime warranty.

Please visit www.leviton.com/surge for more information.

New



700.2 and 700.25 Branch Circuit Emergency Lighting Transfer Switch

Change Summary

- A new 700.25 titled, “Branch Circuit Emergency Lighting Transfer Switch” was added to allow these devices to be used to transfer emergency lighting loads supplied by branch circuits rated at not greater than 20-amperes from the normal branch circuit to an emergency branch circuit. A new definition for Branch Circuit Emergency Lighting Transfer Switch was also added at 700.2.

NEC® Text

700.2 Definitions.

Branch Circuit Emergency Lighting Transfer Switch.

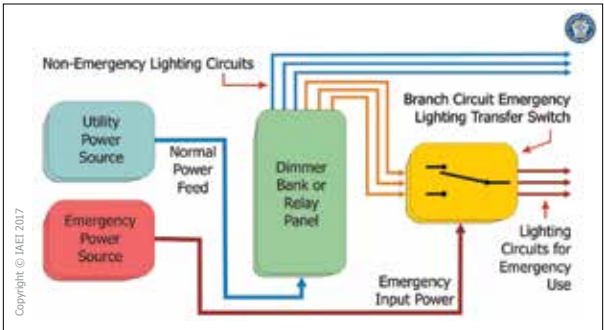
A device connected on the load side of a branch circuit overcurrent protective device that transfers only emergency lighting loads from the normal supply to an emergency supply.

Informational Note: See ANSI/UL 1008, Transfer Switch Equipment, for information covering branch circuit emergency lighting transfer switches.

700.25 Branch Circuit Emergency Lighting

Transfer Switch. Emergency lighting loads supplied by branch circuits rated at not greater than 20 amperes shall be permitted to be transferred from the normal branch circuit to an emergency branch circuit using a listed branch circuit emergency lighting transfer switch. The mechanically held requirement of 700.5(C) shall not apply to listed branch circuit emergency lighting transfer switches.

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Expert Analysis

For the 2017 NEC, a new section was added to Article 700 at 700.25 titled, “Branch Circuit Emergency Lighting Transfer Switch.” This section permits emergency lighting loads supplied by branch circuits rated at not greater than 20-amperes to be transferred from the normal branch circuit to an emergency branch circuit using a listed “branch circuit emergency lighting transfer switch.” The product standard for this new class of transfer switching devices can be found in UL 1008 (Transfer Switch Equipment).

In some past situations, an automatic load control relay (ALCR) has been used to transfer emergency lighting loads from the normal supply to an emergency supply (even though this is a code violation of 700.26). During the 2011 NEC, 700.24 (now 700.26 in the 2017 NEC) was added to the Code. This section covers the requirements for ALCRs and specifically states, “the load control relay shall not be used as transfer equipment.” UL 924 (Standard for Emergency Lighting and Power Equipment) transfer-capable ALCRs were never intended for use as general purpose transfer equipment. However, these devices fall within the NEC definition of transfer equipment because they can be used for transferring a load between two asynchronous power sources (normal and emergency). Even if they do meet the definition of transfer equipment, they do not meet the current requirements of Article 700 for emergency transfer switches. ALCRs have not undergone any evaluation as emergency transfer switches.

This is part of the reason it was necessary for these new branch-circuit emergency lighting transfer switches to be introduced into the 2017 NEC. These devices (and transfer-capable ALCRs that are re-evaluated as branch

circuit emergency lighting transfer switches under UL 1008) will now be evaluated using performance and construction requirements comparable to those applied to traditional emergency transfer switches for use on branch circuits rated up to 20-amperes.

Leviton offers Emergency Transfer Switches only as part of a complete systems solution. For additional details about having a Leviton Solution designed and quoted for your project, please reach out to your local Leviton lighting controls representative. A list of lighting control representatives can be found by clicking on the 'Find a Sales Representative' link at Leviton.com/architecturalcontrols. Or you can call 1-800-959-6004, or email us at lestechnsupport@leviton.com.

Revision and New



700.10(A) Wiring, Emergency System

Change Summary

- Identification for emergency circuits has been expanded to include cables and raceways not associated with boxes or enclosures.
- Emergency system receptacles now require identification with a distinctive color or marking.

NEC® Text

700.10 Wiring, Emergency System.

(A) Identification. Emergency circuits shall be permanently marked so they will be readily identified as a component of an emergency circuit or system by the following methods:

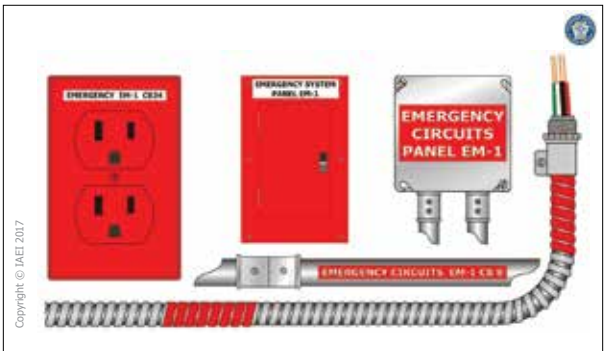
(1) All boxes and enclosures (including transfer switches, generators, and power panels) for emergency circuits shall be permanently marked so they will be readily identified as a component of an emergency circuit or system.

(2) Where boxes or enclosures are not encountered, exposed cable or raceway systems shall be permanently marked to be identified as a component of an emergency circuit or system, at intervals not to exceed 7.6 m (25 ft).

Receptacles supplied from the emergency system shall have a distinctive color or marking on the receptacle cover plates or the receptacles.

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Expert Analysis



For the 2017 NEC, the emergency system identification at 700.10(A) has been expanded to more than just boxes and enclosures and will now be mandated for exposed emergency system cables and raceway systems that might not be associated with junction boxes or enclosures. An example of this type of installation could be a metallic cable system daisy-chained from emergency luminaire to emergency luminaire without installing a junction box between luminaires. This process would leave the emergency system wiring method from luminaire to luminaire indistinguishable from the normal system. New provisions at 700.10(A)(2) will now require exposed emergency circuit or system cable or raceway systems to be permanently marked as a component of an emergency circuit or system, at intervals not to exceed 7.6 m (25 ft) where boxes or enclosures are not encountered.

It is an extremely difficult task for an inspector or installer to follow a cable or raceway in a ceiling where every cable or raceway in that same ceiling is identical and not identified as something other than the normal branch circuits or feeders. This means of identification method could be as simple as spray painting the cable or raceway every 7.6 m (25 ft).

Another significant change occurred involving these emergency system identification requirements at 700.10(A). Receptacles supplied from the emergency system are now required to be identified by a “distinctive color or marking” on the receptacle cover plates or the receptacle itself. As with the boxes, enclosures, cables, and raceways, the Code is not specific as to the means to accomplish this. Red-colored receptacles and covers

similar to what is commonly used in health care facilities would certainly be “distinctive,” as would blue-colored receptacles. These markings are necessary for the end user to identify emergency supplied devices for connection of equipment needed when there is a loss of normal power.

Emergency power is often provided with Red devices to make them stand-out. For even more attention Leviton offers illuminated devices that instantly inform users that the device is energized. The device pictured here is our Hospital Grade M1626. It is made to higher standards which might be beneficial on Emergency circuits. It is also part of our Modular Lev-Lok® line, so installation and change outs are easy and fast.



Cat. No. M1626-ILR

New



702.12(C) Power Inlets Rated at 100-Amperes or Greater, for Portable Generators

Change Summary

- New requirements were added for power inlets used with optional standby generators to ensure that disconnection of the power inlet does not occur under load. Optional standby equipment containing power inlets rated 100-amperes or more for the connection of a generator source are to be listed for the intended use and be equipped with an interlocked disconnecting means.

NEC® Text

702.12 Outdoor Generator Sets. (Optional Standby Systems)

(A) Permanently Installed Generators and Portable Generators Greater Than 15 kW and Permanently Installed Generators.

(B) Portable Generators 15 kW or Less.

(C) Power Inlets Rated at 100 Amperes or Greater, for Portable Generators. Equipment containing power inlets

NEC® Text (continued from previous page)

for the connection of a generator source shall be listed for the intended use. Systems with power inlets shall be equipped with an interlocked disconnecting means.

Exception No. 1: If the inlet device is rated as a disconnecting means.

Exception No. 2: Supervised industrial installations where permanent space is identified for the portable generator located within line of sight of the power inlets shall not be required to have interlocked disconnecting means nor inlets rated as disconnects.

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Expert Analysis



Optional standby systems are those backup systems that are utilized when normal power failure can cause physical discomfort, serious interruption of an industrial process, damage to process equipment, or disruption of business, but the power failure does not cause life-threatening conditions or impose any safety hazards. Optional standby systems typically consist of one of two types of systems — those that are permanently installed in their entirety including prime movers, or those that are arranged for a connection to a premises wiring system from a portable alternate power supply.

It is not uncommon to find power inlet boxes serving as a gateway for the outside power source, typically installed near the main service electrical panelboards and wired to a manual transfer switch, which restores power to the entire main electrical panelboard or selected branch circuits.

For the 2017 NEC, optional standby equipment containing power inlets rated 100-amperes or more

for the connection of a generator source be “listed for the intended use” and be equipped with an interlocked disconnecting means. This new provision will ensure that disconnection of the power inlet does not occur under load conditions. A portable generator can be located outside “line of sight” from the point at which it electrically connects to the building through a permanently installed power inlet. If a person cannot visibly see the generator to which it is connected, disconnecting under load can present a safety hazard if the inlet is not rated for load break or the “intended use.”

Two new exceptions were also added following 702.12(C). The first exception gives an exemption from the requirements for being listed for the intended use and having an interlocked disconnecting means if the power inlet device is rated as a disconnecting means itself. Power inlet devices rated up to 60-amperes that are also rated as a disconnecting means are readily available. There are also load-break solutions available that possess load-break capabilities up to and above 100-amperes. The second exception pertains to supervised industrial installations where permanent space is identified for the portable generator to be located within line of sight of the power inlets. If a supervised industrial installation meets the conditions of this exception, the power inlet box or device is not required to be an interlocked disconnecting means nor be rated as a disconnecting means.

The new language at 702.12(C) is intended to require either that the power inlet devices used with portable outdoor generators be load break rated or that the power inlet be interlocked with a disconnecting means to ensure that the disconnect is opened before disconnecting the portable generator.

Several products within the Leviton Powerswitch® line of Mechanical Interlock Devices comply with Article 702.12(C) and incorporate a safety disconnect switch and IEC 60309-1 and 60309-2 pin and sleeve receptacle in a non-metallic watertight enclosure. The interlock mechanism prevents making and breaking of power under load. The switch cannot be actuated to the ON position until the IEC compatible plug is fully inserted. The plug cannot be removed until the switch is in the OFF position. The color-coded receptacle cover indicates

the voltage rating of the device (matching the plug) and seals against water and dirt when not in use. There are many different ratings within Leviton's mechanical interlock line. Article 702.12(C) is specific to 100-Amps, so this product reference relates to that rating. There are several 100-Amp devices within the line and they are available from 125- to 600-Volts AC.



Cat. No. 3100MI6W



Cat. No. 3100P6W

New



Article 705, Part IV Microgrid Systems

Change Summary

- New Part IV was added to Article 705 recognizing microgrid systems as an interconnected electric power production source.

Microgrid Systems is a specialized area of work for electrical professionals and beyond the scope of this Captain Code document. However we provide this brief mention here to inform our readers of this emerging technology. If you are involved in this work we recommend reading article 705 Part 4 in its entirety in NEC 70.

NEC® Text

Part IV. Microgrid Systems (Interconnected Electric Power Production Sources)

705.150 System Operation.

705.160 Primary Power Source Connection.

705.165 Reconnection to Primary Power Source.

705.170 Microgrid Interconnect Devices (MID).

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Expert Analysis

Microgrid systems are modern, localized, small-scale grids, contrary to the traditional, centralized electricity grid. Microgrids can disconnect from the centralized grid

and operate autonomously, strengthen grid resilience, and help mitigate grid disturbances because they can continue operating while the main grid is down; and they can function as a grid resource for faster system response and recovery. They often use diesel generators and are installed by the community they serve.

Microgrids increasingly employ a mixture of different distributed energy resources, such as solar hybrid power systems, which reduce the amount of emitted carbon significantly.

New



Article 706 Energy Storage Systems

Change Summary

- The new article, “Energy Storage Systems,” applies to all permanently installed energy storage systems (ESS) operating at over 50-volts ac or 60-volts dc that may be stand-alone or interactive with other electric power production sources.

Energy Storage Systems is a specialized area of work for electrical professionals and beyond the scope of this Captain Code document. However we provide this brief mention here to inform our readers of this emerging technology. If you are involved in this work we recommend reading article 706 in its entirety in NEC 70.

NEC® Text

Article 706 Energy Storage Systems

Part I. General

Part II. Circuit Requirements

Part III. Electrochemical Energy Storage Systems

Part IV. Flow Battery Energy Storage Systems

Part V. Other Energy Storage Technologies

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Expert Analysis

An Energy Storage System (ESS) is defined as “one or more components assembled together capable of storing energy for use at a future time.” An ESS can include batteries, capacitors, and kinetic energy devices (e.g., flywheels and compressed air). They can have ac or dc output and can include inverters and converters.

New



708.10(A)(2) Receptacle Identification

Change Summary

- In addition to a distinctive color or marking so as to be readily identifiable, nonlocking-type, 125-volt, 15- and 20-ampere receptacles supplied from the COPS shall also have an illuminated face or an indicator light to indicate that there is power to the receptacle.

NEC® Text

708.10 Feeder and Branch Circuit Wiring. [Critical Operations Power Systems (COPS)] (A) Identification.

(1) Boxes and Enclosures. In a building or at a structure where a critical operations power system and any other type of power system are present, all boxes and enclosures (including transfer switches, generators, and power panels) for critical operations power system circuits shall be permanently marked so they will be readily identified as a component of the critical operations power system.

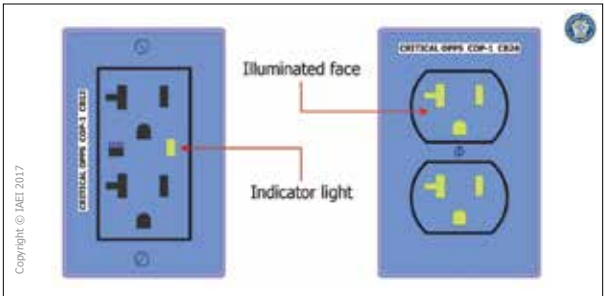
(2) Receptacle Identification. In a building in which COPS are present with other types of power systems described in other sections in this article, the cover plates for the receptacles or the receptacles themselves supplied from the COPS shall have a distinctive color or marking so as to be readily identifiable. Nonlocking-type, 125-volt, 15- and 20-ampere receptacles supplied from the COPS shall have an illuminated face or an indicator light to indicate that there is power to the receptacle.

Exception: If the COPS supplies power to a DCOA that is a stand-alone building, receptacle cover plates or the receptacles themselves shall not be required to have distinctive marking.

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Expert Analysis

Since the 2008 edition of the NEC, Article 708, Critical Operations Power Systems (COPS), has been a part of the Code. This article addresses homeland security issues for facilities that are “mission critical” in disastrous times such as terrorist attacks, flooding, hurricanes, etc. The requirements for COPS designated buildings go far beyond those of Article 700, Emergency Systems. These COPS electrical systems must continue to operate during the full duration of an emergency or disaster and beyond. Examples of facilities that might be



designated as a COPS system include police stations, fire stations, and hospitals.

Cover plates for the receptacles or the receptacles themselves in these COPS facilities are required to have a “distinctive color or marking so as to be readily identifiable” from other receptacles in accordance with 708.10(A)(2). An exception states that receptacle marking and identification of the COPS system receptacles are not required at a designated critical operations area (DCOA) that is a stand-alone building, as all the receptacles would then be supplied from the COPS system. For the 2017 NEC, this COPS receptacle identification has been taken a step further by requiring all nonlocking-type, 125-volt, 15- and 20-ampere receptacles supplied from the COPS to have an “illuminated face or an indicator light” to indicate that there is power to the receptacle.

This new illuminator or indicator light provision provides for ready and continuous ability to identify energized receptacles that are part of the COPS system. It is essential that nonlocking-type 125-volt, 15- and 20-ampere receptacles have either an indicator light or an illuminated face so that users of the receptacles know that they are energized in an emergency when not all receptacles are working. It is not uncommon for receptacles fed from the COPS system to remain de-energized until called upon in an emergency system. Such receptacles that test out to be “un-energized” could suddenly become energized. The COPS receptacle itself also needed an additional identification means to alleviate issues arising from remodeling the room (such as painting) and the original COPS receptacle cover plate not being re-installed properly on its original COPS receptacle.

The ability of a person to distinguish receptacles supplied from the COPS becomes more critical as receptacles controlled for the purpose of energy management or building automation become more prevalent as well [see 406.3(E)].

The Lev-Lok® line of Illuminated Receptacles include Duplex and Decora® configurations. The illuminated face makes it easy to identify energized receptacles in both light and dark conditions, making them ideal for use on Critical Operations Power Systems (COPS) circuits.



Leviton Duplex Lev-Lok® Illuminated Receptacles

They are available in both a traditional duplex configuration and an industry exclusive tamper-resistant version, satisfying National Electric Code (NEC) requirements for safety while at the same time confirming power to the receptacle.

New



Article 710 Stand-Alone Systems

Change Summary

- A new article for “Stand-Alone Systems” was added to address the operating parameters for electric power production sources in a stand-alone mode.

Stand Alone Systems is a specialized area of work for electrical professionals and beyond the scope of this Captain Code document. However we provide this brief mention here to inform our readers of this emerging technology. If you are involved in this work we recommend reading article 710 in its entirety in NEC 70.

NEC® Text

Article 710 Stand Alone Systems

710.1 Scope.

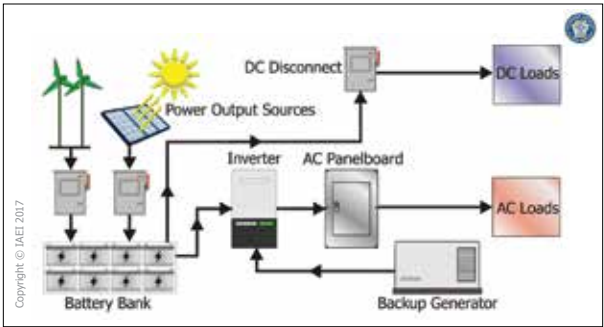
710.6 Equipment Approval.

710.15 General.

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Expert Analysis

A stand-alone power system, sometimes referred to as a remote area power supply, is an off-the-grid system



for locations that are not connected to an electricity distribution system. Stand-alone power systems will typically include one or more methods of electricity generation, energy storage, and regulation.

Stand-alone systems are becoming more prevalent due to emerging technology in energy storage and local generation. Unlike stand-alone systems, optional standby systems do not provide 24/7 power by definition. The lessons learned from tens of thousands of stand-alone PV systems should apply to any stand-alone power source.

New



Article 712 Direct Current Microgrids

Change Summary

- Article 712 “Direct Current Microgrids” was added to the 2017 NEC for a power distribution system consisting of more than one interconnected dc power sources, supplying dc-dc converters(s), dc loads(s), and/or ac loads(s) powered by dc-ac inverters(s).

Direct Current Microgrids is a specialized area of work for electrical professionals and beyond the scope of this Captain Code document. However we provide this brief mention here to inform our readers of this emerging technology. If you are involved in this work we recommend reading article 712 in its entirety in NEC 70.

NEC® Text

Article 712 Direct Current Microgrids

Part I. General

Part II. Circuit Requirements

Part III. Disconnecting Means

Part IV. Wiring Methods

Part V. Marking

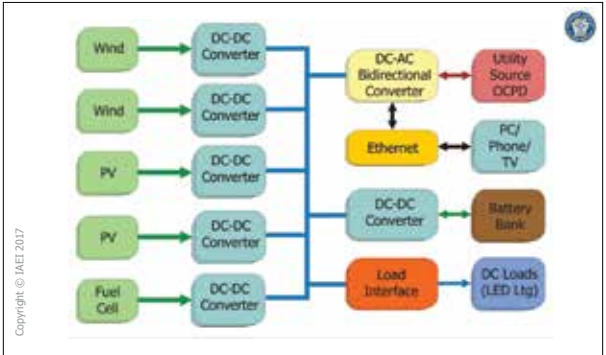
NEC® Text (continued from previous page)

Part VI. Protection

Part VII. Systems over 1000 Volts

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Expert Analysis



A dc microgrid is defined as a power distribution system consisting of more than one interconnected dc power source, supplying dc-dc converters(s), dc loads(s), and/or ac loads(s) powered by dc-ac inverters(s). A dc microgrid is typically not directly connected to an ac primary source of electricity, but some dc microgrids interconnect via one or more dc-ac bidirectional converters or dc-ac inverters. DC microgrids allow the direct utilization of power from dc sources to dc loads such as LED lighting, communications equipment, computers, variable-speed motor drives, etc. Direct utilization of dc, whether generated by PV systems, fuel cells or other means (without intervening dc-ac and ac-dc conversion steps) leads to higher efficiencies and potentially smaller and lower-cost equipment than ac-coupled methods.

New



**725.144, Table 725.144
Transmission of Power and Data.
(Class 1, Class 2, and Class 3
Remote-Control, Signaling, and
Power-Limited Circuits)**

Change Summary

- New 725.144 language and an accompanying Table 725.144 were added limiting bundle size on

Class 2, and 3 cables. In addition a new optional Type “LP” (Limited Power) cable was introduced.

NEC® Text

725.144 Transmission of Power and Data. (Class 1, Class 2, and Class 3 Remote-Control, Signaling, and Power-Limited Circuits)

The requirements of 725.144(A) and (B) shall apply to Class 2 and Class 3 circuits that transmit power and data to a powered device. The requirements of Parts I and III of Article 725 and 300.11 shall apply to Class 2 and Class 3 circuits that transmit power and data. The conductors that carry power for the data circuits shall be copper. The current in the power circuit shall not exceed the current limitation of the connectors.

Informational No. 1: One example of the use of cables that transmit power and data is the connection of closed-circuit TV cameras (CCTV).

Informational Note No. 2: The 8P8C connector is in widespread use with powered communications systems. These connectors are typically rated at 1.3 amperes maximum.

Table 725.144 Ampacities of Each Conductor in Amperes in 4-Pair Class 2 or Class 3 Data Cables Based on Copper Conductors at an Ambient Temperature of 30°C (86° F) with All Conductors in All Cables Carrying Current, 60°C (140°F), 75°C (167°F), and 90°C (194°F) Rated Cables. (See Table 725.144 below)

Table 725.144

AWG	Number of 4-Pair Cables in a Bundle																							
	1			2-7			8-19			20-37			38-61			62-91			92-192					
	Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating								
	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C			
26	1	1	1	1	1	1	0.7	0.8	1	0.5	0.6	0.7	0.4	0.5	0.6	0.4	0.5	0.6	NA	NA	NA			
24	2	2	2	1	1.4	1.6	0.8	1	1.1	0.6	0.7	0.9	0.5	0.6	0.7	0.4	0.5	0.6	0.3	0.4	0.5			
23	2.5	2.5	2.5	1.2	1.5	1.7	0.8	1.1	1.2	0.6	0.8	0.9	0.5	0.7	0.8	0.5	0.7	0.8	0.4	0.5	0.6			
22	3	3	3	1.4	1.8	2.1	1	1.2	1.4	0.7	0.9	1.1	0.6	0.8	0.9	0.6	0.8	0.9	0.5	0.6	0.7			

Note 1: For bundle sizes over 192 cables, or for conductor sizes smaller than 26 AWG, ampacities shall be permitted to be determined by qualified personnel under engineering supervision.

Note 2: Where only half of the conductors in each cable are carrying current, the values in the table shall be permitted to be increased by a factor of 1.4.

Informational Note: The conductor sizes in data cables in wide-spread use are typically 22–26 AWG.

Table 725.144

(A) Use of Class 2 or Class 3 Cables to Transmit Power and Data. Where Types CL3P, CL2P, CL3R, CL2R, CL3, or CL2 transmit power and data, the following shall apply, as applicable:

(1) The ampacity ratings in Table 725.144 shall apply at an ambient temperature of 30°C (86°F).

NEC® Text (continued from previous page)

(2) For ambient temperatures above 30°C (86°F), the correction factors of 310.15(B)(2) shall apply.

Informational Note: One example of the use of Class 2 cables is a network of closed-circuit TV cameras using 24 AWG, 60°C rated, Type CL2R, Category 5e local area network (LAN) cables.

(B) Use of Class 2-LP or Class 3-LP Cables to Transmit Power and Data. Types CL3P-LP, CL2P-LP, CL3R-LP, CL2R-LP, CL3-LP, or CL2-LP shall be permitted to supply power to equipment at a current level up to the marked ampere limit located immediately following the suffix LP and shall be permitted to transmit data to the equipment. The Class 2-LP and Class 3-LP cables shall comply with the following, as applicable:

Informational Note 1: The “(xxA)” following the suffix -LP indicates the ampacity of each conductor in a cable.

Informational Note 2: An example of a limited power (LP) cable is a cable marked Type CL2-LP(0.5A), 23 AWG. A Type CL2-LP (0.5), 23 AWG could be used in any location where a Type CL2 could be used; however, the LP cable would be suitable for carrying up to 0.5 A per conductor, regardless of the number of cables in a bundle. If used in a 7-cable bundle, the same cable could carry up to 1.2 amperes per conductor.

(1) Cables with the suffix “-LP” shall be permitted to be installed in bundles, raceways, cable trays, communications raceways, and cable routing assemblies.

(2) Cables with the suffix “-LP” and a marked ampere level shall follow the substitution hierarchy of Table 725.154 and Figure 725.154(A) for the cable type without the suffix “LP” and without the marked ampere level.

(3) System design shall be permitted by qualified persons under engineering supervision.

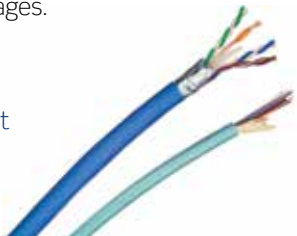
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Expert Analysis

This Article 725.144 and the next article in this book 840.160 both cover to power-over-local area networking (LAN) cable and they are related. As a result we cover analysis for both articles together after article 840.160 on the next few pages.

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New



840.160 Powering Circuits

Change Summary

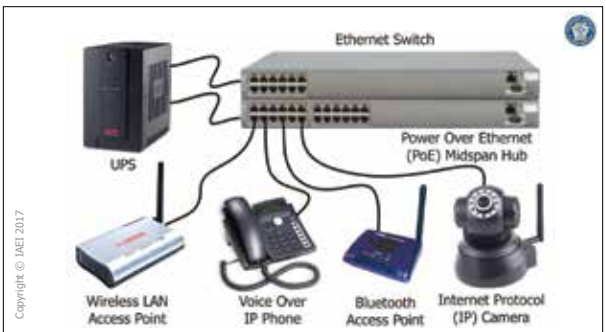
- New 840.160 (Powering Circuits) was added under new Part VI (Premises Powering of Communication Equipment over Communication Cables) with direction to comply with the new 725.144 for power delivery circuits that exceed 60-watts on communications cables.

NEC® Text

Part VI. Premises Powering of Communications Equipment over Communications Cables. (Premises-Powered Broadband Communications Systems)
840.160 Powering Circuits. Communications cables, in addition to carrying the communications circuit, shall also be permitted to carry circuits for powering communications equipment. Where the power supplied over a communications cable to communications equipment is greater than 60 watts, communication cables and the power circuit shall comply with 725.144 where communications cables are used in place of Class 2 and Class 3 cables.

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Expert Analysis



Articles 725.144 and 840.160 both relate to power-over-local area networking (LAN) cable and because of this relation the analysis for both articles is covered together here.

Over the past decade or so, power-over-local area networking (LAN) cable technologies such as Power-over-Ethernet (PoE) have become a viable powering option for a wide range of applications including premises-powered broadband communications systems. PoE is being widely used today with data and communications circuits. Device manufacturers are designing more sophisticated equipment that demands increased power. As this power is increased, the heat generated within the cable increases as well. This is especially true when the cables are deployed in large bundles. The additional heat generated by the increased current could potentially push the cables beyond their rated temperatures.

To address this concern, table 725.144 and its associated language mentioned earlier in this book were added. These new provisions limit the current carrying capacity of communication cables based on conductor size, bundle size, the cables temperature rating and maximum ambient temperature. In addition, a new optional type of “limited-power” (LP) cable has been introduced to simplify the cable choice and installation considerations. LP cable may be installed “regardless of the number of cables in a bundle.” New language added at 725.179(I) indicates that limited power (LP) cables must be listed as suitable for carrying power and data up to a specified current limit for each conductor without exceeding the temperature rating of the cable where the cable is installed in cable bundles in free air or installed within a raceway, cable tray, or cable routing assembly. The cables must also be marked with the suffix “-LP” with the ampere limit located immediately following the suffix LP, where the current limit is in amperes per conductor. For example, a 1-ampere Class 2 limited power cables could be marked “CL2-LP (1.0A).” The ampere limit located immediately following the suffix LP is the ampacity of each conductor in a cable. As with the current ratings for non-LP cable given in table 725.144, the “-LP” current rating only applies up to a maximum ambient temperature of 30C, independent of the cables temperature rating. For maximum ambient temperatures greater than 30C, all cables ampacity ratings must be de-rated using table 310.15(B)(2). The code also states that no conductor (or cable) should be used in such a manner that its operating temperature exceeds its rated maximum temperature. Optical fiber

cables and communications cables are required have a temperature rating of not less than 60°C (140°F) by sections 770.179 and 800.179. Where cables carrying communications and power are installed, cables rated for temperatures above 60°C (140°F) may be required. In addition, the code indicates that the current in the power circuit shall not exceed the current limitations of the conductors utilized in the circuit.

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A dark blue rectangular graphic containing white text. The text is arranged in five lines: "The", "Smart", "Choice", "For a Better", and "Network".

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