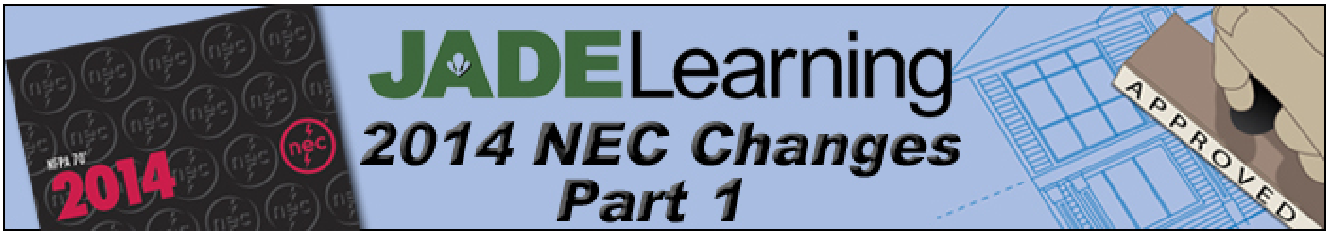


2014 NEC Changes Part 1 (Homestudy)

North Carolina Electrical License

This course will review 50 of the most important National Electrical Code changes from the 2014 NEC. Changes in Articles 100 - Chapter 3 will be covered.

Course# CEC.02302 4 Homestudy Credit Hours $50.00

This course is currently approved by the North Carolina State Board of Examiners of Electrical Contractors under course number CEC.02302.

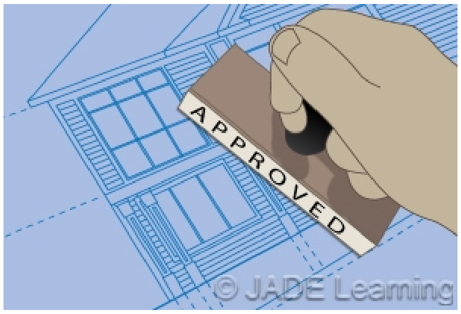
Completion of this continuing education course will satisfy 4.000 credit hours of course credit type 'Homestudy' for Electrical license renewal in the state of North Carolina. Course credit type 'Homestudy'. Board issued approval date: 7/1/2013. Board issued expiration date: 6/30/2018.

2014 NEC Changes Part 1 (Homestudy) - NC

Chapter 1

Question 1: Code Wide. Use of the terms Adequate, Inadequate, and Sufficient.

Question ID#: 615.0



In general the terms "adequate" and "sufficient" have been changed to "approved".

In a continuing effort to make the National Electrical Code more user-friendly and more enforceable, the words "adequate", "inadequate" and "sufficient" have been deleted or replaced in many areas of the code.

The words, "adequate', "inadequate", and "sufficient" are vague and difficult to understand. An installation guide like the NEC needs precise language with easily understood words so that installers and inspectors have common ground when talking about electrical installations.

For example, in Section 314.24 the 2011 NEC said: ***Outlet and device boxes shall have sufficient*** depth to allow equipment installed within them to be mounted properly and without the likelihood of damage to conductors within the box. How deep must the box be to have ***sufficient*** depth? In the 2014 NEC, ***Outlet and device boxes shall have an approved depth to allow equipment installed within them to be mounted properly and without likelihood of damage to conductors within the box.***

Use of the words "adequate", "inadequate", and "sufficient" were used so that the AHJ could take further action in unusual circumstances. It was up to the AHJ to determine what was "adequate" or "sufficient." This is a well-established concept in the NEC, and in general "adequate" and "sufficient" have been changed to "approved."

Other examples:

2011 NEC, 312.5(A): ***Openings through which conductors enter shall be adequately closed.***
2014 NEC: ***Openings through which conductors enter shall be closed in an approved manner***.
2011 NEC, 314.71: ***Pull and junction boxes shall provide adequate space and dimensions for the installation of conductors.***
2014 NEC: ***Pull and junction boxes shall provide approved*** space and dimensions for the installation of conductors.

Question 1: Which of the following statements is from the 2014 NEC?

A: Adequate enclosures, guarding, or both shall be provided.
B: A door sill or curb that is of sufficient height to confine the oil.
C: The identification shall include an approved degree of detail.
D: The framing members shall be adequately supported.

Question 2: Code Wide. 600 Volts to 1000 Volts.

Question ID#: 616.0

Most voltage levels will now be classified as "1000 volts or less" or "over 1000 volts."

The voltage levels in many sections of the 2014 National Electrical Code have been raised from 600 volts to 1000 volts. Solar Photovoltaic (PV) and Wind Generator Systems often operate at voltages greater than 600 volts, and this was the reason for the change.

The breakpoint for nominal voltages is now "over 1000 Volts." Voltage levels will now be classified as "1000 volts or less" or "over 1000 volts."

Not all the 600 volt levels have been raised to 1000 volts. The Code committee decided to leave the "over 600 volts" classification in place for those sections where a change would have had a big impact on the system installation. For example, in Article 110, Requirements for Electrical Installations, Part II is still "600 volts, Nominal, or Less." Part IV is still "Tunnel Installations Over 600 Volts, Nominal."

In Article 400, there is apparently a typo which results in two different sections being labeled as part II. The title of the second Part II is the same as it was in the 2011 NEC, "Portable cables Over 600 Volts, Nominal."

Code sections where the voltage levels have been changed include the following:

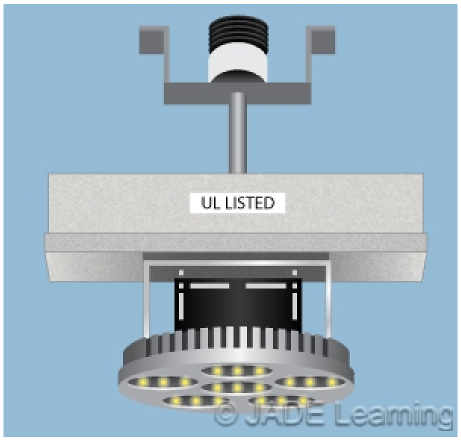
- Article 240, Overcurrent Protection. Part IX Overcurrent Protection over 1000 Volts, Nominal.
- Article 250, Grounding and Bonding. Part X Grounding of Systems and Circuits of over 1000 Volts.
- Article 300, General Requirements for Wiring Methods and Materials. Part II, Requirements for over 1000 Volts, Nominal.
- Article 430, Motors, Motor Circuits, and Controllers. Part XI, Over 1000 Volts, Nominal.
- Article 490, Equipment Over 1000 Volts, Nominal.
- Article 690, Solar Photovoltaic (PV) Systems. Part IX, Systems over 1000 Volts.
- Article 692, Fuel Cell Systems. Part VIII, Outputs over 1000 Volts.
- Article 694, Wind Electric Systems. Part VIII, Systems over 1000 Volts.

Question 2: Which of the following is an actual quote from the 2014 NEC?

A: 690.80, General. Solar PV systems with a maximum system voltage over 1000 volts dc shall comply with Article 490 and other requirements applicable to installations rated over 1000 volts.
B: 692.80, General. Fuel cell systems with a maximum output voltage over 600 volts ac shall comply with the requirements of other articles applicable to such installations.
C: 694.80, General. Wind electric systems with a maximum system voltage exceeding 600 volts ac or dc shall comply with Article 490 and other requirements applicable to installations rated over 600 volts.
D: 400.36 Splices and Terminations. Terminations on portable cables rated over 1000 volts nominal, shall be accessible only to authorized and qualified personnel.

Question 3: Article 100 Definitions. Retrofit Kit.

Question ID#: 618.0



A listed retrofit kit is a complete unit that has been properly tested.

A new term, ***retrofit kit***, has been added to Article 100, Definitions. ***A general term for a complete subassembly of parts and devices for field conversion of utilization equipment.***

This new definition recognizes that extensive upgrades are being made to luminaires, signs, and outline lighting. These field modifications are replacing conventional lighting with LEDs in order to achieve greater energy efficiency.

Section 410.6 requires retrofit kits used for luminaires to be listed. A retrofit kit which isn't listed can introduce hazards that are a threat to people or property. A listed retrofit kit has been tested by Underwriters Laboratories (ULÂ®) or other testing labs and meets their specifications for safety. A set of published standards for the retrofit kits for signs and luminaires will allow the manufacturers of these kits to manufacture them according to the standards.

Because the retrofit kits are listed, the authority having jurisdiction (AHJ) will have a basis for accepting the new installations. Also, listed retrofit kits will give electrical installers the confidence to know that what they are installing is safe.

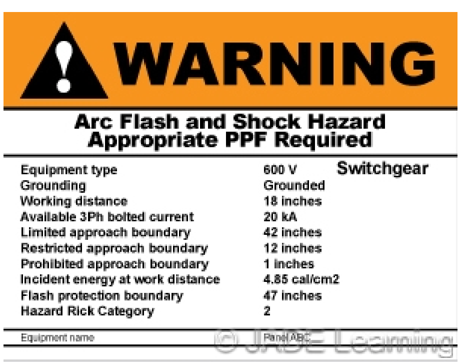
These retrofit kits, as currently defined in Article 100, are not unique to luminaires, signs, and outline lighting. The new definition will apply to other types of equipment that may need to be upgraded in the interest of energy efficiency, safety, or for other reasons. Retrofit kits will be designed, manufactured and installed to a set of specifications that will give the equipment an extended life and will be safe for the general public.

Question 3: Why should retrofit kits, as defined in Article 100, be listed?

A: It is more efficient to manufacture products that are uniform.
B: Listed retrofit kits that are installed and used in accordance with the manufacturer's instructions will not introduce hazards in the field.
C: Listed equipment is easier to install.
D: Everyone benefits because listed equipment is more energy efficient.

Question 4: 110.16 Arc-Flash Hazard Warning.

Question ID#: 627.0



This label contains more information than required by the NEC. A simple label stating: "WARNING, Arc Flash Hazard" applied by the manufacturer meets the 2014 NEC.

An arc-flash is possible anytime there is a fault on energized electrical equipment. An arc-flash hazard warning label draws attention to this danger anytime qualified persons are close to the equipment. The arc-flash label is required to be clearly visible to qualified persons before they examine, adjust, service, or perform maintenance on energized equipment.

The arc flash hazard label may be field or factory applied. The NEC does not provide specific requirements so a label stating WARNING- POTENTIAL ARC FLASH HAZARD is all that the NEC requires. Other standards such as NFPA 70E require more site specific information so as the Incident Energy, Limited approach distance and arc-flash boundary, but this information is not required by the 2014 NEC.

The text in 110.16 has been revised and now "switchgear" is included as one of the types of equipment that must be marked with an arc-flash hazard warning. Adding this new term correlates with the changes made to Article 408 modifying "switchboards and panelboards" to "switchboards, switchgear and panelboards". Other equipment that requires an arc-flash hazard warning are industrial control panels, meter socket enclosures and motor control centers. Electrical equipment for dwellings does not require an arc-flash warning label.

In previous editions of the NEC, all arc-flash hazard warning labels were required to be field applied to the electrical equipment. Now, these labels are permitted to be either field or factory applied, but they must meet the following three labeling requirements found in section 110.21(B):

The marking shall adequately warn of the hazard using effective words and/or colors and/or symbols.

- The labeling shall be permanently affixed to the equipment or wiring method and shall not be hand written.
- The label shall be of sufficient durability to withstand the environment involved.

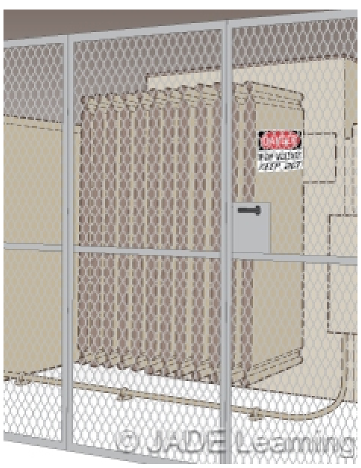
Arc-flash warning labels must alert personnel to the danger of an arc-flash, but there is still not a requirement that the label include approach distances, incident energy, or the arc-flash boundary.

Question 4: Which of the following is true regarding the marking required on electrical equipment when there is a potential arc-flash hazard?

A: The marking must be at least 6 inches wide and 6 inches tall.
B: The marking must warn of the incident energy level and specify appropriate personal protective equipment needed for the qualified person.
C: The marking must be clearly visible to qualified persons before examination or servicing the equipment.
D: The marking must be applied in the field.

Question 5: 110.21(B) Field-Applied Hazard Markings.

Question ID#: 628.0



Caution, Warning, and Danger signs or labels required by the Code must meet specific requirements.

Section 110.21, Markings, now includes two sub-sections: (A) Manufacturer's Marking, which is a direct quotation of section 110.21 in the 2011 NEC, and a new section (B) Field-Applied Hazard Markings.

There are many places in the NEC that require equipment markings to warn the general public or qualified persons working on the equipment about a possible electrical hazard, such as: DANGER - HIGH VOLTAGE - KEEP OUT. Or, WARNING: ARC FLASH HAZARD. Section 110.21(B) will standardize these types of signs and provide guidelines about how the label should look and how it is displayed on the equipment. The Informational Note refers to an ANSI standard with more specific information about warning signs, such as the size of the label, font size, and color.

110.21(B) Field-Applied Hazard Markings. Where caution, warning or danger signs or labels are required by this code, the labels shall meet the following requirements.

1. The marking shall adequately warn of the hazard using effective words and/or colors and/or symbols.
Informational Note: ANSI Z535.4-2011, Product Safety Signs and Labels, provides guidelines for suitable font sizes, words, colors, symbols and location requirements for labels.

2. The label shall be permanently affixed to the equipment or wiring method and shall not be hand written.
Exception to 2: Portions of labels or markings that are variable or could be subject to changes, shall be permitted to be hand written and shall be legible.

3. The label shall be of sufficient durability to withstand the environment involved. Informational Note: ANSI Z535.4-2011, Product Safety Signs and Labels, provides guidelines for the design and durability of safety signs and labels for application to electrical equipment.

Effective words in 110.21(B)(1) refers to the words, DANGER, WARNING, and

CAUTION, which must appear on the warning label.

Question 5: Which of the following is an example of a sign that is permitted to include variable handwritten information?

A: WARNING: ARC FLASH HAZARD.
B: WARNING: PHOTOVOLTAIC POWER SOURCE.
C: DANGER - HIGH VOLTAGE - KEEP OUT.
D: CAUTION - ENGINEERED SERIES COMBINATION SYSTEM RATED ___ AMPERES.

Question 6: 110.24 Available Fault Current.

Question ID#: 629.0

The available fault-current marking is related to required short-circuit current ratings of equipment.

The available fault-current field markings that were first required in the 2011 NEC are meant to be used to determine the interrupting ratings of electrical equipment in non-dwelling locations. The purpose of posting the available fault current is to help select electrical equipment that can withstand a fault approaching the maximum available fault current.

There has been confusion about this section. Some installers and inspectors were using the posted available fault current to determine arc-flash boundaries, safe work practices, and personal protective equipment required by qualified personnel while working on the equipment. ***This was not the intent***. ***NFPA Standard 70E-2012, Standard for Electrical Safety in the Workplace***, is used to determine personnel safety around energized electrical equipment, not the available fault-current label on the electrical equipment.

A new Informational Note has been added to section 110.24:

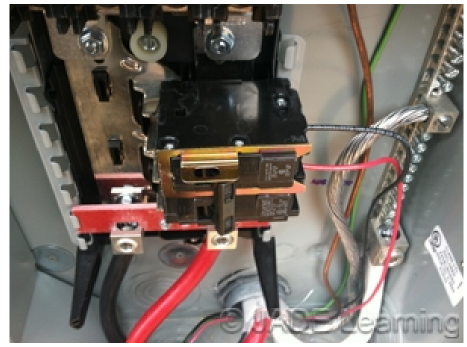
The available fault-current markings(s) addressed in 110.24 is related to required short-circuit current ratings of equipment. NFPA 70E-2012, Standard for Electrical Safety in the Workplace, provides assistance in determining the severity of potential exposure, planning safe work practices, and selecting personal protective equipment.

Question 6: Which of the following statements about marking the available fault current is true?

A: The available fault-current marking must be installed at the factory that manufactured the equipment.
B: The arc-flash boundary is determined by the available fault current marked on the equipment.
C: An available fault current label is required on the service equipment at a single family dwelling.
D: The short-circuit rating of the equipment must not be less than the available fault-current marking.

Question 7: 110.25 Lockable Disconnecting Means.

Question ID#: 630.0



A lockable disconnecting means must be capable of being locked in the open position.

A new Code section has been added to Article 110 which describes a lockable disconnecting means.

Where a disconnecting means is required to be lockable open, elsewhere in this Code, it shall be capable of being locked in the open position. The provisions for locking shall remain in place with or without the lock installed.

Exception: Cord-and-plug connection locking provisions shall not be required to remain in place without the lock installed.

The new section provides a point of reference for a requirement that is seen many times throughout the NEC. Where a disconnecting means for equipment is required to be lockable, such as for motors or compressors, the Code requires: ***The provision for locking or adding a lock to the disconnecting means shall be installed on or at the switch or circuit breaker used as the disconnecting means and shall remain in place with or without the lock installed.***

The new Code section places these general requirements in one central location that can be referred to by other Code sections. This will help reduce having the same Code language throughout a number of different Code articles. Some Code sections may still have additional requirements that modify this general rule but sections that require a lockable disconnecting means will require the disconnecting means to be lockable in accordance with section 110.25.

An exception permits clamshell type lockout type devices to be used with cord ends so as to prevent the cord from being plugged in, even though the clamshell does not remain on the cord when the lock is removed.

Question 7: Which of the following is a lockable disconnecting means?

A: Circuit breakers installed in a panelboard that has a lockable door.
B: A circuit breaker equipped with a lockable device capable of locking the breaker open, and that remains in place regardless of whether or not a padlock is installed in it.
C: A disconnect switch that is only capable of being locked in the closed position.
D: A disconnect switch where only the enclosure of the switch is capable of being locked but the switch handle can be opened or closed while the lock is in place.

Question 8: 110.26(C)(3) Entrance to and Egress from Working Space. Personnel Doors.

Question ID#: 631.0

The requirement for panic hardware on personnel doors has been expanded to include equipment rated 800 amperes or more.

Additional hazards exist when large electrical equipment is located within an enclosed room rather than outside in an open area. In the event of an arc flash or fire, people within the room need to be able to get out quickly. In earlier editions of the Code, where equipment rated 1200 amps or more and containing overcurrent devices, switching devices, or control devices was located in an enclosed room, all personnel doors intended for entrance and exiting the room that were within 25 feet of the equipment's workspace were required to open out in the direction of egress. They were also required to be equipped with panic bars, pressure plates, or other devices that are normally latched but open under simple pressure.

In the new text for section 110.26(C)(3), the 1200 amp threshold has been reduced to 800 amps. Significant arc flash hazards and dangers can exist with electrical equipment regardless of the size or rating. Reducing the threshold to 800 amps will ensure that exit doors for rooms containing distribution panels and other equipment will open in the correct direction and under simple pressure rather than standard door hardware which can be confusing for someone who is disoriented after an arc flash.

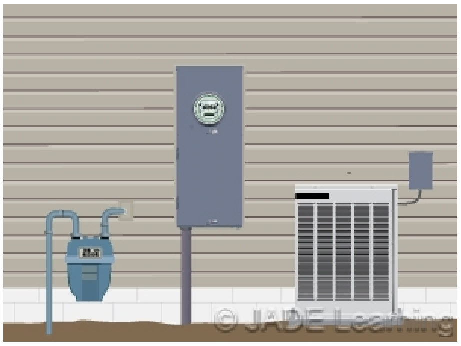
The last change to this section clarifies what type of door hardware may be used in rooms that meet the criteria above. The previous Code text allowed "pressure plates or other devices that are normally latched but open under simple pressure". This Code language left the door hardware requirements open to interpretation. The new Code change eliminates this sentence from the text and now only allows "listed panic hardware" to be used in these electrical rooms. Allowing only ***listed*** panic hardware in such electrical rooms ensures that the panic hardware has been evaluated and tested prior to being installed and can be easily opened by simple pressure delivered from any angle.

Question 8: Which of the following electrical rooms requires listed panic hardware on the exit door?

A: An electrical room enclosing an 800 amp switchboard where the door is located 30 feet from the equipment's required work space.
B: An electrical room enclosing a 1000 amp switchboard where the door is located 22 feet from the equipment's required work space.
C: An electrical room enclosing a 600 amp switchboard where the door is located 5 feet from the equipment's required work space.
D: An electrical room enclosing a 1000 amp switchboard where the door is located 35 feet from the equipment's required work space.

Question 9: 110.26(E)(2) Dedicated Equipment Space. Outdoor.

Question ID#: 632.0



Outdoor dedicated equipment space extends from grade to 6 ft. above the equipment.

Dedicated equipment space is now clearly required for outdoor equipment as well as indoor equipment. The same basic language that described the requirements for dedicated equipment space indoors has been added for outdoor electrical equipment.

For outdoor electrical equipment: ***The space equal to the width and depth of the equipment and extending from grade to a height of 6 ft. above the equipment shall be dedicated to the electrical installation. No piping or other equipment foreign to the electrical installation shall be located in this zone.***

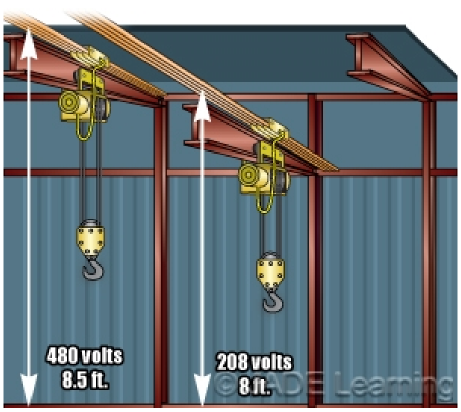
Designers and architects often want all the equipment in the same location. Gas piping, water piping, mechanical refrigeration lines, phone equipment, cable and satellite equipment and many other types of equipment are often found alongside the electrical service. All this equipment can interfere with the electrical installation and infringe on the dedicated space required for electrical enclosures, raceways, and conductors. It is clear now that there is a reserved space for electrical equipment that is equal to the width and depth of the equipment and extends from grade to a height of six feet above the equipment.

Question 9: What is the minimum dedicated space around electrical equipment installed outdoors?

A: The width and depth of the equipment and extending from grade to a height of 3 feet above the equipment.
B: The width and depth of the equipment and extending from grade to a height of 4 feet above the equipment.
C: The width and depth of the equipment and extending from grade to a height of 6 feet above the equipment.
D: The width and depth of the equipment and extending from grade to a height of 8 feet above the equipment.

Question 10: 110.27(A) Guarding of Live Parts. Live Parts Guarded Against Accidental Contact.

Question ID#: 633.0



Guarding of live parts by elevation requires a minimum height of 8 ft. for 50 to 300 volts and 8.5 ft. for 301 to 600 volts.

There are new elevation requirements for the guarding of live parts. The required height above the floor or working platform that will provide a safe buffer between the exposed parts and a person depends on the operating voltage of the equipment that has exposed parts.

For equipment that operates between 50 and 300 volts, the minimum elevation is 8.0 ft. For equipment that operates between 301 volts and 600 volts, the minimum elevation is 8 1/2 ft.

Eight feet is thought to be the average height of a man standing with his arms raised over his head.

The idea that the elevation for exposed live parts should increase as the voltage increases is well established in the NEC. Section 230.24 increases the vertical clearance for overhead service conductors from a minimum of 10 ft. for conductors not greater than 150 volts to ground to 12 ft. for conductors not greater than 300 volts to ground. Likewise, Table 110.34(E) requires 9 ft. of clearance for live parts between 601 volts and 7,500 volt, and 9 1/2 ft. clearance for live parts operating between 7,501 volts and 35,000 volts.

The clearance requirements in section 110.27 do not specify that the voltage is measured from phase-to-ground or from phase-to-phase. This means that the minimum clearance for a 120/208 volt, 3-phase, 4-wire system is 8 ft. The clearance for a 277/480 volt, 3-phase, 4-wire system is 8 1/2 ft.

Question 10: Which of the following options is an acceptable way to provide protection from accidental contact for a 480-volt exposed terminal knife switch that does not have an enclosure?

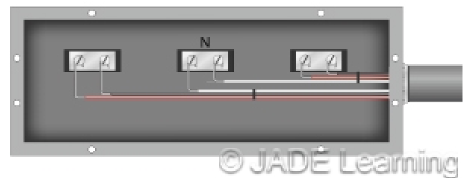
A: Locating the switch 8 feet above the work surface.
B: Locating the switch in a location that is accessible to all occupants of the building.
C: Locating the switchÂ 8.5 feetÂ above the work surface.
D: Locating the switch 5 feet above the floor in a room accessible to unqualified persons.

Chapter 2

Question 11: 200.4 Neutral Conductors.

Question ID#: 634.0

The new text in this section expands on the requirements in section 210.4 that grounded conductors must be grouped with ungrounded conductors of the same circuit. The difference between 200.4 and 210.4 is that section 200.4 requires the grounded conductor to be grouped with the ungrounded conductors of the same circuit in any enclosure, such as a wireway, gutter or junction box, and 210.4 applies only to panelboards or where the circuit originates.



With multiple circuits, grounded circuit conductors of each circuit shall be grouped with the ungrounded circuit conductor.

This should be a big help for locating which grounded conductor is associated with which ungrounded conductors of the same circuit in an enclosure other than a panelboard. Wireways can have dozens of circuits, and finding the grounded conductor that is used with a set of ungrounded multi-wire branch circuit conductors was difficult without the grounded and ungrounded conductors being grouped together.

Based on the new Code change to section 200.4, where more than one neutral conductor associated with different circuits is in an enclosure, the grounded circuit conductors of each circuit shall be identified or grouped to correspond with the ungrounded circuit conductor(s) by wire markers, cable ties, or similar means in at least one location within the enclosure. Two exceptions follow that allow for the grounded conductors to remain ungrouped:

1. The requirement for grouping shall not apply if the branch circuit or feeder conductors enter the enclosure from a cable or raceway unique to the circuit that makes the grouping obvious.
2. The requirement for grouping shall not apply if the branch circuit conductors pass through a box or conduit body without a loop as described in 314.16(B)(1) or without a splice or termination.

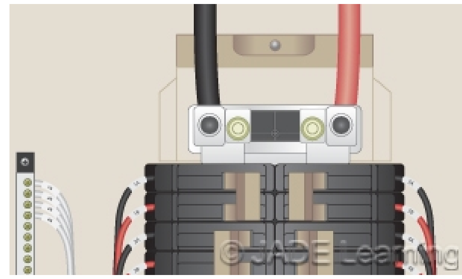
Question 11: When must neutral conductors associated with ungrounded conductors be grouped or marked within a junction box?

A: When the box contains only a single cable entry with one neutral conductor and two ungrounded circuit conductors.
B: When the box contains only a single raceway entry with one neutral conductor associated with three ungrounded circuit conductors.
C: When there are more than two neutral conductors associated with different circuits and the correct grouping is obvious.
D: When there is more than one neutral conductor associated with different circuits and the correct grouping is not obvious.

Question 12: 210.4(D) Multiwire Branch Circuits. Grouping.

Question ID#: 635.0

The general requirement in 210.4(D) about the grouping of grounded and ungrounded conductors in a multiwire branch circuit inside a panelboard is the same in the 2014 NEC as it was in the 2011 NEC. Multiwire circuit conductors are required to be grouped unless the circuit enters the panelboard in a cable or through a raceway that makes grouping obvious.



Multiwire branch circuits can be identified at their terminations with numbered wire markers.

However, in the 2014 NEC, new language was added to the exception that permits the grounded and ungrounded conductors of a multiwire branch circuit to remain ungrouped provided all grounded and ungrounded multiwire circuit conductors are identified at their terminations with numbered wire markers corresponding to the circuit number.

This provides some relief for the problem in crowded panelboards with several rows of raceway entries and finding these wire groupings among the other conductors entering the panelboard, especially following the grounded conductor to its termination at the grounded terminal bus. If the ungrounded and grounded conductors of a multiwire branch circuit all are identified where they are terminated with the same circuit number, it should be easier to identify the conductors of a single multiwire branch circuit.

Question 12: Under the revised exception in the 2014 NEC, which of the following is true when using wire markers to identify the grounded or ungrounded conductors of a multiwire branch circuit in a panelboard?

A: The wire marker must be located nearest the point where the conductors enter the enclosure.
B: The wire marker must be placed at the equipment grounding conductor termination.
C: The wire markers must be placed where the conductors enter the enclosure and at the point of termination on the grounded bus.
D: The multiwire branch circuit conductors are not required to be grouped if they are identified with wire-markers where the conductors are terminated.

Question 13: 210.5(C) Identification for Branch Circuits. Identification of Ungrounded Conductors.

Question ID#: 636.0

Ungrounded DC branch circuit conductors over 50 volts must be identified by polarity. DC conductors which are grounded are identified like AC grounded conductors, per 200.6.

Branch circuit DC ungrounded conductors of No. 6 AWG or smaller need to be identified by polarity.

Ungrounded DC branch circuit conductors size 4 AWG and larger must be identified at all termination, connection, and splice points by marking tape, tagging, or other approved means.

Ungrounded DC branch circuit conductors size 6 AWG and smaller must be identified at all termination, connection, and splice points according to the following requirements:

The conductor with positive polarity is identified by:

(1) A continuous red outer finish.

(2) A continuous red stripe along the entire length of the conductor on insulation which is not green, white, gray, or black.

(3) A plus sign (+) or the word POSITIVE or POS marked on insulation which is not green, white, gray, or black, repeated at least every 24 inches.

The conductor with negative polarity is identified by:

(1) A continuous black outer finish.

(2) A continuous black stripe along the entire length of the conductor on insulation which is not green, white, gray, or red.

(3) A minus sign (-) or the word NEGATIVE or NEG marked on insulation which is not green, white, gray, or red, repeated at least every 24 inches.

The identification method must be documented in a manner that is readily accessible or be permanently posted at each branch circuit panelboard.

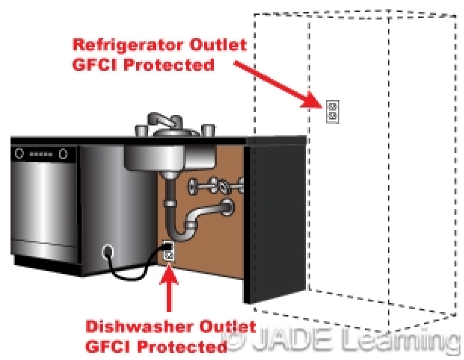
Question 13: Which of the following types of identification for ungrounded DC circuit conductors operating at more than 50 VDC is a Code Violation?

A: A No. 10 AWG conductor with red insulation used as a positive conductor.
B: A No. 6 AWG conductor with black insulation used as a negative conductor.
C: A No. 6 AWG conductor with black insulation re-identified with red marking tape and used as a positive conductor.
D: A No. 4 AWG conductor with black insulation re-identified with red marking tape used as a positive conductor.

Question 14: 210.8(A)(7) Ground-Fault Circuit-Interrupter Protection for Personnel. Dwelling Units.

Question ID#: 637.0

Any 125-volt, single-phase, 15 or 20 amp receptacle installed within 6 ft. of the outside edge of a sink in a dwelling unit is now required to have GFCI protection, including in kitchens. For dwellings, the 2011 NEC required GFCI protection for receptacle outlets within 6 ft. of the outside edge of a sink, except in kitchens. The phrase, "located in areas other than kitchens" has been deleted, so now any receptacle outlet within 6 ft. of a sink in a dwelling unit kitchen must be GFCI protected.



Receptacle outlets installed within 6 ft. of the sink require GFCI protection, even in kitchens.

Under the new rules a receptacle outlet for a food disposer, a refrigerator, or above a range hood will all require GFCI protection if installed within 6 ft. of the outside edge of a sink.

There is no mention of how the 6 ft. measurement is to be taken. Receptacle outlets that serve the kitchen countertop have been required to be GFCI protected for a number of years, so the measurement from the outside edge of the sink is not intended to be just horizontal. The intent is to measure the shortest possible route between the outside edge of a sink and a receptacle outlet in any direction, up, down, or sideways. The idea is to provide the added protection that a GFCI can provide if there is a chance a person could be in contact with a live circuit while being wet or having their hands in water.

The requirement to have receptacle outlets be GFCI protected if installed within 6 ft. of the outside edge of a sink makes sense because these same type of outlets located in other than dwelling units have been required to be GFCI protected since 2008. If there is a shock hazard for receptacles installed within 6 ft. of a sink in a non-dwelling location, then the same hazard exists in dwellings.

Question 14: Which of the following dwelling unit receptacles is required to have GFCI protection?

A: A 20-amp 125-volt single-phase receptacle located behind a gas stove located 6.5 feet from the outside edge of a kitchen sink.
B: A 50-amp 250-volt single-phase receptacle located behind an oven located 5 feet from a kitchen sink.
C: A 15-amp 125-volt single-phase receptacle located behind a refrigerator located 7 feet from a wet bar sink.
D: A 15-amp 125-volt single-phase receptacle located behind a refrigerator, within 6 feet from the outside edge of a wet bar sink.

Question 15: 210.8(A)(9) Ground-Fault Circuit-Interrupter Protection for Personnel. Dwelling Units. Bathtubs or Shower Stalls.

Question ID#: 638.0

By the definition in Article 100, bathrooms are areas that include a basin and one or more toilets, a tub, a shower, a bidet, or similar fixtures. These areas are required to have all 125- volt, single-phase, 15- and 20-ampere receptacle outlets protected by a ground-fault circuit-interrupter type device.

The problem was there are times when a bathtub or a shower stall may be in an area or separate room where no basin or sink is present and therefore by definition, these areas are not classified as bathrooms. Because they are not bathrooms, no GFCI protection was required for receptacle outlets installed in these areas.

Section 210.8(A)(9), now requires that in dwelling units all bathtub and shower stall areas, even without a basin or sink being present, are required to have all 125-volt, single-phase, 15- or 20- ampere receptacle outlets installed within 6 feet of the outside edge of the bathtub or shower stall protected by a ground-fault circuit-interrupter.

GFCI protection is required within 6 ft. of the outside edge of a bathtub or shower stall, even outside of bathrooms.

Question 15: Which of the following 125-V, 15 & 20-A receptacle outlets would NOT require GFCI protection at a dwelling unit?

A: A receptacle installed outside the bathroom and located in a bedroom 8 ft. away from the tub in the bathroom.
B: A receptacle installed outdoors, in a wet location, 7 feet from an outdoor shower stall.
C: A receptacle installed in a bathroom next to the sink.
D: A receptacle installed 4 feet from a shower stall or tub in a bathroom.

Question 16: 210.8(A)(10) Ground-Fault Protection for Personnel. Dwelling Units. Laundry Areas.

Question ID#: 639.0

All 125-volt, single-phase, 15- and 20-ampere receptacle outlets in dwelling unit laundry areas will now require ground-fault circuit-interrupter protection, including the outlet for the washing machine.

This new requirement is similar to other requirements for GFCI protection in the NEC when water may be present where electricity is used. The risk of shock is increased when a person may be in contact with water while operating an electric appliance. New requirements in the 2014 NEC require washing machines and dishwashers to be protected by GFCIs.

Existing sections that apply to laundry areas in dwelling units are:

- 220.52(B): 1500 VA is required to be added to a dwelling unit calculation for the laundry circuit.
- 210.52(F): At least one receptacle outlet must be installed for the laundry.
- 210.8(A)(7): GFCI protection is required for receptacles that are installed within 6 ft. of the outside edge of the sink.

GFCI protection is now required for receptacle outlets in dwelling unit laundry areas.

GFCI receptacles in the laundry area must be readily accessible.

Question 16: Which of the following is an area that is NOT required to have all 125-volt, 15- and 20- ampere receptacle outlets protected by a GFCI type device in a residential dwelling?

A: Bathrooms.
B: Laundry areas.
C: Outdoors.
D: Family rooms.

Question 17: 210.8(B) GFCI Protection for Personnel. Other Than Dwelling Units. Exception No. 1 to (3). Rooftops.

Question ID#: 640.0

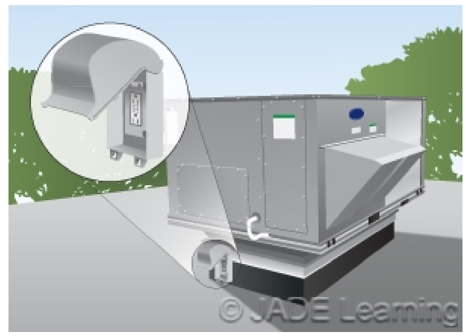
A new exception will allow GFCI receptacle outlets that are mounted on rooftops to be considered ***readily accessible*** if they are readily accessible while on the rooftop.

These receptacles on rooftops shall not be required to be readily accessible except from the rooftop.

This means that neither a permanent stairway nor a permanent ladder is required to access a rooftop where receptacles are installed. Once you are on the rooftop, (regardless of the means necessary to get on the rooftop) if no ladder is required to reach that GFCI protected receptacle installed on the rooftop, the installation complies with the requirements of the 2014 NEC.

Ground-Fault Circuit-Interrupter(s) must be installed in a readily accessible location, whether in the form of a receptacle or a circuit-breaker. The definition of readily accessible includes a statement that equipment must be able to be reached quickly and must be installed so that portable ladders are not necessary.

If every rooftop had a permanent ladder installed for access, this Code would never have been in question, but many rooftops are accessible ***only*** by someone providing and setting up a portable ladder. This new exception now makes it clear that GFCI receptacle outlets installed on rooftops are to be considered readily accessible if they are readily accessible once you are on the rooftop.



GFCI receptacles on rooftops are considered readily accessible if they are readily accessible while on the rooftop.

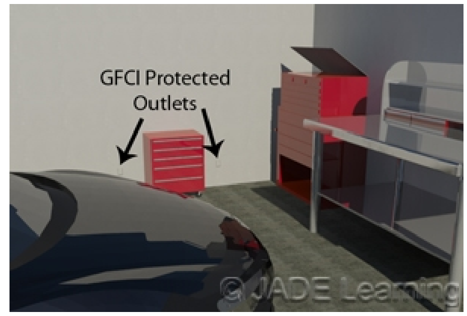
Question 17: Which of the following statements about rooftop receptacles on non-dwelling rooftops is true?

A: If rooftop receptacles are type WR, they are not required to be GFCI protected.
B: A GFCI receptacle outlet can be installed on a rooftop that is accessible by a portable ladder.
C: GFCI protection for rooftop receptacle outlets is only permitted to be provided by GFCI circuit breakers.
D: GFCI receptacle outlets cannot be installed on rooftops unless the rooftop is accessible by permanent stairs or a permanent ladder.

Question 18: 210.8(B)(8) GFCI Protection for Personnel. Other Than Dwelling Units. Garages.

Question ID#: 641.0

Since 1987, ground-fault circuit-interrupter (GFCI) protection has been required in commercial repair garages for 15- and 20-amp single-phase 125-volt receptacles that serve areas where electrical diagnostic equipment, electrical hand tools, or portable lighting equipment are used. This requirement comes from Article 511 and was incorporated into section 210.8(B)(8) for the 2011 NEC.



GFCI protection is required for all 15- and 20-amp single-phase 125-volt receptacles in garages, service bays, and similar areas.

After careful consideration during the 2014 Code cycle, a clarification was made and section 210.8(B)(8) has been revised to require GFCI protection for all 15- and 20-amp single-phase 125-volt receptacles located in "garages, service bays, and similar areas other than vehicle exhibition halls and showrooms".

The previous Code requirements were specific to only certain receptacles in the garage area where diagnostic equipment, electric hand tools and portable lights were used and left other receptacles in a commercial repair garage without GFCI protection. Changing this section from only requiring GFCI protection where diagnostic equipment, electric hand tools or portable lights are used to a more general requirement that covers all 15- and 20-amp, single-phase, 125-volt receptacles located in a commercial garage will ensure that GFCI protection is provided regardless of where the receptacle is located or what it is used for in a commercial repair garage.

Question 18: Which of the following receptacles does NOT require ground-fault circuit-interrupter protection?

A: A 20-amp, single-phase, 125-volt receptacle located next to an air compressor in a dwelling unit garage.
B: A 15-amp, single-phase, 125-volt receptacle located next to an air compressor in a commercial repair garage.
C: A 20-amp, single-phase, 125-volt receptacle located on the wall of an automobile showroom.
D: A 20-amp, single-phase, 125-volt receptacle located on the ceiling in a commercial repair garage.

Question 19: 210.8(D) GFCI Protection. Kitchen Dishwasher Branch Circuit.

Question ID#: 642.0

A new item (D) has been added to 210.8, Ground-Fault Circuit-Interrupter Protection for Personnel. The new section is (D) Kitchen Dishwasher Branch Circuit. In dwelling units, kitchen dishwasher outlets will now be required to have ground-fault circuit-interrupter protection.

GFCI protection is now required for outlets that supply dishwashers in dwelling units.

The number of deaths from electrocution has dropped significantly since the introduction of GFCIs. For this reason, with each Code cycle, the types and number of outlets that require GFCI protection have increased. Ground-fault circuit-interrupter protection will de-energize an outlet when a ground-fault current of 6mA or more is detected. Low levels of electrical current can be fatal in ranges well below 1 amp.

For the dishwasher outlet in a dwelling unit, protection can be provided by a GFCI circuit breaker or a GFCI receptacle. If a GFCI receptacle is installed under the counter top adjacent to the dishwasher in the open space under a sink, it can be accessed without having to move the dishwasher or to use tools. GFCI devices must be readily accessible, per 210.8, and a GFCI receptacle for the dishwasher installed under the sink is considered readily accessible.

GFCI protection for the dishwasher makes sense because when an appliance uses electricity and water, the shock hazard is increased. Also, the newer electronically controlled dishwashers pose a greater risk of shock as they age.

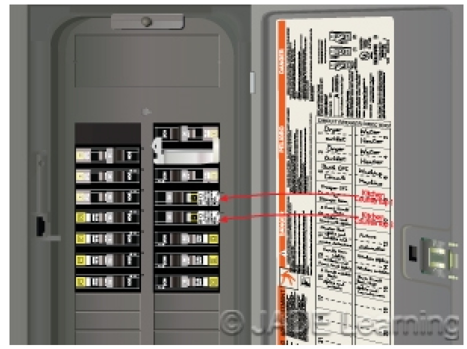
Question 19: Which of the following is a true statement?

A: A 240-volt, 20 amp dishwasher in a hotel kitchen is required to have GFCI protection.
B: A 208-volt, 30 amp dishwasher in a restaurant is required to have GFCI protection.
C: A 125-volt, 15 amp, dishwasher in an apartment is required to have GFCI protection.
D: A 125-volt, 30 amp dishwasher in a drive-thru coffee stand is required to have GFCI protection.

Question 20: 210.12(A) Arc-Fault Circuit-Interrupter Protection. Dwelling Units.

Question ID#: 643.0

Arc-Fault Circuit-Interrupter protection is now required in the kitchen and laundry areas, in addition to family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways or similar rooms or areas. Basically the only areas in a dwelling unit that do not require AFCI protection are the bathrooms, garage, crawl space, attic, and outdoors.



AFCI protection is now required in dwelling unit kitchen and laundry areas.

AFCI protection is also now required for all 120-volt, single-phase, 15- and 20-ampere branch circuits supplying outlets installed in dormitory unit bedrooms, living rooms, hallways, closets, and similar rooms.

Both types of arc-fault circuit-interrupters, the circuit breaker type arc-fault circuit-interrupter and the outlet branch circuit receptacle type arc-fault circuit-interrupter must be readily accessible. That was not a problem when the circuit breaker type of AFCI was the only type of arc-fault protection available. The outlet branch circuit receptacle type of AFCI that is on the market now must be installed in a readily accessible location so the resident of the dwelling can test the outlet on a regular basis, as is required by the manufacturer's instructions.

In the rooms and areas that require AFCI protection, devices and outlets must be protected. A device is a part of an electrical system, like a light switch, that carries or controls electric energy. An outlet, like a receptacle, is used to supply utilization equipment. In the 2014 edition of the NEC, a light switch in a bedroom that controls an outside light will require AFCI protection.

Question 20: Which statement about Arc-Fault Circuit-Interrupter protection is true?

A: AFCI protection is required in bathrooms.
B: A receptacle type AFCI can be installed behind an appliance that is fastened in place.
C: In a dwelling, a washing machine outlet installed in a laundry must have AFCI protection.
D: AFCI protection is required in dwelling unit garages.

Question 21: 210.12(A)(1)-(6) Arc-Fault Circuit-Interrupter Protection. Dwelling Units.

Question ID#: 644.0

In the 2011 National Electrical Code, there were 3 ways to provide arc-fault circuit-interrupter protection:

- Install a listed combination-type AFCI circuit breaker.
- Install an outlet branch circuit type AFCI receptacle as the first outlet on the branch circuit. The wiring between the circuit breaker and the first outlet is required to be installed in RMC, IMC, EMT, Type MC, or steel armored Type AC cable, and the outlet and junction boxes have to be metal.
- Install an outlet branch circuit type AFCI receptacle as the first outlet on the branch circuit with the conduit or tubing between the circuit breaker and the first outlet encased in not less than 2 inches of concrete.

There are 3 new ways to provide arc-fault circuit-interrupter protection in required areas such as bedrooms, living rooms family rooms, and dining rooms.

In the 2014 NEC, those 3 methods are still permitted, and there are 3 more new ways to provide arc-fault circuit-interrupter protection.

- Install a listed branch/feeder type AFCI circuit breaker ***and*** a listed outlet type branch circuit AFCI receptacle as the first outlet on the circuit. The first outlet box must be marked to show it is the first outlet on the circuit.
- Install a listed supplemental arc protection circuit breaker with a listed outlet branch circuit type AFCI receptacle as the first outlet on the circuit if all of the following conditions are met:
- The branch circuit must be continuous from the circuit breaker to the outlet branch circuit arc-fault circuit interrupter.
- The maximum length of the branch circuit wiring from the circuit breaker to the outlet branch circuit arc-fault receptacle is not greater than 50 ft. for a No. 14 AWG or 70 ft. for a No. 12 AWG conductor.
- The first outlet box in the branch circuit shall be marked to indicate that it is the first outlet of the circuit.

- Install a listed outlet branch circuit type arc-fault circuit interrupter as the first outlet on the branch circuit in combination with a listed branch-circuit overcurrent protective device if all the following conditions are met:
- The branch circuit must be continuous from the circuit breaker to the outlet branch circuit arc-fault circuit interrupter.
- The maximum length of the branch circuit wiring from the circuit breaker to the outlet branch circuit arc-fault receptacle is not greater than 50 ft. for a No. 14 AWG or 70 ft. for a No. 12 AWG conductor.
- The first outlet box in the branch circuit shall be marked to indicate that it is the first outlet of the circuit.
- The combination of the branch circuit overcurrent device and the outlet branch circuit AFCI is identified as meeting the requirements for a "System Combination" type AFCI and is listed as such.

The outlet branch circuit type arc-fault circuit-interrupter receptacle is currently available on the market. The supplemental arc protection circuit breakers and a "System Combination" type AFCI are not yet available as of January 1, 2014.

Question 21: A listed supplemental arc protection circuit breaker is installed at the origin of the branch circuit and a listed outlet branch-circuit type arc-fault circuit interrupter is installed at the first outlet box on the branch circuit.
If No. 14 AWG conductors are used for the branch circuit, what is the maximum distance between the branch-circuit overcurrent device and the first outlet?

A: 40 feet.

B: 50 feet.
C: 60 feet.
D: 70 feet.

Question 22: 210.12(B) Exception. Branch Circuit Extensions or Modifications - Dwelling Units.

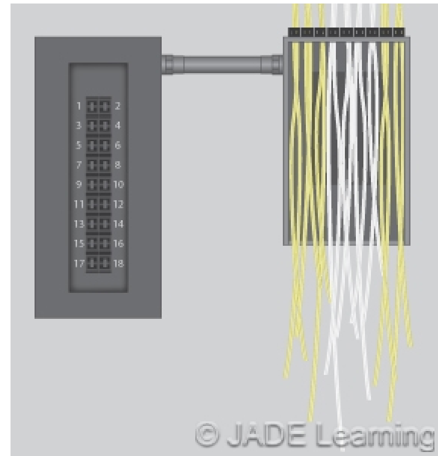
Question ID#: 645.0

In living rooms, bedrooms, family rooms, kitchens or any of the areas of a dwelling unit where AFCI protection is required, if the branch-circuit wiring is replaced, extended, or modified, the branch-circuit must be brought up to Code and arc-fault circuit-interrupter protection provided.

A new exception says that if the branch-circuit is not extended more than 6 feet, and does not include any additional outlets or devices, AFCI protection is not required.

In many cases when a dwelling branch-circuit is extended or modified, it is to add a new receptacle outlet. In these cases, AFCI protection is required to be provided because an additional outlet or device has been added.

This exception was added to cover cases where the dwelling unit panelboard is replaced or upgraded, and the original branch-circuit wiring has to be extended to reach the new location. The Code panels felt 6 ft. was a long enough distance to cover this type of circuit modification.



AFCI protection is not required for an extension not more than 6 ft. with no additional outlets or devices.

Question 22: Which of the following installations will require AFCI protection?

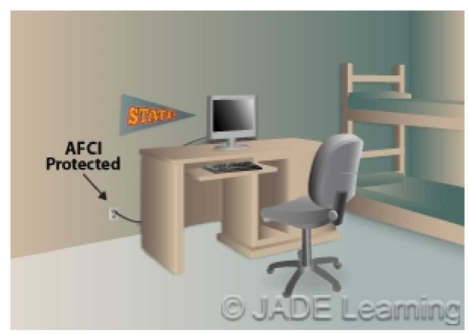
A: A 7 foot extension of an existing branch circuit serving an unfinished attic to add a new receptacle in the attic.
B: A 7 foot extension of an existing branch circuit to add a new receptacle in a family room.
C: A 7 foot extension of an existing branch circuit located in a bathroom to add an additional receptacle in the bathroom.
D: A 5 foot extension of an existing branch circuit in order to terminate the circuit in a replacement panelboard that was re-located.

Question 23: 210.12(C) Dormitory Units.

Question ID#: 646.0

Arc-Fault Circuit-Interrupter protection is now required for all 120-volt, single-phase, 15- and 20-ampere branch circuits supplying outlets installed in dormitory unit bedrooms, living rooms, hallways, closets and similar rooms.

Dormitories are considered dwelling units and this section extends the same requirements for AFCI protection in one- and two-family dwellings and multi-family dwellings to dormitories. A dwelling unit provides permanent provisions for living, sleeping, cooking and sanitation. However, even a dormitory unit that does not have permanent provisions for cooking will require AFCI protection for 120-volt, single-phase, 15- and 20-ampere branch circuits in bedrooms, living rooms, hallways, closets, and similar rooms.



AFCI protection is now required in dormitory unit bedrooms, living rooms, hallways, closets, and similar rooms.

Between 2007 and 2011 there was an annual average of 3,810 structure fires in dormitories, fraternities, sororities, and barracks. These fires caused several fatalities a year, multiple injuries and millions of dollars in property damage. Most of the fires were caused by cooking and heating equipment, but a significant percentage were caused by electrical distribution and lighting equipment.

Arc-fault circuit-interrupters provide protection for branch circuit wiring against series and parallel faults that may be caused by damage to the branch circuit wiring.

Question 23: In a college dormitory, which of the following locations requires AFCI protection?

A: A common dining room where all the residents eat.
B: A sleeping room in an individual dormitory unit.
C: A common reception room at the building entrance.
D: A common kitchen shared by residents that is not part of a specific dorm room.

Question 24: 210.13 Ground-Fault Protection of Equipment.

Question ID#: 647.0

Branch-circuit disconnects rated 1000 amps or more and installed on solidly grounded wye electrical systems of more than 150 volts to ground require GFPE.

For many years the Code has required a feeder or service disconnect rated 1000 amps or more and installed on solidly grounded wye electrical systems of more than 150 volts to ground, but not exceeding 600 volts phase-to-phase, to be provided with ground-fault protection of equipment (GFPE). Until now this requirement has never been applied to branch circuits.

The voltage to ground in a 277/480 volt wye connected three phase system is 277 volts. The voltage to ground in a 120/208 volt wye connected three phase system is 120 volts.

GFPE is intended to provide protection of equipment and should not be confused with GFCI which is intended to provide protection for personnel. Disconnects equipped with GFPE have ground-fault relays that offer protection for equipment from the effects of low level ground faults. The size of ground-fault current depends on the method of system grounding. The NEC requires GFPE for solidly grounded systems since these systems are more prone to high levels of ground-fault currents. According to Article 100, ground-fault protection of equipment is provided at current levels less than the levels of fault current required to protect conductors from damage by the operation of a supply circuit overcurrent device.

Section 210.13 is new in the 2014 Code and provides similar language to that found in 215.10 and 230.95. Although not common, it is possible that a 480 volt branch circuit could be protected by a 1000 amp or larger overcurrent device and supply power directly to a single piece of utilization equipment. This type of installation would meet the definition in Article 100 of a branch circuit, rather than a feeder, and therefore would not be subject to the requirements found in 215.10 or 230.95. Under the provisions of the 2011 NEC, this type of installation would not require Ground Fault Protection for Equipment. In the 2014 NEC this branch circuit would require GFPE.

Along with the new Code section come two exceptions that are similar to the language found in the two exceptions that follow section 215.10.

Question 24: Which of the following installations will require ground-fault protection of equipment?

A: A branch-circuit disconnect rated 1000 amps installed on a 277/480-volt solidly grounded wye electrical system.
B: A branch-circuit disconnect rated 1200 amps installed on a 120/208-volt solidly grounded wye electrical system.
C: A feeder disconnect rated 800 amps installed on a 277/480-volt solidly grounded wye electrical system.
D: A service disconnect rated 2000 amps installed on a 120/208-volt solidly grounded wye electrical system.

Question 25: 210.17 Electric Vehicle Charging Circuit.

Question ID#: 648.0

A new section 210.17, Electric Vehicle Branch Circuit, provides that ***outlet(s) installed for the purpose of charging electric vehicles shall be supplied by a separate branch circuit. This circuit shall have no other outlets***.

Outlets installed for charging electric vehicles shall be supplied by a separate electric vehicle branch circuit.

Section 625.2 defines Electric Vehicle as an ***automotive-type vehicle for on-road use, such as passenger automobiles, buses, trucks, vans, neighborhood electric vehicles, electric motorcycles and the like, primarily powered by an electric motor that draws current from a rechargeable storage battery, fuel cell, photovoltaic array, or other source of electric current. Plug-in hybrid electric vehicles (PHEV) are considered electric vehicles. For the purpose of this article, off-road, self-propelled electric vehicles, such as industrial trucks, hoists, lifts, transports, golf carts, airline ground support equipment, tractors, boats, and the like are not included.***

The dedicated branch circuit is to be rated for the anticipated load. If additional loads are permitted on the circuit, the overcurrent device could trip in response to an overload or ground fault, leaving the electric vehicle battery uncharged.

Level 1 electric vehicle chargers operate at 125 volts and can be connected to a 20 amp circuit. Level 1 electric vehicle chargers can take more than 14 hours to fully charge a car battery. Level 2 electric vehicle chargers operate at 240 volts and are connected to 30 or 40 amp circuits. A level 2 charger can charge a car battery in half the time of a Level 1 charger.

In designing an electric vehicle charging outlet and branch circuit, it is important to determine whether the intended equipment falls within the definition of Electric Vehicle. For example, a golf cart is not considered an electric vehicle.

Note that this new Code requirement is found in NEC Chapter Two, Wiring and Protection, not in Chapter Six, Special Equipment.

Question 25: How many different types of loads, other than electric vehicle chargers, are permitted on the electric vehicle charging circuit?

A: zero
B: one
C: Two
D: Three

Question 26: 210.19(A)(1) Conductors - Minimum Ampacity and Size. Branch Circuits Not More than 600 Volts. General.

Question ID#: 649.0

Question: What is the correct way to calculate the size of a conductor that carries a continuous load and is installed with more than 3 current-carrying conductors in conduit or in an ambient temperature hotter than 86Â°F?

Answer: Using Table 310.15(B)(16), compare the conductor size needed to serve the continuous load with the size of the conductor needed to allow for any adjustment or correction factors, and ***select the larger of the two conductors***.

The new code change in 210.19(A)(1) now makes it clear that when we select a conductor size to supply a load, we may "double derate" the ampacity of the conductor when there are more than 3 conductors in conduit, and the ambient temperature is other than 86Â°F, but when the load is continuous and these conditions exist, we never "triple derate" and factor in another 125% for the continuous load on top of the other two correction factors.

We simply must choose a conductor based on ***the larger of***:

- 125% of the continuous load, ***OR***
- 100% of the maximum load (not 125% of it) multiplied by the correction factors based on conditions of use.

For example: What size THWN cu. conductor is needed to supply a 100-amp continuous load when there are 7 current-carrying conductors in conduit?

Step 1 100 amp continuous load X 125% = 125 amps
Conductor size = No. 1 THWN cu. (Good for 130 amps)

Step 2 7 current-carrying conductors = 70% adjustment (from table 310.15(B)(3)(a))
1/0 THWN cu. 150 amps x .70 = 105 amps (ok for the 100 amp load)

Step 3 Select ***the larger of*** the two conductors.
1/0 THWN cu.

It is not necessary to add both the continuous load (125 amps) and the adjustment factor for the 7 conductors in conduit (125 amps Ã· .70 = 179 amps). Doing so would require a 3/0 THWN cu. conductor ***which is not code required.***

Question 26: What is the minimum size THWN cu. conductor required to supply a 50-amp continuous load with 7 current-carrying conductors in conduit (75Â°C terminals)?

A: No. 8 THWN cu.
B: No. 6 THWN cu.
C: No. 4 THWN cu.
D: No. 3 THWN cu.

Question 27: 210.52(E)(1) Outdoor Dwelling Unit Receptacles.

Question ID#: 651.0

In the 2011 NEC, the outdoor outlets that are required at the front and back of one-family dwellings, and each unit of a two-family dwelling that is at grade level, were required to be accessible while standing at grade level. ***The 2014 NEC has deleted the phrase "while standing at grade level"*** and now requires the outdoor receptacle to be readily accessible from grade.

The required outdoor receptacle outlet must be installed at a readily accessible location not more than 6.5 feet above grade level.

According to the definition of ***readily accessible*** in Article 100, if a person can access a receptacle located on a deck without removing obstacles or using a portable ladder the receptacle is considered to be readily accessible. Permanent stairs from grade level to deck provides ready access to a receptacle located anywhere on the deck. If the receptacle is not more than 6 1/2 feet above grade level it is permitted to be counted as one of the required outdoor receptacles required for dwellings.

The purpose of the change is to permit a receptacle on an outdoor deck, porch or balcony to serve as one of the required outdoor receptacles, even if the receptacle is not accessible from grade. For instance, a receptacle outlet installed in the middle of a deck that could not be reached while standing at grade level but is still readily accessible from grade by walking up onto the deck (and not more than 6.5 feet above grade level) is now permitted to be counted as one of the two required outdoor outlets at dwellings.

A receptacle outlet installed anywhere on a deck, so that the receptacle is located not more than 6 1/2 ft. above grade, will serve a double purpose. It can be counted as one of the required outdoor outlets at dwellings in 210.52(E)(1), and the required receptacle outlet for a balcony, deck or porch in 210.52(E)(3).

Question 27: If a receptacle outlet is installed on an outdoor deck, when can it be counted as one of the required outdoor receptacle outlets at a one-family dwelling?

A: Only when it is accessible while standing at grade level, 6.5 feet above grade level.
B: When it is installed at the edge of the deck, 7.5 feet above grade level.
C: When it can be reached after climbing a ladder from grade level.
D: When the receptacle is installed serving the deck, is not more than 6.5 feet above grade level, and the deck can be accessed by permanent stairs which extend from grade level to the deck.

Question 28: 210.52(E)(3) Balconies, Decks, and Porches.

Question ID#: 652.0

There are two important changes to this section that require a receptacle outlet at a balcony, porch, or deck. (1) The balcony, deck, or porch must be attached to the dwelling, as well as accessible from inside the dwelling unit. In the 2011 NEC there was not a requirement that the balcony, deck, or porch be attached to the dwelling. (2) The required receptacle outlet no longer has to be "within the perimeter" of the balcony, deck, or porch. As long as the receptacle outlet is accessible from the balcony, deck, or porch it will count as the required receptacle outlet. The outlet must be located no more than 6 1/2 ft. above the balcony, deck, or porch walking surface.

The required receptacle outlet no longer has to be within the perimeter of the balcony, deck, or porch as long as it is accessible.

The fact that the receptacle outlet no longer has to be within the perimeter of the balcony, deck, or porch will make it easier to install the outlet. Especially for smaller spaces, often there is literally no place to locate the outlet. A sliding glass door can take up the entire opening into the dwelling, leaving no practical way to install an outlet within the perimeter of the balcony.

Also, the added flexibility of being able to install the required outlet outside of the footprint of the balcony, deck, or porch, will make it easier to have a single outlet satisfy the requirement for an outdoor outlet at the front and back of one- and two-family dwelling units, as well as the requirement for a receptacle outlet at the balcony, deck, or porch.

Question 28: Which of the following statements about the required receptacle outlet at a balcony, deck, or porch is true?

A: A receptacle outlet must be installed within the perimeter of the porch.
B: A receptacle outlet can be installed 7 ft. above the walking surface of a deck.
C: A deck that is not attached to the dwelling is required to have at least one receptacle outlet.
D: A receptacle outlet that is installed directly outside of a balcony railing is still counted as the required receptacle outlet.

Question 29: 210.52(G) Receptacle Outlets. Basements, Garages, and Accessory Buildings.

Question ID#: 653.0

Two important changes have been made to this section on garages. In each attached garage and in each detached garage with electric power: (1) At least one ***receptacle*** outlet must be installed for each car space and (2) The ***branch circuit*** supplying the garage receptacle outlets cannot supply other outlets outside the garage.

In one-family dwellings, a receptacle outlet is required for each car space.

Some garages may have workshops or garage door openers that require additional outlets. The requirement for a receptacle outlet for each car space is in addition to any receptacles required for specific equipment that might be present in a garage. Also, with electric and hybrid electric vehicles becoming more popular, there is an increased need for electric charging units. Even though electrical vehicle charging units are covered in Article 625, there are smaller charging units with maximum continuous loads of 12 amperes that operate at 120 volts. With at least two receptacle outlets in a two car garage, there will be less need to use extension cords which can be damaged and pose a shock hazard.

The requirement for dwelling unit garage branch circuit to have no other outlets outside the garage will add another required branch circuit. Outdoor outlets will no longer be able to be included on a garage branch circuit. This new garage branch circuit may require that the design and layout of dwelling unit circuits be changed.

210.52(G)(2) and (3) still require accessory buildings with electric power and any portion of an unfinished basement area to have a minimum of one receptacle outlet installed. Receptacle outlets installed in these areas do not require any dedicated circuitry and can be installed on a branch circuit that serves other receptacle outlets.

Question 29: What is the MINIMUM number of receptacle outlets required for a three car garage in a one-family dwelling?

A: 1.
B: 2.
C: 3.
D: 4.

Question 30: 210.52(I) Dwelling Unit Receptacle Outlets - Foyers.

Question ID#: 654.0

The change to this section should help to more clearly define the wall space in a foyer. There has been no change to the requirement that a receptacle outlet is required for wall spaces at least 3 ft. or more in width in a dwelling unit foyer that has an area greater than 60 ft.2.

Doorways in foyers are not counted as wall space; neither are door-side windows and similar openings.

Doorways in a foyer are not counted as wall space. In the 2011 NEC, floor-to-ceiling windows were also not counted as wall space. The confusion was about door-side windows that are part of the door assembly but didn't extend all the way to the ceiling. Some inspectors said the door-side windows still had to be counted as wall space because they did not extend all the way to the ceiling.

Many custom entry doors have sidelights that extend the vertical length of a door but not from floor-to-ceiling. If an inspector was to literally interpret the text of the article, and a window did not extend from the floor to the ceiling, then an outlet would be required above the window. This is not practical and creates a conflict with the fact that perimeter receptacle outlets must not be installed more than 5 1/2 feet above the floor.

The new language in section 210.52(I) says: ***Doorways, door-side windows that extend to the floor, and similar openings shall not be considered wall space.***

Question 30: How many receptacle outlets are required in a foyer that has an area greater than 60 sq. ft. and has a 4 foot wall space on each side of the front door and two 2 foot wall spaces opposite the door?

A: 1 receptacle outlet.
B: 2 receptacle outlets.
C: 3 receptacle outlets.
D: 4 receptacle outlets.

Question 31: 210.64 Electrical Service Areas.

Question ID#: 655.0

A new section 210.64, Electrical Service Areas, now requires a 125-volt, single phase, 15- or 20-ampere-rated receptacle outlet to be installed within 50 ft. of the electrical service equipment.

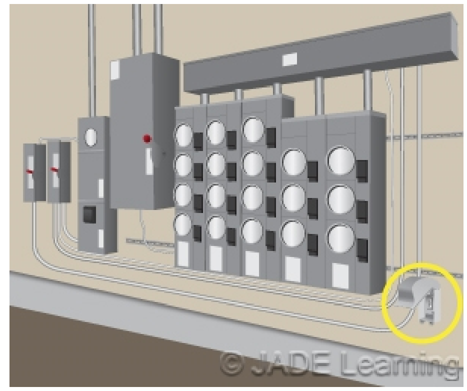
At least one 125-volt, single-phase, 15- or 20-ampere-rated receptacle outlet shall be installed within 50 ft. of the electrical service equipment.

An exception allows the receptacle outlet at the electrical service area to be omitted at one- and two-family dwellings.

For the same reason that a receptacle outlet is required within 25 ft. of HVAC equipment, a receptacle outlet is now required within 50 ft. of the electrical service equipment. Technicians and maintenance personnel need a place to connect their testing and servicing equipment without running extension cords through door-ways or throughout the building.

Power quality companies need to connect data acquisition equipment at the service equipment to monitor the performance of the electrical system and may have to leave their equipment connected for a day or longer. Using an extension cord for the monitoring equipment is even more dangerous if left unattended.

The 15- or 20-ampere rated receptacle outlet must be installed in the "electrical service area," whether that is indoors or outdoors. If outdoors, the receptacle must be weather- resistant and the enclosure suitable for a wet location.



Other than in one- and two-family dwellings, a receptacle outlet shall be installed within 50 ft. of electrical service equipment.

Question 31: Which of the following receptacle outlets complies with the minimum requirements for receptacles installed in the electrical service area?

A: A 125-volt, single-phase, 15- or 20-ampere outlet installed 25 ft. from the electrical service area in a one-family dwelling.
B: A 125-volt, single-phase, 15- or 20-ampere outlet installed 45 ft. from the electrical service area in a two family dwelling unit.
C: A 125-volt, single-phase, 15- or 20-ampere outlet installed 55 ft. from the electrical service area in a multifamily dwelling.
D: A 125-volt, single-phase, 15- or 20-ampere outlet installed 40 ft. from the electrical service area in a multifamily dwelling.

Question 32: 215.12(C)(2) Identification for Feeders. Identification of Ungrounded Conductors. Feeders Supplied from Direct-Current Systems.

Question ID#: 657.0

Feeder DC ungrounded conductors of No. 6 AWG or smaller need to be identified by polarity.

Ungrounded DC feeder conductors are identified in the same manner as DC branch circuit conductors.

Ungrounded DC feeder conductors over 50 volts must be identified by polarity. DC conductors which are grounded are identified like AC grounded conductors, per 200.6.

Ungrounded DC feeder conductors size 4 AWG and larger must be identified at all termination, connection, and splice points by marking tape, tagging, or other approved means.

Ungrounded DC feeder conductors size 6 AWG and smaller must be identified at all termination, connection, and splice points according to the following requirements:

The conductor with positive polarity is identified by:

(1) A continuous red outer finish.

(2) A continuous red stripe along the entire length of the conductor on insulation which is not green, white, gray, or black.

(3) A plus sign (+) or the word POSITIVE or POS marked on insulation which is not green, white, gray, or black, repeated at least every 24 inches.

The conductor with negative polarity is identified by:

(1) A continuous black outer finish.

(2) A continuous black stripe along the entire length of the conductor on insulation which is not green, white, gray, or red.

(3) A minus sign (-) or the word NEGATIVE or NEG marked on insulation which is not green, white, gray, or red, repeated at least every 24 inches.

The identification method must be documented in a manner that is readily available or be permanently posted at each feeder panelboard.

Question 32: If a feeder conductor with black insulation is used as a "positive" conductor to carry 80 volts DC, which of the following must apply so that it could be re-identified with red tape?

A: It must be No. 4 AWG or larger.
B: It must be larger than No. 4 AWG.
C: It must not be larger than No. 4 AWG.
D: It cannot be re-identified with red tape.

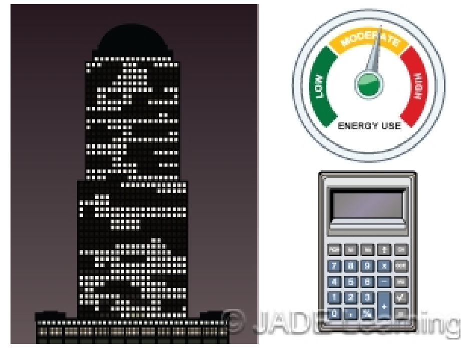
Question 33: 220.12 Lighting Load for Specified Occupancies. Exception.

Question ID#: 658.0

A new Exception to Section 220.12, Lighting Loads for Specified Occupancies, provides that:

Where the building is designed and constructed to comply with an energy code adopted by the local authority, the lighting load shall be permitted to be calculated at the values specified in the energy code where the following conditions are met:

- ***A power monitoring system is installed that will provide continuous information regarding the total general lighting load of the building.***
- ***The power monitoring system will be set with alarm values to alert the building owner or manager if the lighting load exceeds the values set by the energy code.***
- ***The demand factors specified in 220.42 are not applied to the general lighting load.***



Where permitted and under specific conditions, the lighting load can be calculated at the values specified in the local energy code.

Table 220.12 lists the required unit load in volt-amperes per sq. ft. to be used to calculate the general lighting load by occupancy. From the Table, schools require the general lighting load to be calculated at 3 VA per sq. ft., office buildings at 3.5 VA per sq. ft., and auditoriums at 1 VA per sq. ft.

Buildings that are designed and built to meet local energy codes are more energy efficient than buildings that do not meet energy codes. The new exception to 220.12 takes into account that the unit loads per sq. ft. for general lighting may be too high if the building has been designed and built to meet energy codes.

Using the new exception, the general lighting load for a new building can be calculated according to the local energy code, and not Table 220.12. A power monitoring system must be installed to constantly monitor the electric usage in the building and sound an alarm if the power demand exceeds set points. Also, the demand factors found in Table 220.42 cannot be used to calculate the general lighting load for the building.

Question 33: When can the exception to Section 220.12 be used?

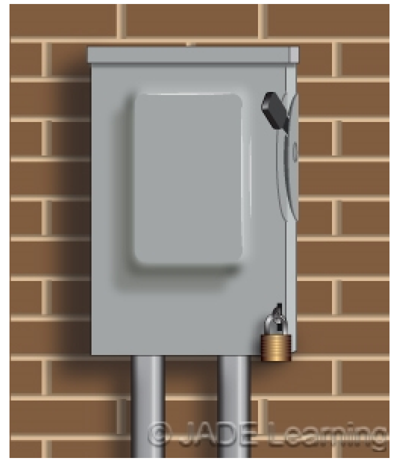
A: When it is requested by the local electrical inspector.
B: When the building has been built according to a local energy code.
C: When the building is part of an educational campus.
D: When the facility is staffed with qualified persons.

Question 34: 225.36 Buildings or Other Structures Supplied By a Feeder or Branch Circuit. Type.

Question ID#: 660.0

Two important changes have been made to this section about the disconnecting means for buildings supplied by an outside branch circuit or feeder.

- 3-way and 4-way switches are no longer permitted as the disconnecting means for garages and outbuildings on residential property.
- The disconnecting means is no longer required to be suitable for use as service equipment (except for older installations where a 3-wire feeder instead of a 4-wire feeder supplies an outbuilding).



Appropriate disconnecting means include a circuit breaker, molded case switch, general-use switch, or snap switch.

Three-way and four-way switches do not provide an actual way to disconnect power from a building, and the exception that permitted it was deleted in 225.36 and 225.38.

The disconnecting means for a building supplied by an outside branch circuit or feeder is required to disconnect all the ungrounded conductors that feed or pass through the building, and can be one of the following:

- Circuit breaker
- Molded case switch
- General use switch
- Snap switch
- Other approved means

The disconnecting means is no longer required to be suitable for use as service equipment unless it is installed according to the first exception in section 250.32(B). Exception No. 1 to 250.32(B) provides for situations where previous Code editions allowed the practice of supplying a building by a feeder or branch circuit that had no equipment ground. The grounded conductor run with the supply conductors would then be used as a ground-fault return path by connecting it to the grounded neutral bar. The grounded neutral bar is bonded to the remote building's disconnect enclosure. In this case, the disconnecting means must be suitable for use as service equipment.

Under normal circumstances, when the exceptions in section 250.32(B) are not used, there is no need for a branch circuit or feeder disconnect to be suitable for use as service equipment. Equipment that is listed as "suitable for use as service equipment", undergoes different testing and has different construction characteristics than general use switches or other similar devices that are perfectly capable of disconnecting branch circuit or feeder conductors that are protected by an upstream overcurrent device.

Question 34: Which of the following is NOT permitted to be used to disconnect a single phase, 120/240-volt, 20-amp branch circuit that supplies power to a new residential outbuilding?

A: A circuit breaker.
B: A molded case switch.
C: A cord-and-plug connection.
D: A general use switch.

Question 35: 225.56 Inspections and Tests.

Question ID#: 662.0

Outside branch circuits and feeders that operate at voltages over 1000 volts must be performance tested before being put in service.

For installations over 1000 volts, most electricians that are responsible for the initial equipment installation do not take part in adjusting circuit breaker settings in order to correlate with a protective device study or perform current injection tests as required by this section. These types of tests are usually conducted by a third party firm or the electrical equipment manufacturer in accordance with the coordination study based on the design of the system.

Distribution systems over 1000 volts must be tested before being energized.

The changes to this section provide clarifications that make it more general in nature and easier to apply. The revisions make it clear that the complete electrical system design, including settings for protective, switching, and control circuits, must be prepared in advance and made available on request to the authority having jurisdiction, and shall be performance tested when first installed on-site. Requiring the complete electrical system design to be prepared in advance and made available upon request from the authority having jurisdiction provides an opportunity for the AHJ to review the design and request corrections or revisions if so desired.

Question 35: Which of the following items are required to undergo pre-energization tests after the initial installation is complete?

A: A 4160-volt, 2000-amp electrical switchboard that contains switching and control circuits.
B: An 800-amp, 480-volt switchboard that has a maximum voltage rating of 1000 volts.
C: A direct current photovoltaic system that has a maximum rating of 1000 volts.
D: A 277/480-volt, 225-amp panelboard that has circuit breakers controlling normal area illumination in a hospital.

Question 36: 230.28 Service Masts as Supports.

Question ID#: 664.0

This section has been reorganized and two new requirements have been added. (1) Hubs that are used with service masts must be identified for use with service-entrance equipment. (2) Overhead service conductors cannot be attached to the service mast between the weatherhead and a coupling in the conduit that is above the last point of support to the building.

Hubs intended for use with a conduit that serves as a service mast shall be identified for use with service-entrance equipment.

In the 2011 NEC, section 230.28 required all raceway fittings used for a service mast to be identified for use with service masts. This language has been removed since rigid metal conduit and associated fittings are commonly used as service masts and provide adequate support but are not identified for use with service masts. Now, only hubs that are intended for use with a service mast are required to be identified for use with service-entrance equipment.

230.28(B) is new and provides rules for the proper attachment of overhead service conductors. The new subsection requires that service-drop or overhead service conductors shall not be attached to a service mast between a weatherhead and a coupling in the service mast, where the coupling is located above the last point of support to the building, or is located above the building. Having a coupling between the raceway's last point of support on the building and the actual weatherhead places unneeded strain on the coupling. A far better installation would be a solid section of rigid metal conduit without joints or couplings, or if a coupling was absolutely necessary, locating the coupling below the last point of support to the building for the raceway mast.

There is an identical requirement for using outside branch circuits and feeder masts as supports in 225.17.

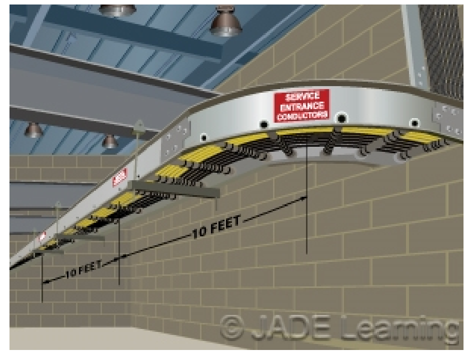
Question 36: Which of the following statements about a rigid metal conduit service mast is true?

A: All raceway fittings shall be identified for use as service masts.
B: A hub used at the service enclosure must be identified for use with service-entrance equipment.
C: Couplings in the service mast are not permitted.
D: The service mast must be supported by braces or guys.

Question 37: 230.44 Cable Trays.

Question ID#: 666.0

A new labeling requirement has been added for cable trays that contain service-entrance conductors. Permanent labels must be installed on cable trays that contain service-entrance conductors that say, "Service-Entrance Conductors." The labels must be spaced no more than 10 ft. apart. The requirement that the labels be installed not more than 10 ft. apart is new to the 2014 NEC.



The "Service-Entrance Conductors" labels must be visible; maximum spacing between labels is 10 ft.

The reason for the new requirement is that electrical system cable trays may be close to other mechanical or piping tray systems. Non-electrically qualified maintenance personnel may not be able to identify the cables in the cable tray as service-entrance cables and could mistake them for non-electrical components. Such a mistake could be fatal.

Even though cable trays containing service-entrance cables can be hundreds of feet long, they must be labeled at intervals not exceeding 10 ft. to identify them as cable trays containing service-entrance conductors. The requirement applies to both commercial and industrial locations. There is no exception that would override this requirement for the labeling of cable tray that contain service-entrance conductors. For some electrical installation requirements in the NEC, there are exceptions for industrial locations with qualified engineering and maintenance support. There is no such exception for this rule.

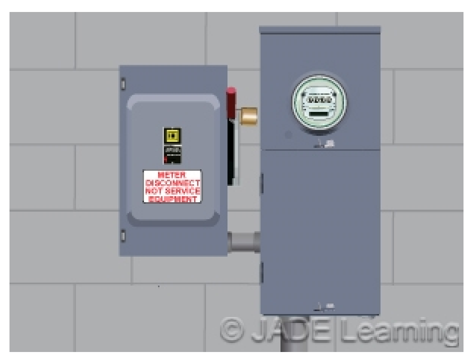
Question 37: What is required when a cable tray is used to support 350 kcmil copper service-entrance conductors?

A: The service-entrance conductors must be labeled at ten foot intervals with the words "service-entrance conductors".
B: The cable tray must be labeled with the words "service- entrance conductors;" the maximum spacing between these labels is 10 feet.
C: The cable tray must have a CT rating.
D: The cable tray must have a barrier to separate service-entrance conductors from each other.

Question 38: 230.82 Equipment Connected to the Supply Side of Service Disconnect.

Question ID#: 667.0

The voltage threshold for meters, meter sockets, and meter disconnect switches in 230.82 has been raised to 1000 volts and a new labeling requirement has been added for meter disconnecting switches.



A meter disconnect switch must be marked: Meter Disconnect Not Service Equipment.

Section 230.82 specifies what types of equipment are permitted to be connected on the supply side of the service disconnect. In the 2011 NEC, meters, meter sockets, and meter disconnect switches connected on the supply side of the service were to be rated not more than 600 volts. Now the meters, meter sockets, and meter disconnect switches can be rated up to 1000 volts.

A new labeling requirement has been added to section 230.82(3) which requires a meter disconnect to be legibly field marked on its exterior in a manner suitable for the environment as follows:

METER DISCONNECT
NOT SERVICE EQUIPMENT

Meter disconnect switches are usually installed in order to disconnect the load prior to pulling the meter from the meter socket during servicing or meter replacement. These types of switches are more common in 3-phase, 4-wire, 277/480 volt systems where a greater arc potential exists. The intent of the new labeling requirement is to make sure that these types of switches are not confused with any required service disconnecting switches and also to make sure that they are not labeled as a service disconnecting means by mistake.

An agreement between installers and inspectors about where exactly the service disconnecting means is located is very important. With meter disconnects located on the supply side of the service clearly labeled, there is less chance that the meter disconnect will be mistaken for the service disconnect.

Question 38:   Which of the following meter disconnect installations would be acceptable to the Authority Having Jurisdiction?

A: A meter disconnect located on the load side of the service disconnecting means.
B: A meter disconnect located on the supply side of the service disconnect and labeled "meter disconnect".
C: A meter disconnect with no labeling located on the supply side of the service disconnect and rated 2,500 V.
D: A meter disconnect located on the supply side of the service disconnect, labeled as a "METER DISCONNECT NOT SERVICE EQUIPMENT", and rated 1000 volts.

Question 39:   240.87 Arc Energy Reduction.

Question ID#: 669.0

There are two new methods to reduce the clearing time of an adjustable trip circuit breaker.

The new title, Arc Energy Reduction, better describes a section where the intent is to limit the power of an arc blast on systems with adjustable trip circuit breakers. The trip setting of adjustable trip circuit breakers can be increased as part of a coordinated system of overcurrent protection. The problem is that if there is a fault on the system, the higher trip levels will allow the fault current to be greater and an arc blast to be more dangerous.

The five methods listed to reduce the clearing time of an adjustable trip circuit breaker now only apply to circuit breakers where the trip setting is 1200 amps or higher. Two of the methods used to reduce the clearing time are new: An energy-reducing active arc flash mitigation system or an approved equivalent means.

The purpose of all five methods to reduce the clearing time is to protect personnel who are working on or testing the energized equipment by reducing the possibilities of or the intensity of an arc blast.

Documentation must be made available to those authorized to design, install, operate, or inspect the installation as to the location of the circuit breaker(s). Being made aware of all circuit breaker locations that are part of the selectively coordinated system is the first step in the process of setting breakers properly to reduce incident energy levels.

Informational Note 2 is new to the 2014 Code and informs the user that an energy-reducing active arc flash mitigation system helps in reducing the arcing duration in the electrical distribution system. It also says no change in the circuit breaker or the settings of other devices is required during maintenance when a worker is working within an arc flash boundary as defined in ***NFPA 70E***-2012, ***Standard for Electrical Safety in the Workplace.***

Question 39:   Which of the following installations will require that documentation about the location of the circuit breaker be made available to those authorized to inspect the installation?

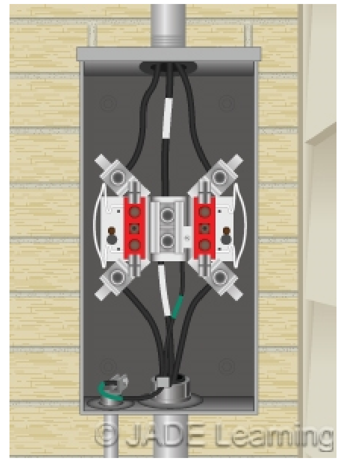
A: An adjustable circuit breaker with a 1200 amp trip unit.
B: An adjustible trip circuit breaker rated at 800 amps.
C: An adjustable circuit breaker with a 1000 amp trip unit.

D: An instantaneous trip circuit breaker rated at 1000 amps.

Question 40: 250.24(A)(1) Grounding Service-Supplied Alternating-Current Systems. System Grounding Connections. General.

Question ID#: 670.0

The terms "overhead service conductor" and "underground service conductor" have been added to Section 250.24(A)(1) in order to include the definitions of these items that were new in the 2011 Code cycle.



A premises wiring system supplied by a grounded AC service needs a grounding electrode conductor connected to the grounded service conductor at each service.

Section 250.24(A)(1) states that the grounding electrode conductor connection shall be made at any accessible point from the load end of the overhead service conductors, service drop, underground service conductors, or service lateral to, and including the terminal or bus to which the grounded service conductor is connected at the service disconnecting means.

According to 250.24(A), every premises supplied by a grounded AC service is required to have a grounding electrode conductor connected to the grounded service conductor at each service location. In a typical overhead electrical service installation, there are 3 locations that are acceptable for proper termination of a grounding electrode conductor.

- One is at the load end of the overhead service drop. This method is not commonly used because it not very practical and requires twice the amount of grounding electrode conductor to reach the grounded conductor at the overhead service drop.
- The second method can be used whether the service is fed overhead or underground and is to terminate the grounding electrode conductor to the main service disconnect enclosure at the same point where the grounded conductor terminates
- The third method can be used whether the service is fed overhead or underground and is to terminate the grounding electrode conductor to a terminal inside a separate meter enclosure ahead of the service disconnect if the enclosure is considered accessible.

Some utility companies lock out the meter enclosure at each service rendering it inaccessible in order to avoid power theft. It is always a good idea to check with the local Authority Having Jurisdiction to see if they consider the meter enclosure as an accessible place for terminating the grounding electrode conductor.

Question 40: Which of the following is an acceptable location for proper termination of a grounding electrode conductor?

A: To the grounded conductor inside a subpanel located downstream of the main service disconnect.
B: To an isolated grounding terminal inside the service disconnect enclosure that has no connection to the grounded conductor.
C: To an equipment grounding terminal bar within the enclosure of a subpanel downstream of the main service disconnect.
D: To the grounded conductor at the overhead service drop.

Question 41: 250.64(B) Grounding Electrode Conductor Installation. Securing and Protection Against Physical Damage.

Question ID#: 672.0

When a supplemental ground rod is installed at a service because a single ground rod cannot provide 25 ohms or less resistance, the connection between the two ground rods is called a grounding electrode bonding jumper. The grounding electrode bonding jumper is connected to both ground rods and buried below grade.

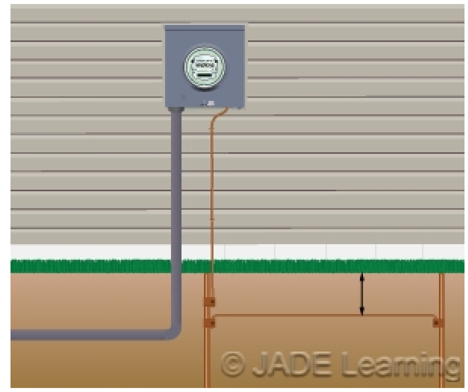


Table 300.5 does not apply to buried grounding electrode bonding jumpers.

The revision to section 250.64(B) states that the burial depth of the grounding electrode bonding jumper, or the grounding electrode conductor, does not have to meet the burial depth requirements of 300.5.

Section 300.5 provides burial depth and protection requirements for underground conductors rated 0 to 1000 volts. Prior to this Code change, it was unclear if the minimum burial depth requirements in section 300.5 also applied to grounding electrode conductors and grounding electrode bonding jumpers. Some inspectors may have previously required that the GEC or grounding electrode bonding jumper installed between two ground rods, for example, meet the minimum burial depth requirements as specified in table 300.5. This new Code change should help to eliminate the confusion.

According to Table 300.5, direct buried conductors on residential property are required to be buried 18 inches deep. In order to protect the grounding electrode conductor or grounding electrode bonding jumper from physical damage, it will not be necessary to bury the conductor this deep.

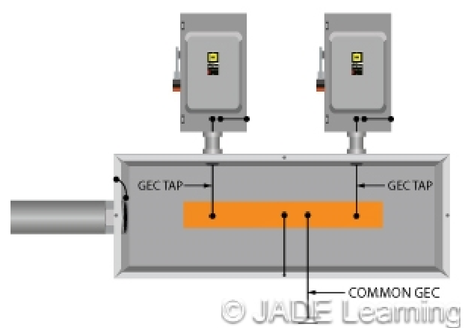
Question 41: What is the minimum burial depth required for a No. 4 AWG copper grounding electrode bonding jumper that connects two ground rods spaced 6 feet apart and not subject to physical damage?

A: 6 inches.
B: 18 inches if enclosed in PVC conduit.
C: There is no minimum burial depth requirement.
D: 12 inches.

Question 42: 250.64(D) Grounding Electrode Conductor Installation. Building or Structure with Multiple Disconnecting Means in Separate Enclosures.

Question ID#: 673.0

A number of changes have been made to section 250.64(D).



The minimum dimensions of a busbar used as a common GEC are 1/4 in. thick, 2 in. wide. It must be able to accommodate the terminations needed.

The title to the section has been changed from, "Service with Multiple Disconnecting Means Enclosures," to "Building or Structure with Multiple Disconnecting Means in Separate Enclosures." By eliminating the word "service" from the heading and adding the word "feeder" to the supporting text, the new Code language makes it clear that this section, which specifies how the grounding electrode connections must be made, not only applies to buildings supplied by a service, but also applies to buildings supplied by a feeder with multiple disconnecting means.

In 250.64(D)(1) "Common Grounding Electrode Conductor and Taps" when covering the dimensions of a copper or aluminum busbar used for a common grounding electrode, the required minimum dimensions of the busbar are listed as 1/4 in. thick x 2 in. wide. A new requirement has been added that the busbar used as the common grounding electrode conductor be long enough to accommodate the number of terminations necessary for the installation.

When making connections from individual grounding electrode conductors, the connection can be made at:

(1) The grounded conductor in each service equipment disconnecting means enclosure.
(2) The equipment grounding conductor installed with the feeder.
(3) The supply-side bonding jumper.

The size of the individual grounding electrode conductor is selected from Table 250.66 based on the size of the ungrounded conductor supplying the individual disconnecting means.

Question 42: A service location at a building consists of 3 individual service enclosures connected to a common wireway which contains service-entrance conductors. If a grounding electrode conductor tap is used for one of the individual service enclosures, how is the tap required to be sized?

A: Using Table 250.66 based on the circular mil area of the service-entrance conductors in the wireway that supply all 3 service enclosures.
B: Using Table 250.66 based on the largest service-entrance conductor serving the individual enclosure.
C: Using Table 250.66 based on the largest service-entrance conductor serving all three enclosures.
D: Using Table 250.122 based on the largest service-entrance conductor serving the individual enclosure.

Question 43: 250.66 (A)&(B) Connections to a Rod, Pipe, or Plate and Concrete-Encased Electrode(s).

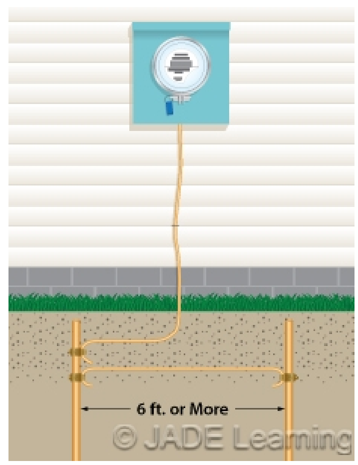
Question ID#: 675.0

Section 250.66(A) and 250.66(B) have been changed to make it clearer that the size of the grounding electrode conductor to more than one driven ground rod doesn't have to be larger than No. 6 AWG copper. The grounding electrode conductor to one or more concrete-encased electrodes doesn't have to be larger than No. 4 AWG copper.

For example, if two ground rods are installed to meet the requirements of 250.53(A)(2), then the grounding electrode conductor from the ground rod to the grounded conductor in the service equipment, and the bonding jumper between the two ground rods is not required to be larger than No. 6 AWG.

Before the rewrite of this section, some inspectors were interpreting 250.66(A) to mean that if a 400 ampere service is used with 500 kcmil copper conductors, the grounding electrode conductor to the first ground rod, pipe or plate is sized from Table 250.66, size 1/0 copper.

The changes to 250.66(A) and (B) should clear up any confusion about the fact that if there is a single ground rod, two ground rods, or more than two ground rods, the grounding electrode conductor never is required to be larger than No. 6 AWG.



Grounding electrode conductors connected to single or multiple rod, pipe, or plate electrodes are not required to be larger than No. 6 AWG copper.

Question 43: If two ground rods are installed for a 400 amp service, what is the maximum required size for a copper grounding electrode conductor connected to a rod, pipe, or plate electrode?

A: No. 8 AWG.
B: No. 6 AWG.
C: No. 4 AWG.
D: 1/0 AWG.

Question 44: 250.68(C) Grounding Electrode Connections.

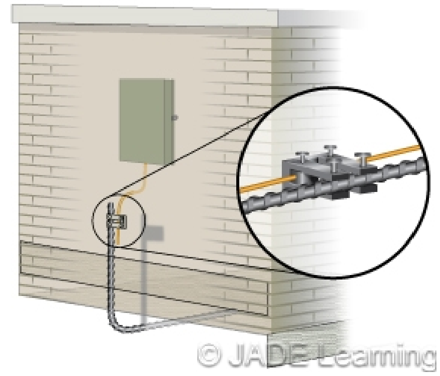
Question ID#: 676.0

A concrete-encased electrode that has been extended from inside the concrete foundation to an accessible location is still considered an "extension" of the Grounding Electrode. This is similar to the understanding that the first 5 ft. of metal water piping inside a building is an extension of the water pipe as a Grounding Electrode.

If the rebar has been turned up outside the foundation, it is still part of the concrete-encased Grounding Electrode and can be used as a place to connect a Grounding Electrode Conductor or Bonding Jumpers.

Also, the metal structural frame of a building is permitted to be used as a conductor to interconnect electrodes that are part of the grounding electrode system. This is true even if the metal frame of the building is not considered a Grounding Electrode by having a structural member in contact with the ground for 10 ft. or more.

In order for the metal building frame to be considered a Grounding Electrode, per 250.52(A)(2), at least one structural metal member must be in contact with the earth for 10 ft. or more, or the hold-down bolts of a steel column in the building must be connected to rebar in the foundation. But even if the metal frame of the building does not qualify as a Grounding Electrode, it still can be used as a Grounding Electrode Conductor, to connect other grounding electrodes together.



A concrete-encased electrode that has been extended from inside the concrete foundation to an accessible location is an extension of the grounding electrode.

Question 44: Which of the following statements about a concrete-encased electrode is true?

A: In order to be considered a grounding electrode, it must be inside the foundation for its entire length.
B: A concrete-encased electrode cannot be turned up outside the foundation.
C: A grounding electrode conductor can be connected to a concrete-encased electrode at a point outside of the foundation.
D: Bonding jumpers to other grounding electrodes cannot be connected to a concrete-encased electrode.

Question 45: Table 250.102(C)(1) Grounded Conductor, Main Bonding Jumper, System Bonding Jumper, and Supply Side Bonding Jumper for Alternating-Current Systems.

Question ID#: 677.0

A new Table has been added to Article 250 which will be used to select the size of the grounded conductor, the main bonding jumper, the system bonding jumper, and the supply side bonding jumper. In earlier editions of the NEC, Table 250.66 was used to select these conductors. All of these grounding and bonding conductors are located at the service or at a separately derived system, ahead of any overcurrent devices.

The new table should make Article 250 easier to apply, because the title to Table 250.66 is "Grounding Electrode Conductor for Alternating-Current Systems". None of the conductors in the new table are Grounding Electrode Conductors, but Table 250.66 was still used to select the correct size conductor. This was confusing to many users.

The grounded conductor, main bonding jumper, system bonding jumper, and supply side bonding jumper are based on the size of the largest ungrounded conductor or equivalent area for parallel conductors. When the ungrounded conductors are over 1100 kcmil copper or 1750 kcmil aluminum, the grounded conductor and the bonding conductors are selected based on 12.5% of the area of the largest ungrounded supply conductor or equivalent area for parallel supply conductors. An informational note says Table 8 in Chapter 9 can be used to find the circular mill area of conductors.

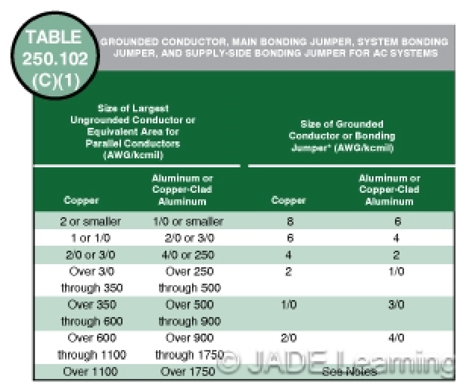


TABLE 250.102 (C)(1)
GROUNDED CONDUCTOR, MAIN BONDING JUMPER, SYSTEM BONDING JUMPER, AND SUPPLY-SIDE BONDING JUMPER FOR AC SYSTEMS

Size of Largest Ungrounded Conductor or Equivalent Area for Parallel Conductors (AWG/kcmil)		Size of Grounded Conductor or Bonding Jumper* (AWG/kcmil)	
Copper	Aluminum or Copper-Clad Aluminum	Copper	Aluminum or Copper-Clad Aluminum
2 or smaller	1/0 or smaller	8	6
1 or 1/0	2/0 or 3/0	6	4
2/0 or 3/0	4/0 or 250	4	2
Over 3/0 through 350	Over 250 through 500	2	1/0
Over 350 through 600	Over 500 through 900	1/0	3/0
Over 600 through 1100	Over 900 through 1750	2/0	4/0
Over 1100	Over 1750	See Notes	

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Table 250.102(C)(1) is new and will be used to size grounded conductors, main bonding jumpers, system bonding jumpers, and supply-side bonding jumpers.

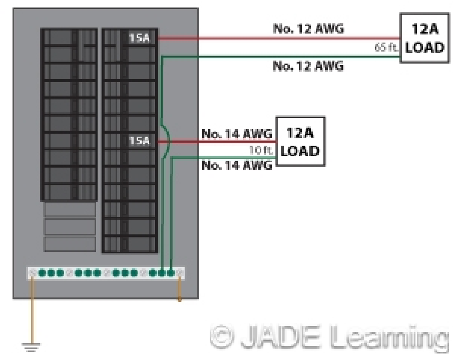
Question 45: What is the minimum size, (copper) main bonding-jumper that is required when the ungrounded conductor size is 500 kcmil copper?

A: 2/0 cu.
B: 1/0 cu.
C: No. 2 cu.
D: No. 4 cu.

Question 46: 250.122(B) Size of Equipment Grounding Conductors. Increased in Size.

Question ID#: 679.0

Equipment grounding conductors are selected from Table 250.122 based on the size of the overcurrent device protecting the circuit. If the ungrounded conductors of the circuit are increased to allow for voltage drop, or because of manufacturer's instructions, the equipment grounding conductor must be increased in size by the same proportion that the ungrounded conductors have been increased. For example, if the size of the ungrounded conductors is increased by 25%, the size of the equipment grounding conductor must be increased by 25%.



Wire-type grounding conductors only need to be increased in size when ungrounded conductors are increased in size from the minimum size that has sufficient ampacity.

The language in the 2011 NEC was not clear about why the ungrounded conductors would be increased in size. Ungrounded conductors are often increased in size because when more than 3 current-carrying conductors are in conduit, or used in a hot ambient temperature, the conductor cannot perform at the same ampacity. The intent of this section was not to require an increase in the size of the equipment grounding conductor under these conditions of use for the ungrounded conductors.

The 2014 NEC clears this up by saying the equipment grounding conductor needs to be increased in size only if the ungrounded conductors are increased in size beyond what is needed for the "sufficient ampacity for the intended installation." ***In other words***, if the ungrounded conductors are increased in size because there are more than 3 current-carrying conductors in conduit, or the ambient temperature is above 86Â°F, the equipment grounding conductor is not required to be increased in size.

In the 2011 NEC there was also confusion about what to do if the equipment grounding conductor was a metallic raceway. Was it necessary to increase the size of the raceway if the ungrounded conductors were increased in size? This was never intended, and the 2014 refers to "wire-type" equipment grounding conductors as the only type of equipment grounding conductor that needs to be increased in size.

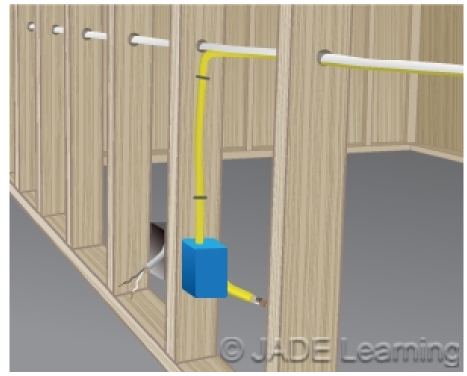
Question 46: If the copper ungrounded conductors for a circuit are increased in size by 25% because there are 4 current-carrying conductors in conduit, which of the following statements about the equipment grounding conductor is true?

A: The equipment grounding conductor is required to be increased in size by 25%.
B: The equipment grounding conductor does not need to be increased in size.
C: The equipment grounding conductor is required to be the same size as the ungrounded conductors in the circuit.
D: The size of the equipment grounding conductor must be increased to match the size of the grounding electrode conductor.

Question 47: 250.130(C) Nongrounding Receptacle Replacement or Branch Circuit Extensions.

Question ID#: 680.0

When a nongrounding type receptacle needs to be replaced, the most common way to do it is to install a GFCI receptacle outlet, as is permitted in 406.4(D). Section 250.130(C) allows a grounding-type receptacle to be used as a replacement, instead of a GFCI protected outlet, if the equipment grounding terminal of the receptacle is connected to an acceptable grounding means.



An equipment grounding conductor that is part of another branch circuit that originates in the same panelboard as the branch circuit for the receptacle can be used to provide a grounding means for the replacement receptacle.

In the 2011 NEC, the grounding terminal of a replacement receptacle used in a two wire system could be connected to the grounding electrode system, the grounding electrode conductor, or the equipment grounding terminal bar in the same enclosure where the branch circuit for the receptacle originates.

A new option for connecting the grounding terminal of a replacement receptacle has been added in 2014. Now an equipment grounding conductor that is part of another branch circuit that originates in the same panelboard as the branch circuit for the receptacle can be used to provide a grounding means for the replacement receptacle.

The new option is similar to the permission to connect the replacement receptacle grounding screw to the equipment grounding terminal bar in the enclosure where the branch circuit for the receptacle originates. However, it could be much easier to connect to an equipment grounding conductor from another branch circuit than to install a new equipment grounding conductor all the way back to the panelboard.

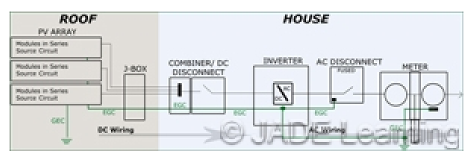
Question 47: Which of the following is NOT an acceptable method to properly ground a grounding-type receptacle installed to replace a non-grounding receptacle in an existing branch-circuit which does not include an equipment grounding conductor?

A: By connecting an equipment grounding conductor to any accessible point on the grounding electrode system.
B: By connecting an equipment grounding conductor to the closest metallic water piping which may be insulated from the grounding electrode system.
C: By connecting the grounding terminal of the receptacle to an equipment grounding conductor of a different circuit when both circuits originate from the same panelboard enclosure.
D: By connecting an equipment grounding conductor from the receptacle grounding screw to the grounding terminal bar where the branch circuit originates.

Question 48: 250.166 Size of the Direct-Current Grounding Electrode Conductor.

Question ID#: 681.0

The method to properly size a grounding electrode conductor for DC systems is different than the method used for AC systems. When sizing the grounding electrode conductor for DC systems, the provisions of 250.166 must be used.



DC system grounding electrode conductors are not required to be larger than 3/0 copper or 250 kcmil aluminum.

As written in the 2011 NEC, section 250.166 set no maximum size limitations for the grounding electrode conductor with the exceptions of:

- When connected to the rod, pipe, or plate electrodes ***listed in 250.52(A)(5) and (7)***, the grounding electrode conductor was not required to be larger than No. 6 AWG copper or No. 4 aluminum.
- When connected to a concrete-encased electrode, the maximum size was not required to be greater than No. 4 AWG copper.
- When connected to a ground ring, the grounding electrode conductor that was the sole connection to the grounding electrode was not required to be larger than the conductor used for the ground ring.

In the 2011 NEC, section 250.166(B) stated that, for other than the above, the grounding electrode conductor could not be smaller than the largest conductor supplied by the system. As written, if three 500 kcmil parallel conductors were supplying a large DC system, the grounding electrode conductor would be required to be 1500 kcmil at minimum. ***This was determined to be more restrictive than necessary. So, in the 2014 NEC, the revision now reads that the grounding electrode conductor shall meet the sizing requirements in the section but shall not be required to be larger than 3/0 copper or 250 kcmil aluminum.***

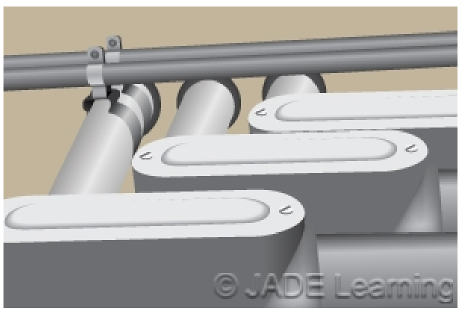
Question 48: What is the required size for a copper grounding electrode conductor connected to building steel in a DC system with two, 250 kcmil ungrounded conductors connected in parallel per phase?

A: No. 3/0 cu.
B: 350 kcmil cu.
C: 400 kcmil cu.
D: 500 kcmil cu.

Chapter 3

Question 49: 300.11(B)(1) Securing and Supporting. Raceways Used as Means of Support.

Question ID#: 685.0



Raceways that are used as a means of support must be identified as such.

Raceways that are used as a means of support for other raceways, cables, or nonelectrical equipment must be identified as a means of support. In the 2011 NEC, raceways could be used as a means of support if they were "identified for the purpose."

The Code writers thought the phrase "identified for the purpose" is too vague and it was better to say that if the raceway was going to be used as a means of support, it should be identified as a means of support.

In Article 100, "identified" is defined as meaning:

Recognizable as suitable for the specific purpose, function, use, environment, application, and so forth, where described in a particular Code requirement.

An informational note after the definition of ***identified*** in Article 100 says that the way to determine the suitability of equipment for a specific purpose, environment, or application is to have it listed and labeled by a qualified 3rd party testing laboratory, an inspection agency, or other organization that does product evaluation. In other words, just because the manufacturer says a raceway can be used as a means of support for another raceway does not mean that the Authority Having Jurisdiction will take their word for it.

The 3 conditions where a raceway can be used as a means of support for other raceways, cables, or nonelectrical equipment are:

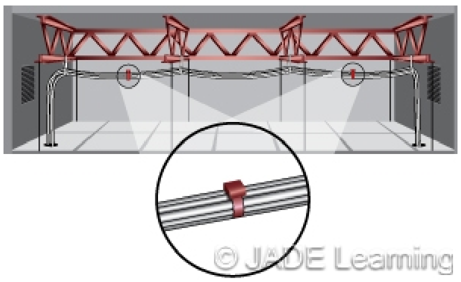
- Where the raceway or means of support is identified ***as a means of support.***
- Where the raceway contains power supply conductors for electrically controlled equipment and is used to support Class 2 circuit conductors or cables that are solely for the purpose of connection to the equipment control circuits.
- Where the raceway is used to support boxes or conduit bodies in accordance with 314.23 or to support luminaires in accordance with 410.36(E).

Question 49: Which of the following is required for raceways to support luminaires?

A: The installation instructions indicate that the luminaire is permitted to be supported by a raceway.
B: The manufacturer says that the raceway is permitted to be used to support a luminaire.
C: The raceway is installed correctly with fittings that can support a luminaire installed in accordance with 410.36(E).
D: The raceway is installed correctly.

Question 50: 300.22(C)(1) Other Spaces Used for Environmental Air (Plenums). Wiring Methods.

Question ID#: 686.0



The space above a dropped ceiling is "other space used for environmental air."

Section 300.22(C)(1), which provides the requirements for wiring methods installed within a plenum, has been slightly modified for clarity, and new provisions have been added about nonmetallic cable ties that are installed to secure cables within a plenum.

A plenum is considered to be an area that has not specifically been fabricated for air handling purposes, such as a duct, but does in fact handle or convey environmental air. The most common type of plenum is the area above a suspended grid-type ceiling when designed so that return air is pulled through the above-ceiling space and recirculated into the supply air system. ***Metallic raceways or wiring methods are required to be used if installed within a plenum*** in order to reduce the possibility that the melting of a nonmetallic wiring method could release smoke or flames into the environmental air system.

Mineral insulated cable (type MI) was previously allowed to be used within a plenum, but now MI cable used within a plenum must have a metal jacket. The code says that the MI cable shall be of the type ***without an overall nonmetallic covering***. In addition, new requirements to this section now specify that if nonmetallic cable ties and other nonmetallic cable accessories are used to secure and support cables within a plenum, they shall be listed as having low smoke and heat release properties.

The new informational note after this section refers to ANSI/UL 2043-2008, ***Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces*** which is a publication commonly used to determine flame spread and smoke density levels of products used in air-handling spaces.

Question 50: Which of the following wiring methods is permitted to be installed in a plenum?

A: Nonmetallic sheathed cable.
B: Flat conductor cable (type FCC).
C: Integrated gas spacer cable (type IGS).
D: Mineral insulated cable (type MI) with a metal jacket.

Answer Sheet **Darken the correct answer. Sample: A ● C D**

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