

Changes to the 2017 National Electrical Code®

Chapter 4 – Equipment for General Use

404.2(C) Switches Controlling Lighting Loads

- For 2017, 404.2(C) provides five locations at which the grounded conductor is not required to be installed at the lighting switch. In 2014 there were seven locations.
- The 2014 condition (4) excluded rooms that were not habitable. This same condition is still excluded but the language was moved into the body of the main text in 404.2(C).
- Where multiple switches are located in one room, the grounded conductor is only required at one of the locations. This was exception (5) in 2014 and is now in the main text of 404.2(C).
- In 2014 the grounded conductor was to be “provided at the location”. In 2017 it is now to be “installed” at the location.

404.2(C) Switches Controlling Lighting Loads

- All electronic lighting control switches are required to be listed. As of Jan. 1, 2020, electronic lighting control switches (with exceptions) will not be permitted to introduce current on the equipment-grounding conductor during normal operation.
- Manufacturers will only make devices that place current on the equipment-grounding conductor during normal operation for replacement/retrofit.
- New exception places limits to electronic switches to the following levels.
 - Branch circuit (5)
 - Or feeder (25)

404.2(C) Grounded Conductor at Sw. Locations

(C) Switches Controlling Lighting Loads. The grounded circuit conductor for the controlled lighting circuit shall be 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 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.

404.2(C) Grounded Conductor at Sw. Locations

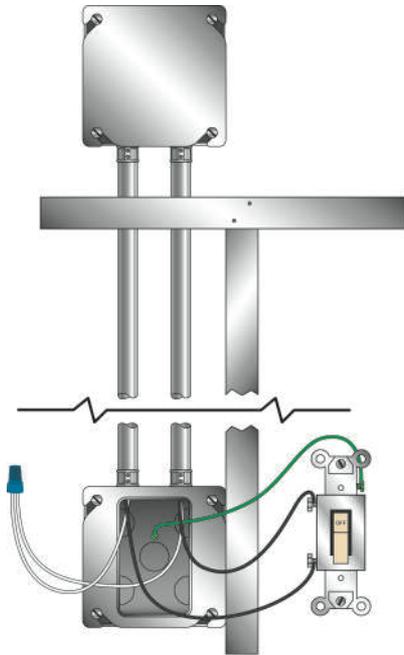
(C) Switches Controlling Lighting Loads. (cont.) A grounded conductor shall not be required to be installed at lighting switch locations under any of the following conditions:

- (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 lighting in the area is controlled by automatic means
- (5) Where a switch controls a receptacle load

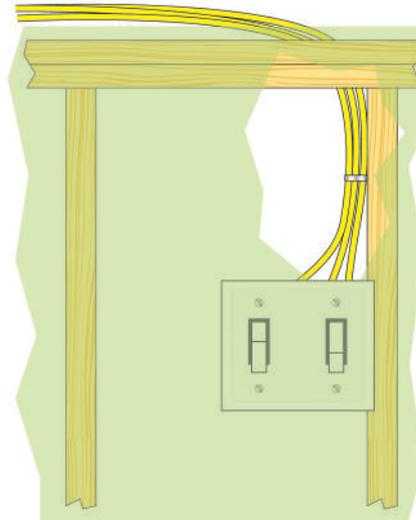
404.2(C) Grounded Conductor at Switch Locations

A grounded conductor is generally required to be installed and connected to the switching device at locations where switches control lighting loads that are supplied by a grounded general purpose-branch circuit.

Grounded conductor is generally NOT required at the following locations:



Raceway system that can be used for future grounded conductor



Accessible to add cable without removing finished materials



Snap switches with integral enclosures comply with 300.15(E)

404.2(C) Grounded Conductor at Switch Locations

A grounded conductor is generally required to be installed and connected to the switching device at locations where switches control lighting loads that are supplied by a grounded general purpose-branch circuit.

Grounded conductor is generally NOT required at the following locations:



Lighting controlled by automatic means



Where a switch controls a receptacle load



Switch for non-habitation type room or occupancies as defined by applicable building codes

404.22 Electronic Lighting Control Switches

- Section 404.22 compliments the changes in 404.2(C).
- “Electronic Lighting Controlled Switches” will not be allowed to introduce current on an equipment ground effective Jan 1, 2020.
- Switches that introduce current on the equipment ground are permitted only for replacement and retrofit applications. These switches shall be listed.
- Code wants to eliminate the circulating current that could be rather large in large buildings with many electronic switches.

404.2(C) Grounded Conductor at Switch Locations

A grounded conductor is generally required to be **installed and connected to the switching device** at locations where switches control lighting loads that are supplied by a grounded general-purpose branch circuit

Grounded is generally **NOT** required at the following locations:



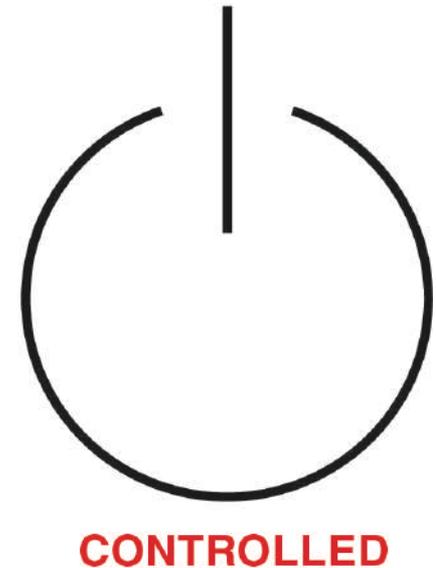
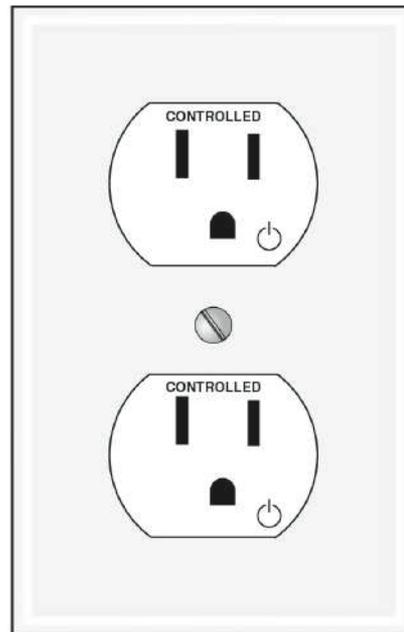
Where **multiple switch locations** control the same lighting load such that the entire floor area of the room or space is visible from the single or combined switch locations, the grounded circuit conductor shall only be **required at one location**

406.3(E) Controlled Receptacle Marking

- Many energy standards are requiring receptacles to be switched “on” and “off” by a automation system.
- In these cases in 2017 the word “Controlled” is required to be located on the receptacle with a symbol.
- The symbol and the word “Controlled” are to located on the receptacle face, not the faceplate or cover and shall remain visible after installation.
- This will provide additional safety to the electrician to acknowledge that the receptacle may not be de-energized and is controlled by an automatic source.

406.3(E) Controlled Receptacle Marking

(E) Controlled Receptacle Marking. All nonlocking-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 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.”



406.3(F) Receptacle with USB Charger

- New Text has been added to clarify the when USB Charging ports are integral to a 125-volt, 15- or 20- amp receptacle the Class 2 circuitry necessary for the USB charging is integral to the receptacle.
- Receptacle shall be listed.
- Certain Class 2 power supplies and output connector(s) are intended to be secured and directly connected to a duplex receptacle. This is not permitted according to the new text.

Receptacle with USB Charger



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

AFCI for Replacement of Existing Receptacles

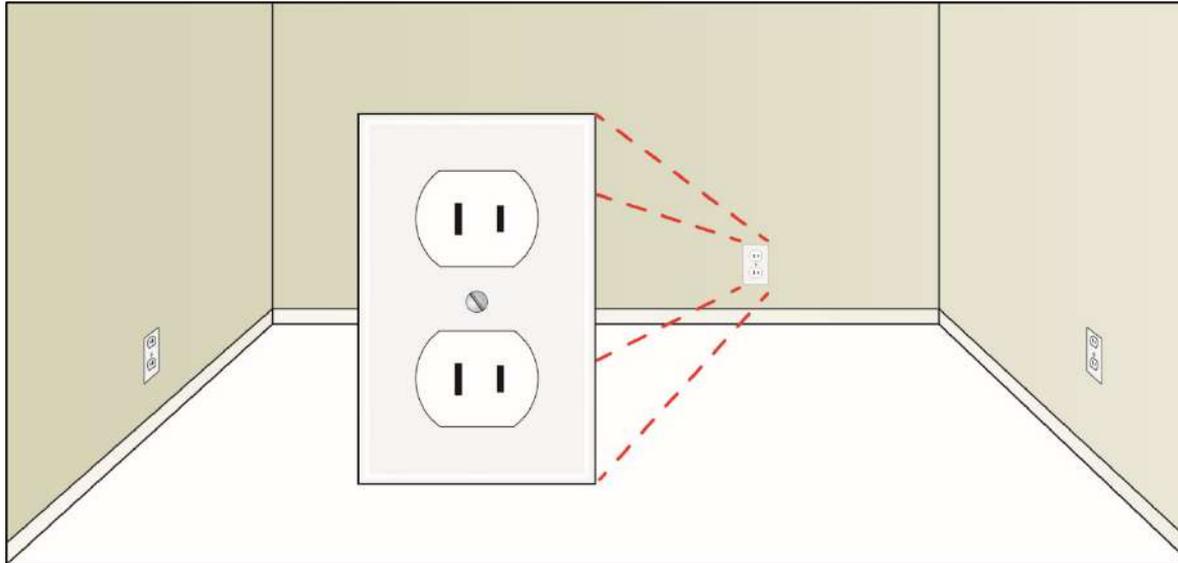
- Four exceptions were added to this section which covers replacement of receptacles in areas that 210.12(A) and (B) now requires to have AFCI protection.
 - AFCI is not required when replacing a non-grounding receptacle and no ground exists.
 - AFCI is not required when there is not equipment ground.
 - A listed combination type arc-fault circuit-interrupter circuit breaker is not commercially available.
 - GFCI/AFCI dual function receptacles are not commercially available.
- Exception to 210.12(B) 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

406.4(D)(4), Ex. No. 1 and Ex. No. 2 AFCI for Replacement of Existing Receptacles

- Arc Fault replaces are not necessary if the Exception to 210.12(B) applies.
- This exception 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.

406.4(D)(4) Replacement Receptacles (AFCI)

Where a receptacle outlet is located in any areas specified in 210.12(A) or (B), a replacement receptacle at this outlet must be AFCI protected



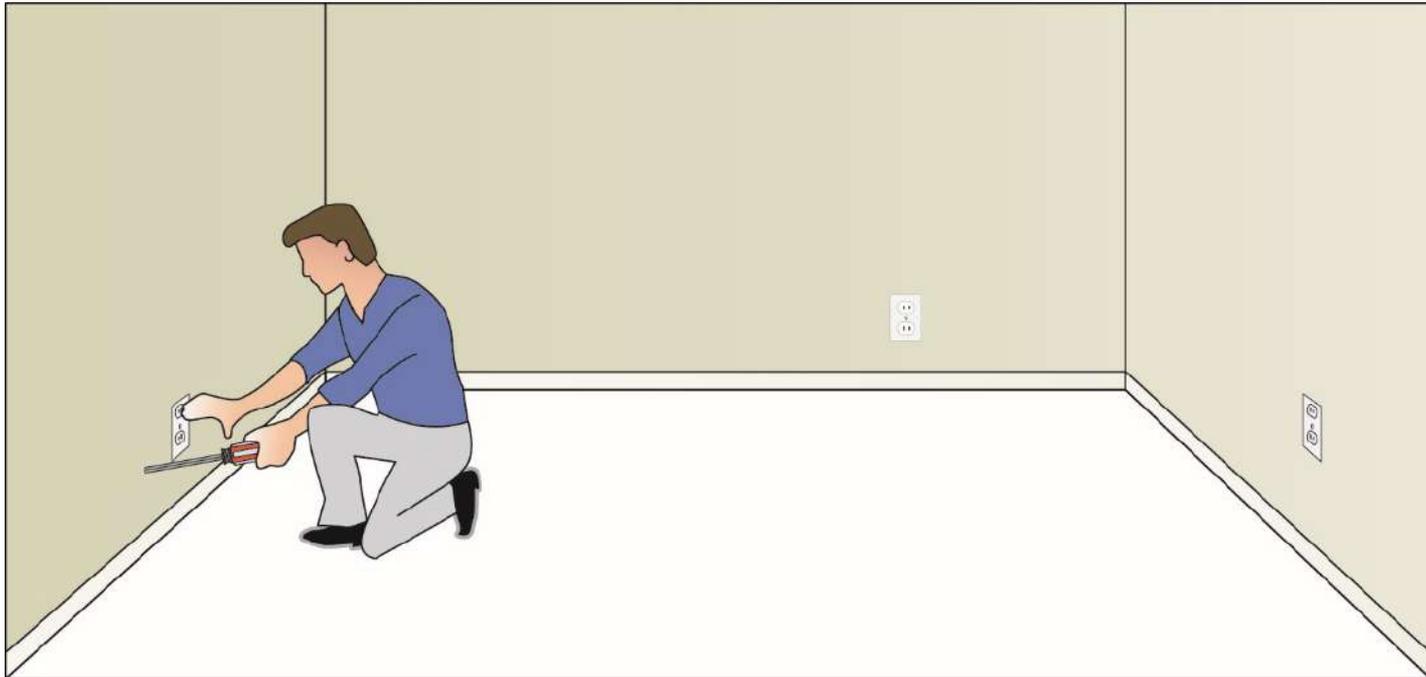
Ex. No. 1: AFCI protection **not required** where all of the following apply:

- (1) Replacement complies with 406.4(D)(2)(b) (*two-wire system-GFCI*)
- (2) Impracticable to provide an EGC as provided by 250.130(C)
- (3) Listed combination type AFCI circuit breaker not commercially available
- (4) GCFI/AFCI dual function receptacles not commercially available

Ex. No. 2: Exception at 210.12(B) **shall not apply** to replacement of receptacles

406.4(D)(4) Replacement Receptacles (AFCI)

Where a receptacle outlet is located in any areas specified in 210.12(A) or (B), a replacement receptacle at this outlet must be AFCI protected



Ex. No. 2: Exception at 210.12(B) **shall not apply** to replacement of receptacles

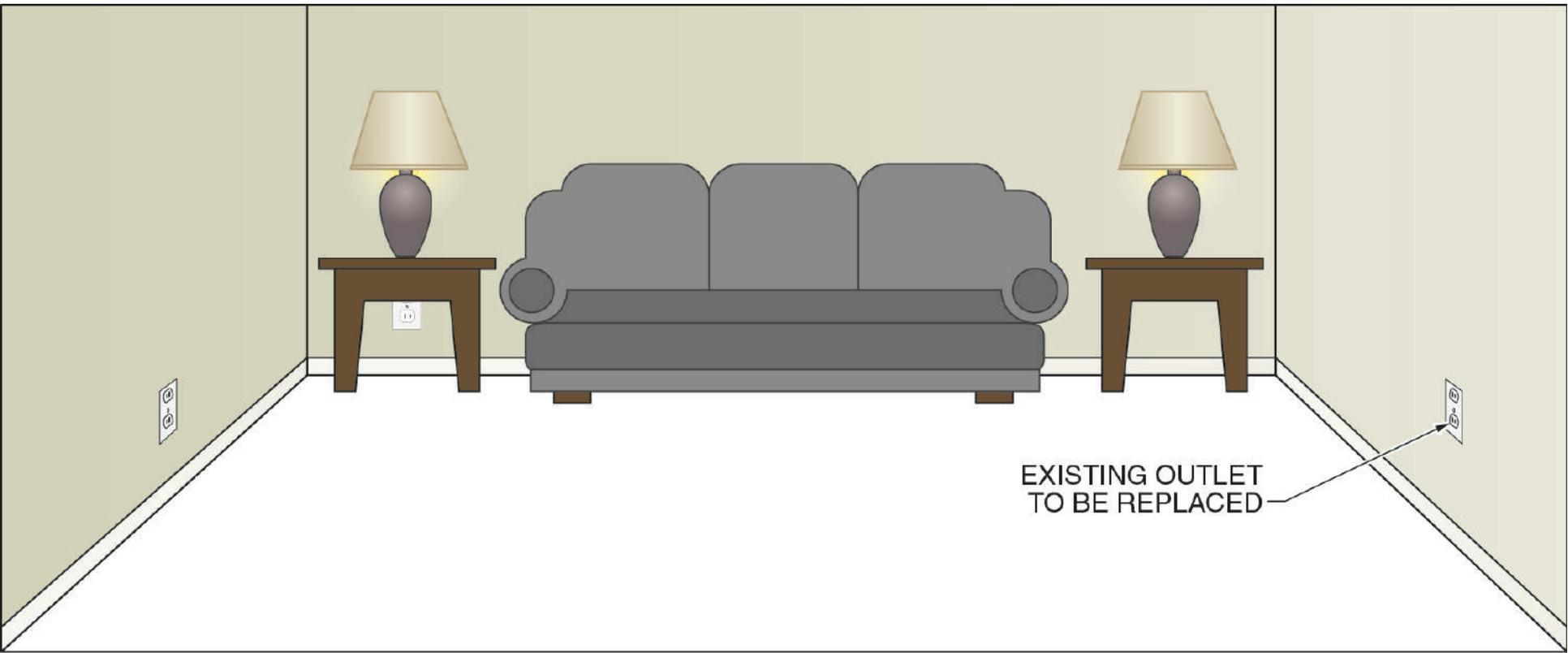
[210.12(B), Ex.: AFCI protection not required where the extension of the existing conductors is not more than 1.8 m (6 ft.) and does not include any additional outlets or devices]

Tamper-Resistant Receptacles for Replacements

- Tamper-resistant receptacles are presently not manufactured in a nongrounding type, two-prong receptacle
- Therefore, when replacing receptacles, tamper-resistant receptacles are required for all replacements in those areas required by the code unless a non-grounding receptacle is replaced with another non-grounding receptacle type.

406.4(D)(5) Replacement with Tamper Resistant

(5) Tamper-Resistant Receptacles. Listed tamper-resistant receptacles shall be provided where replacements are made at receptacle outlets that are required to be tamper-resistant elsewhere in this Code, except where a non-grounding receptacle is replaced with another non-grounding receptacle.



406.6(D) Receptacle Faceplate (Cover Plates) with Integral Night Light and/or

Need to change

3 Charger

- New requirements were added pertaining to receptacle faceplates with integral night lights and/or USB chargers
- These faceplates must be listed and constructed such that the night light and/or Class 2 circuitry is “integral with the flush device cover plate”
- Plug-in night light/covers that is not “integral with the flush device cover plate,” but simply designed to be plugged directly into a receptacle outlet presents a problem
- The ease in removing these night light-type covers from the receptacle outlet increases its safety hazard

406.6(D) Receptacle Faceplate (Cover Plates) with Integral Night Light and/or USB Charger.

A flush device cover plate that additionally provides a night light and/or Class 2 output connector(s) shall be listed and constructed such that the night light and/or Class 2 circuitry is integral with the flush device cover plate.





SnapPower

406.12 Tamper-Resistant Receptacles

- The locations where tamper-resistant (TR) receptacles are required to be installed has expanded to include many other areas.
 - Dwelling units (210.52)
 - Mobile and manufactured homes (550.13)
 - Guest rooms and guest suites of hotels and motels
 - Child care facilities
 - Preschools and elementary education facilities
 - Medical and dental waiting rooms
 - Places of assembly occupancies (518.2)
 - Dormitories

406.12 Tamper-Resistant Receptacles (cont.)

- Expanded to include 250 volt receptacles as well as 125 volt receptacles
- 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

Tamper-Resistant Receptacles (cont.)



**Preschools / Elementary
Education Facilities**



Dormitories



Mobile and Manufactured Homes



**Places of waiting clinics, medical and dental offices, transportation,
gymnasiums, skating rinks, and auditoriums**

408.3(A)(2) Barriers at Service Panelboards

- New requirement to provide barrier in all service panelboards such that no uninsulated, ungrounded service busbar or service terminal be exposed to inadvertent contact by persons
- Helps with arc-flash concern and lowers incident energy if energized work performed on load side of main.
- Requirement came from Canadian Electrical Code.
- An exception was also added eliminating the barriers at panelboards installed to comply with the requirements of 408.36, Ex. No. 1, 2, and 3
- Exceptions to 408.36 address the “six means of disconnect” rules and the old “split-bus” panelboards that could be present

408.3(A)(2) Barriers at Service Panelboards

Barriers required in all **service panelboards**, switchboards, and switchgear such that no uninsulated, ungrounded service busbar or service terminal is exposed to inadvertent contact by persons or maintenance equipment while servicing load terminations



Schneider Electric

Exception: This requirement shall not apply to service panelboards with provisions for more than one service disconnect within a single enclosure as permitted in 408.36, Exceptions No. 1, 2, and 3

1831/21

CAUTION*
STAY CLEAR OF ROLLERS,
GASKETS, SPRINGS AND
ALL MOVING PARTS.
DO NOT USE FORCE





EATON
Industrial Circuit Breaker

FD 35k

FD Interrupting Capacity
RMS Sym. Ampere

Volt	MA
240 ~	65
480 ~	35
600 ~	18
250 vac	10

~ = 50/60 Hz

On
Off

20% AMP
40°C

422.2 Definition: Vending Machine

- Definition of “Vending Machine” has been removed.
- Listing requirement of vending machines eliminates need for definition.
- Vending machine is considered an appliance. Required to be protected by GFCI. Requirement has moved to section 422.5(A)(5).
- All appliances operating at 50 volts or more are now required be listed.



422.5 GFCI Protection for Appliances

- Ground-Fault Circuit-Interrupter (GFCI) requirements throughout Article 422 for specific equipment moved to a single location 422.5 in Article 422
- Dishwashers and their associated GFCI requirements remain in Article 210 to eliminate confusion on who provides the GFCI protection, the manufacturer or the electrician. Keeping it in 210 clarifies that typically the electrician will install a GFCI type outlet.
- New 422.5(B) was added to clarify five options for the location and type of GFCI protective device in order to deliver GFCI protection to specific appliances listed at 422.5(A)

422.5(A) GFCI Protection for Appliances (*cont.*)

- 422.5(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 water coolers

(3) High-pressure spray washing machines — cord-and-plug-connected

(4) Tire inflation machines provided for public use

(5) Vending machines

422.5(B) Type. GFCI Protection for Appliances

422.5(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

422.5 GFCI Protection for Appliances

GFCI requirements for Appliances (*250 volts or less and 60 amperes or less, single- or 3-phase*) have been moved to one location in Article 422

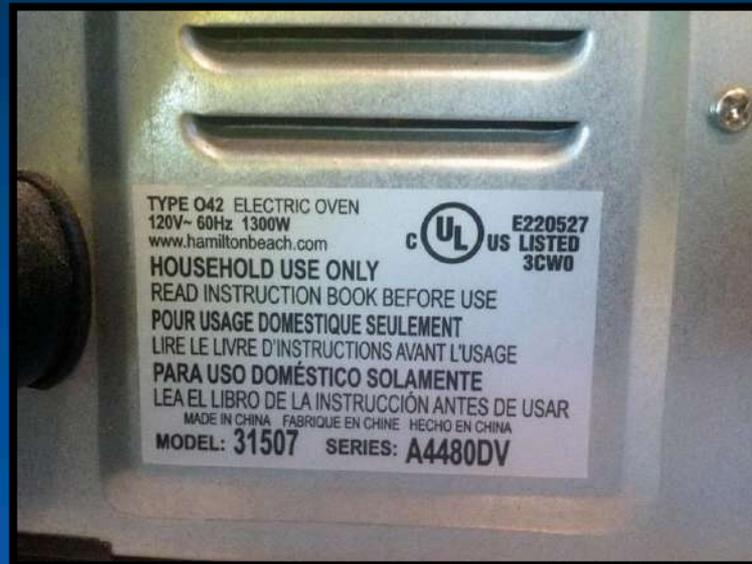
(Multiple GFCI devices permitted but not be required)



(1) Automotive vacuum machines; (2) Drinking water coolers; (3) High-pressure spray washing machines (*cord-and-plug-connected*); (4) Tire inflation machines; (5) Vending machines

422.6 Listing Required (Appliances)

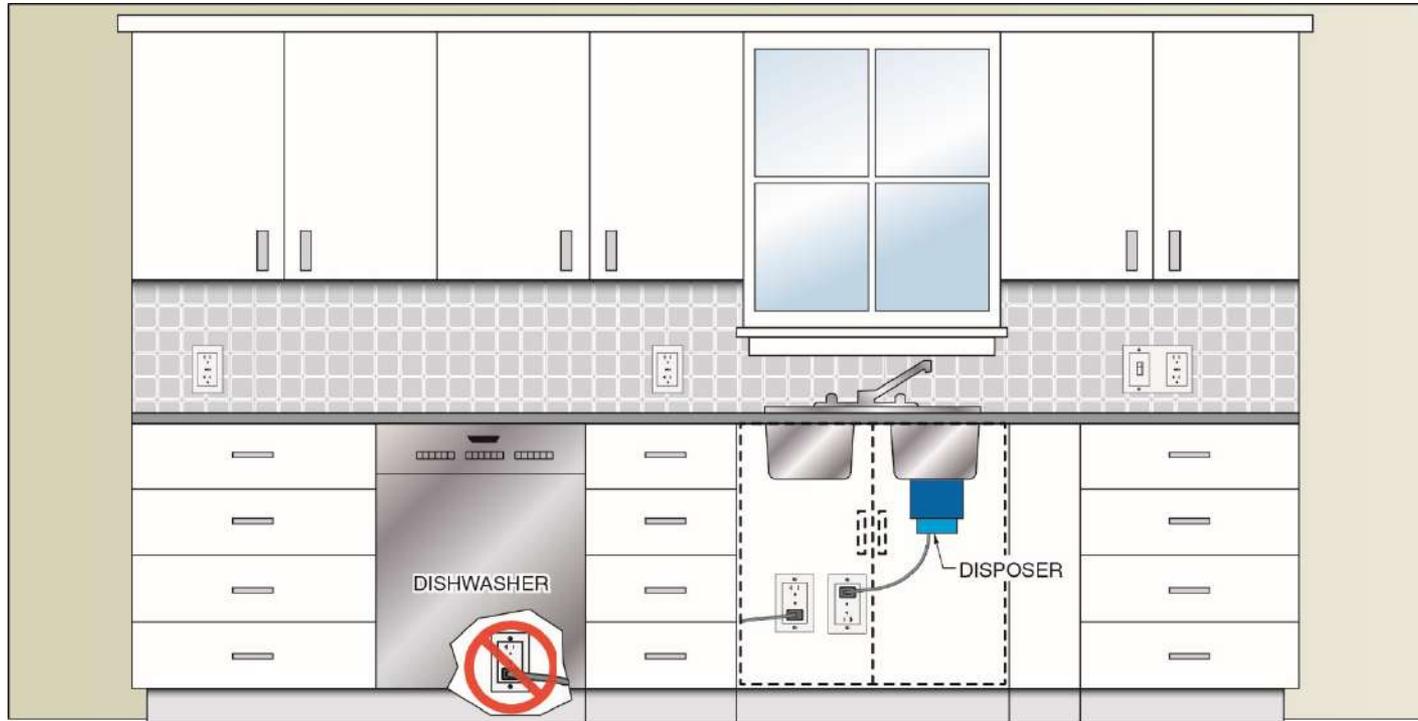
- New section has been added to Article 422 requiring all appliances operating at 50 volts or more must be listed
- Listing requirement for appliances helps ensure equipment is installed and used in accordance with any instructions included in the listing or labeling of that particular piece of equipment [see 110.3(B)]



422.16(B)(2) Built-In Dishwashers

- Built-in Dishwashers that are cord-and-plug-connected are now required to have receptacle outlet located in space adjacent to the space occupied by the dishwasher.
- Length of dishwasher cord was increased from 4 ft to 6.5 ft, “measured from the face of the attachment plug to the plane of the rear of the appliance”.
- Trash compactor cord is still required to be between 3 and 4 ft.
- Trash compactor receptacle is required to be located in adjacent space as well.

422.16(B)(2) Built-in Dishwashers



Receptacle outlet for cord-and-plug connected built-in dishwasher required to be located in the **space adjacent to the space containing the dishwasher only** with the length of a cord for a built-in dishwasher lengthened from 1.2 m (4 ft) to 2.0 m (6-1/2 ft)



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430.99 Available Fault Current

- There is a movement in the NEC over past several code cycles to require fault-current marking on various types of equipment. (i.e elevators, service, etc.)
- New requirements are added for available short circuit current at motor control centers .
- Requirement to document short-circuit current with the following:
 - Available fault current at the motor control center
 - Date the fault current calculation was performed

Available Fault Current for Electrical Equipment

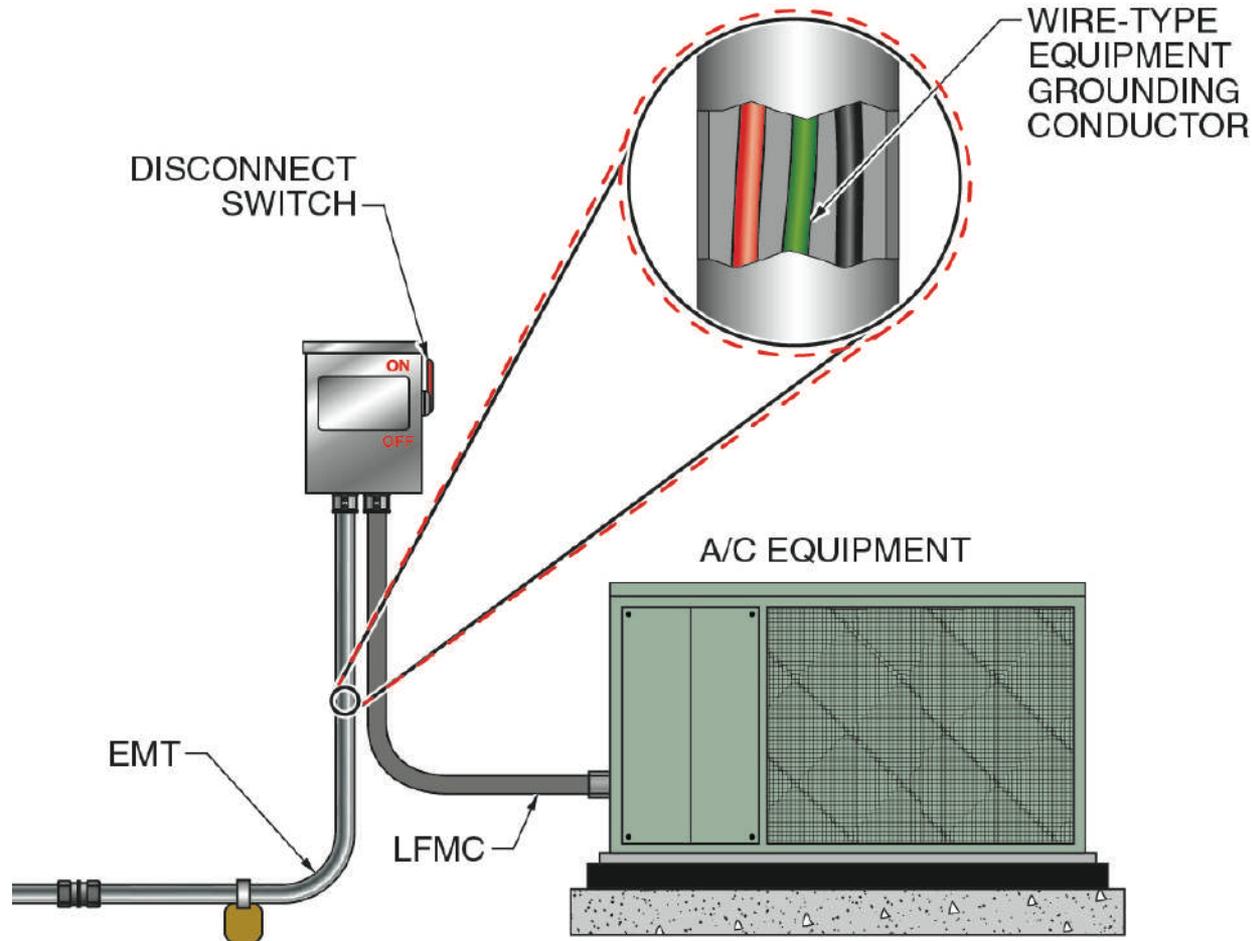
- **110.16** **Service Equipment** **Field Marked**
- **409.22(B)** **Industrial Control Panels** **Field Marked**
- **430.99** **Motor Control Centers** **Field Marked**
- **440.10** **A/C Equipment** **Marked with manufacturer's marking**
- **620.51(D)(2)** **Elevator Control Panels** **Field Marked**
- **670.5** **Industrial Machinery** **Field Marked**



440.9 Grounding and Bonding of Rooftop A/C Equipment

- The was a change that was put through by IEC Code Panel Member.
- Safety concern when conduit pulls a part on roof with no equipment ground.
- Outdoor portions of metallic raceway systems using non-threaded fittings are now required to include an equipment grounding conductor (EGC). (green wire)
- This requirement applies for both outdoor multi-motor and combination-hvac equipment on a roof.

440.9 Grounding and Bonding Rooftop Equipment



Where multi-motor and combination-load equipment is installed outdoors on a roof, an equipment grounding conductor of the wire type shall be installed in outdoor portions of metallic raceway systems that use non-threaded fittings.



445.11 Nameplate Marking for Generators

- Nameplate marking requirements for generators have been updated and reformatted in a list format.
- Item (4) in the list, “marking for inherent overcurrent protection”, has been added to assist the AHJ in complying with the exception to 445.13.
- “Impedance” was replaced with “reactance” since that is the more appropriate technical term.
- Inverter generators are being manufactured, mainly in the smaller sizes. It is difficult to determine the fault current for these type generators and therefore this specific class of generators are required to be marked with the actual maximum short-circuit current rather than the reactances.
- Revised information will assist the AHJ in determining compliance with 445.13 (ampacity of conductors for generators)



UNBALANCED LOAD CAPABILITY-25%

GENERATOR SET DATA			MADE IN USA		
MODEL	0051910	SERIAL	4307416		
TYPE CODE	SG030-A163.0V18HBYCC	ENGINE NO.	0E8336		
RATED KW	30	RATED KVA	30	UPSIZING	40
VOLTS	120/240	AMPS	125		
PHASE	1	POWER FACTOR	1.0	HERTZ	60
ALT. R.P.M.	1800	ENG R.P.M.	1800	PROD. DATE	11/10/05
CLASS <input checked="" type="checkbox"/> ROTOR <input checked="" type="checkbox"/> STATOR WINDING INSULATION AT 40°C AMBIENT					

GENERAC POWER SYSTEMS, INC.
WAUKESHA, WI

Submittal Data: 480 Volts*, 700 kW, 875 kVA, 0.8 P.F., 1800 RPM

MII-Std-705B

Method	Description	Value
301.1b	Insulation Resistance	>1.5 Meg
302.1a	High Potential Test	
	Main Stator	2000 Volts
	Main Rotor	1500 Volts
	Exciter Stator	1500 Volts
	Exciter Rotor	1500 Volts
	PMG Stator	1500 Volts
401.1a	Stator Resistance, Line to Line	
	High Wye Connection	0.0074 Ohms
	Rotor Resistance	0.472 Ohms
	Exciter Stator	23 Ohms
	Exciter Rotor	0.045 Ohms
	PMG Stator	2.1 Ohms
410.1a	No Load Exciter Field Amps at 240/480 Volts Line to Line	0.65 A DC
420.1a	Short Circuit Ratio	0.489
421.1a	Xd Synchronous Reactance	3.09 pu
		0.814 ohms
422.1a	X2 Negative Sequence React.	0.217 pu
		0.057 ohms
423.1a	X0 Zero Sequence Reactance	0.058 pu
		0.015 ohms
425.1a	X'd Transient Reactance	0.153 pu
		0.04 ohms
426.1a	X"d Subtransient Reactance	0.132 pu
		0.035 ohms
--	Xq Quadrature Synchronous	1.25 pu
		0.329 ohms
427.1a	T'd Transient Short Circuit Time Constant	0.127 sec.
428.1a	T"d Subtransient Short Circuit Time Constant	0.009 sec.
430.1a	T'do Transient Open Circuit Time Constant	1.67 sec.
432.1a	Ta Short Circuit Time Constant of Armature Winding	0.015 sec.



ELECTRIC GEN SET

MODEL 300.0DFS-17R/20428C

SERIAL NO. C790405274

IMPORTANT - ALWAYS GIVE ABOVE NOS. WHEN ORDERING PARTS

TIME RATING 8 STANDBY

HERTZ-60 RPM-1800

3 PHASE

1 PHASE

KW

KVA

KW

KVA

300.0

375.7

VOLTS 120/208 127/220 139/240 120/240 220/380

AMPS 1042 984 954 904

VOLTS 240/416 240/480 254/440 277/480 347/600

AMPS 521 492 452

120/240

P.F. 0.8

BAL. 2%

VOLTS 10

FOR ELEC. EQPT. ONLY

SR-3927

INSUL. NEMA CLASS F AMB 40°C
 MFD. BY ONAN DIV. OF ONAN CORP.
 MINNEAPOLIS, MN. U.S.A.
 99-1034

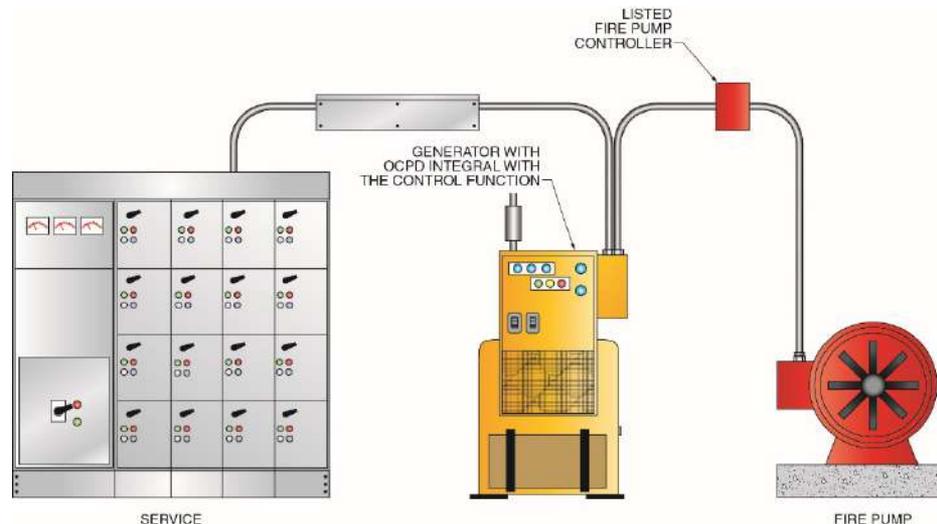
Article 445 - Generators

- In 2014 section 445.19 was deleted which would allow a feeder from a generator to be tapped. 445.13(B) was added to correct the the deletion of the 2014 text. The 445.13(B) section clarifies that a feeder from a generator can be tapped if the generator is equipped with an internal overcurrent relate or internal overcurrent protective device (Not to be confused with factory mounted breaker)
- Feeder tap rules of **240.21(B)** can be used
- New revision can be applied unless the tapped conductors are for portable generators rated **15 kW** or less where field wiring connection terminals are not accessible
- This change should reduce confusion among some users of the *Code* about the conditions under which tap conductors for generators are acceptable

445.13(B) Generator OCPD Provided

Ampacity of conductors between a generator and the first overcurrent protection device cannot be less than 115% of the nameplate current rating on the generator nameplate

An exception permits these conductors to have an ampacity of not less than 100% of the generators nameplate current rating if the generator is designed to operate to prevent overloading [see 445.13(A) and exception]



Feeder tap rules of 240.21(B) can be used if the generator or generator set is equipped with an overcurrent device

Tapped conductors are not allowed for portable generators rated 15 kW or less where field wiring connection terminals are not accessible

445.18 Generator Disconnecting Means and Shutdown of Prime Mover

- This section has been reorganized to better assist the AHJ for clarity.
- A generator can have two types of disconnects.
 - An EPO button on the generator that is capable of being locked-out
 - or a Disconnecting Means (i.e. generator circuit breaker from the factory)
- In 2014, section 445.18 indicated that a generator should be “equipped” with a disconnect. This term was removed. Not all disconnects are mounted on the generator, i.e. medium voltage.

445.18 Generator Disconnecting Means and Shutdown of Prime Mover

- Generators installed to operate in parallel are not manufactured with breakers on the genset but use the EPO button as the disconnecting means.
- Portable generators with receptacles do not need disconnects.

445.18 Generator Disconnecting Means and Shutdown of Prime Mover (*cont.*)

- Additional requirements were necessary to provide a remote shutdown means in the event of an emergency
- New 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
- New 445.18(C) was also added titled “**Generators Installed in Parallel**”
- Clarifies where generators are installed in parallel it is not necessary to provide a disconnecting means at each generator and at the paralleling equipment as long as the generator is capable of isolating the generator output terminals from the paralleling equipment



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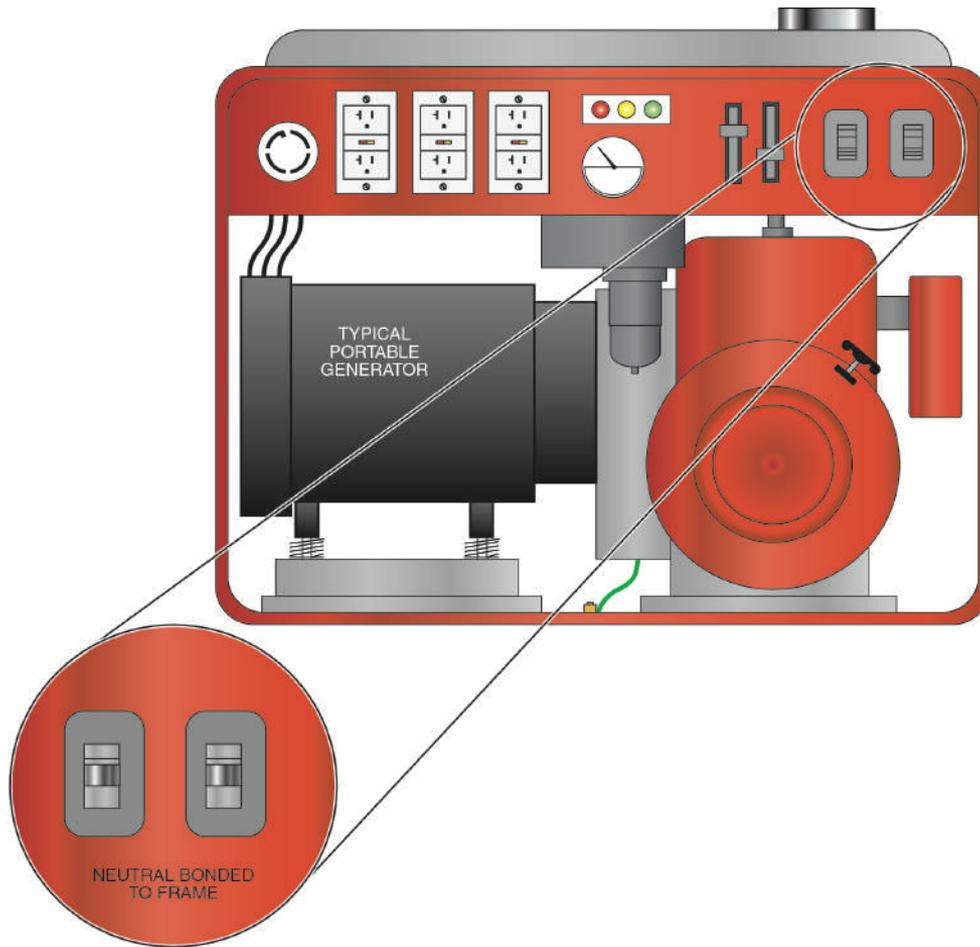
445.20 GFCI Protection for Receptacles on 15-KW or Smaller Portable Generators

- Listed cord sets were always allowed to be used in conjunction with portable generators that had gfcı protection on them. Text was added to clarify this.
- Portable generators are required to have gfcı protection for all 15- and 20- amp receptacles on the generators. This section was rewritten to indicate there are two types of generators, bonded and unbonded.
- Unbonded (*floating neutral*) generators require 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.
- *Floating generators are used in conjunction with transfer switches and need a unbonded neutral in most cases to operate*

Unbonded vs Bonded Portable Generators

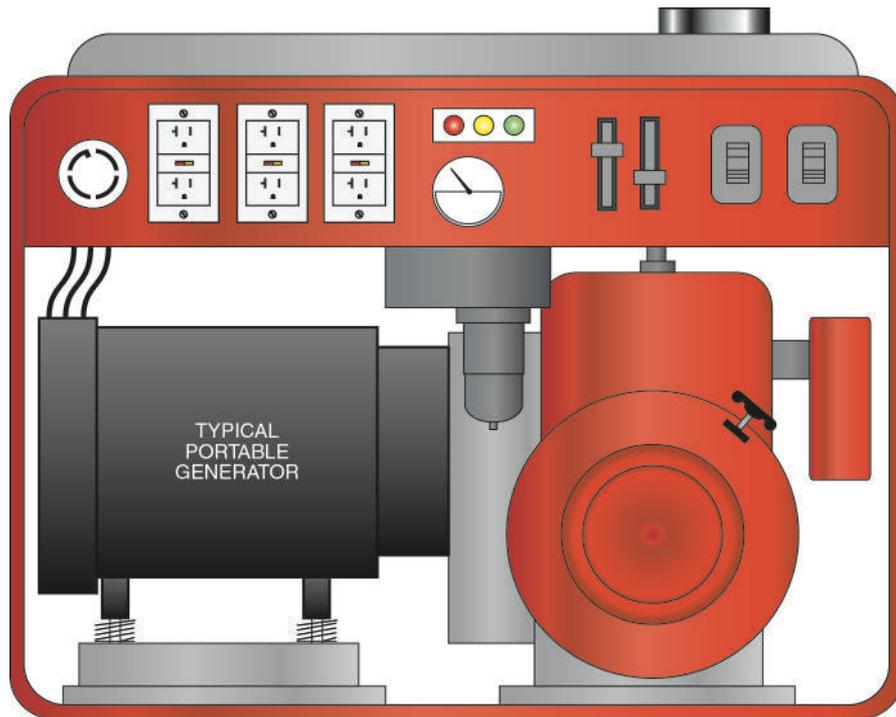
- Floating neutral or unbonded portable generators are used in conjunction with transfer switches for emergency situations.
- Bonded generators are required as stand-alone such as when used on construction sites.

Bonded neutral generators used for construction sites



15- and 20- amp receptacle outlets on 15-kW or smaller portable generator shall have listed ground-fault circuit-interrupter protection. This requirement is for generators that have their neutrals bonded to the frame as well as those generators whose neutrals are unbonded or are floating.

445.20 Ground-Fault Circuit-Interrupter Protection for Smaller Portable Generators.



There is one exception where 15- and 20- amp GFCI protection is not required and this is only for the floating neutral type generators.

These generators are used with one larger amperage receptacle that typically serves a transfer switch to power a home in the case of an emergency. In these cases when the higher amperage outlet is in use, it can be interlocked to turn off the GFCI protection for the other smaller 15- and 20-amp on the generator.



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480.3 Equipment (*Storage Batteries*)

- New requirements were added at 480.3 that will require storage batteries and battery management equipment to be listed. This does not apply to lead-acid batteries.
- Most batteries are lead acid batteries.
- Through the use of new technologies, energy density for storage batteries has significantly increased and continues to increase
- Lithium-ion battery energy density has been increasing at approximately 10 percent annually. Commonly used in home electronics.



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480.4 Terminations (*Storage Batteries*)

(A) Corrosion Prevention. Where mating dissimilar metals, antioxidant material suitable for the battery connection shall be used where recommended by the battery manufacturer.

- Note : In 2014 this section was titled “Dissimilar Metals”. Changed to a more appropriate title and to notify user that corrosion could occur if mating materials and antioxidant materials are not considered when connecting batteries.