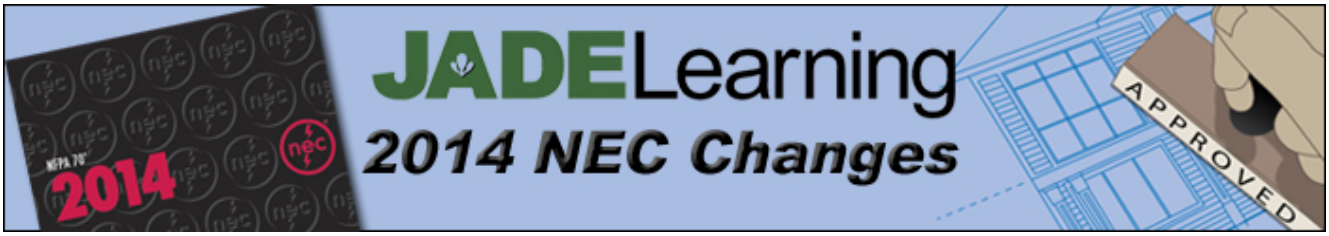


2014 NEC Changes (Homestudy)

Arkansas Electrical License

This course will review 100 of the most important National Electrical Code changes from the 2014 NEC. Changes in Articles 100 - Chapter 9 will be covered.

8 Code Update Credit Hours $90.00

This course is currently accepted by the Arkansas Board of Electrical Examiners.

Completion of this continuing education course will satisfy 8.000 credit hours of course credit type 'Code Update' for Electrical license renewal in the state of Arkansas. Course credit type 'Code Update'. Board issued approval date: 6/6/2014. Board issued expiration date: 12/31/2017.

JADELearning

2014 NEC Changes (Homestudy) - AR

Chapter 1

Question 1: 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:

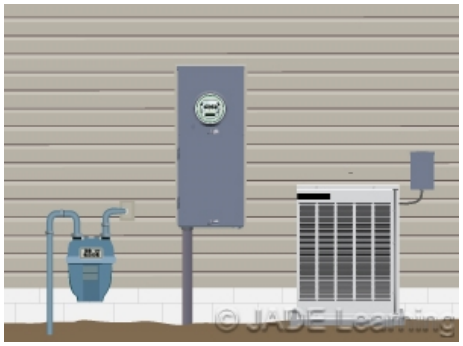
- Article 240, Overcurrent Protection. Part IX Overcurrent Protection over 1000 Volts, Nominal.
- Article 250, Grounding and Bonding. Part X Grounding of Systems and Circuits of over 1000 Volts.
- Article 300, General Requirements for Wiring Methods and Materials. Part II, Requirements for over 1000 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 1: Which of the following is an actual quote from the 2014 NEC?

A: 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.
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: 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.
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 2: 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.***

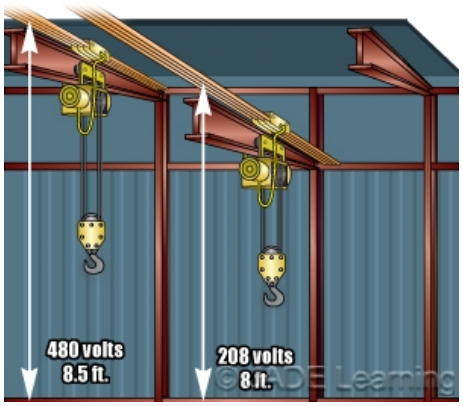
Designers and architects often want all the equipment in the same location. Gas piping, water piping, mechanical refrigeration lines, phone equipment, cable and satellite equipment and many other types of equipment are often found alongside the electrical service. All this equipment can interfere with 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 2: 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 6 feet above the equipment.
B: The width and depth of the equipment and extending from grade to a height of 3 feet above the equipment.
C: The width and depth of the equipment and extending from grade to a height of 8 feet above the equipment.
D: The width and depth of the equipment and extending from grade to a height of 4 feet above the equipment.

Question 3: 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 3: 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 switchÂ 8.5 feetÂ above the work surface.
C: Locating the switch 5 feet above the floor in a room accessible to unqualified persons.
D: Locating the switch in a location that is accessible to all occupants of the building.

Question 4: 110.25 Lockable Disconnecting Means.

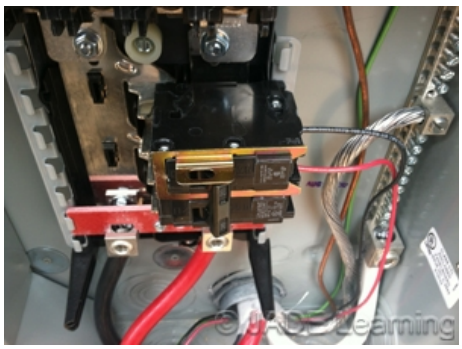
Question ID#: 630.0

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.***



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

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.

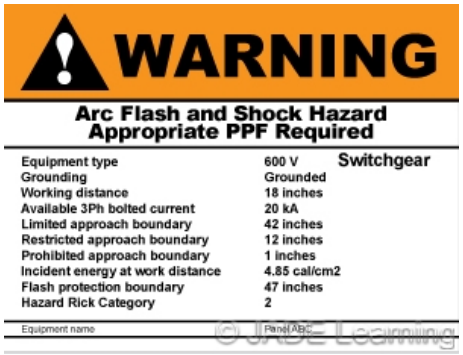
An exception permits clamshell type lockout type devices to be used with cord ends so as to prevent the cord from being plugged in, even though the clamshell does not remain on the cord when the lock is removed.

Question 4: Which of the following is a lockable disconnecting means?

A: 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.
B: Circuit breakers installed in a panelboard that has a lockable door.
C: 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.
D: A disconnect switch that is only capable of being locked in the closed position.

Question 5: 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 5: 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 clearly visible to qualified persons before examination or servicing the equipment.
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 at least 6 inches wide and 6 inches tall.
D: The marking must be applied in the field.

Question 6: 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 6: 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 600 amp switchboard where the door is located 5 feet from the equipment's required work space.
C: An electrical room enclosing a 1000 amp switchboard where the door is located 35 feet from the equipment's required work space.
D: An electrical room enclosing a 1000 amp switchboard where the door is located 22 feet from the equipment's required work space.

Question 7: 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:

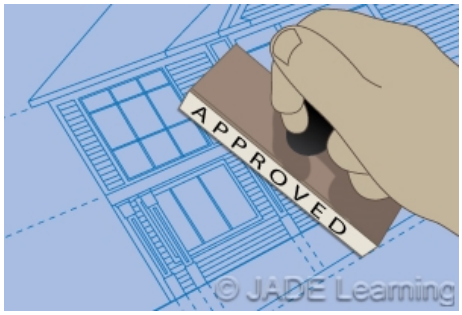
The available fault-current markings(s) addressed in 110.24 is related to required short-circuit current ratings of equipment. NFPA 70E-2012, Standard for Electrical Safety in the Workplace, provides assistance in determining the severity of potential exposure, planning safe work practices, and selecting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

Question 7: Which of the following statements about marking the available fault current is true?

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

Question 8: 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:

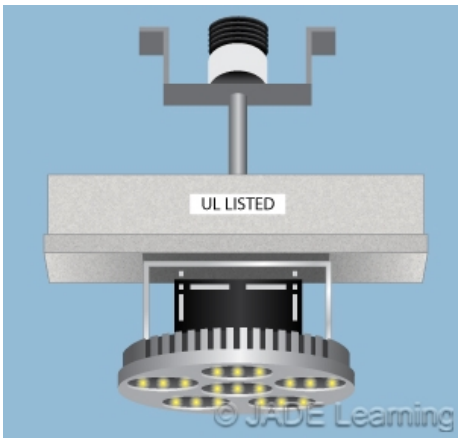
2011 NEC, 312.5(A): ***Openings through which conductors enter shall be adequately closed.***
2014 NEC: ***Openings through which conductors enter shall be closed in an approved manner***.
2011 NEC, 314.71: ***Pull and junction boxes shall provide adequate space and dimensions for the installation of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

Question 8: Which of the following statements is from the 2014 NEC?

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

Question 9: 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 9: Why should retrofit kits, as defined in Article 100, be listed?

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

Question 10: 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 10: Which of the following is an example of a sign that is permitted to include variable handwritten information?

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

Chapter 2

Question 11: 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 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.

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

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 11: 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: 3 receptacle outlets.
B: 4 receptacle outlets.
C: 1 receptacle outlet.
D: 2 receptacle outlets.

Question 12: 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 12: 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 13: 210.8(A)(7) Ground-Fault Circuit-Interrupter Protection for Personnel. Dwelling Units.

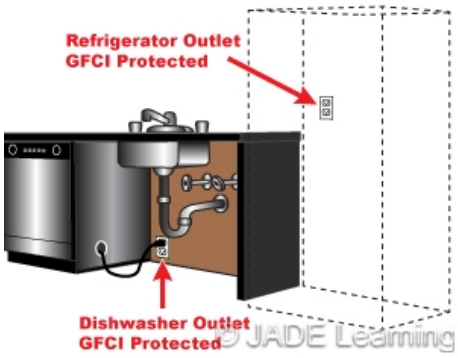
Question ID#: 637.0

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.

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.



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

Question 13: Which of the following dwelling unit receptacles is required to have GFCI protection?

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

Question 14: 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	

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 14: 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 15: 250.64(D) Grounding Electrode Conductor Installation. Building or Structure with Multiple Disconnecting Means in Separate Enclosures.

Question ID#: 673.0

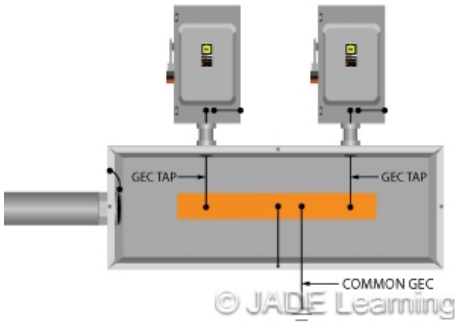
A number of changes have been made to section 250.64(D).

The 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



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.

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

Question 16: 215.12(C)(2) Identification for Feeders. Identification of Ungrounded Conductors. Feeders Supplied from Direct-Current Systems.

Question ID#: 657.0

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.

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

Question 16: 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 not be larger than No. 4 AWG.
B: It must be No. 4 AWG or larger.
C: It cannot be re-identified with red tape.
D: It must be larger than No. 4 AWG.

Question 17: 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 receptacles in the laundry area must be readily accessible.

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

Question 17: 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: Laundry areas.
B: Family rooms.
C: Bathrooms.
D: Outdoors.

Question 18: 250.130(C) Nongrounding Receptacle Replacement or Branch Circuit Extensions.

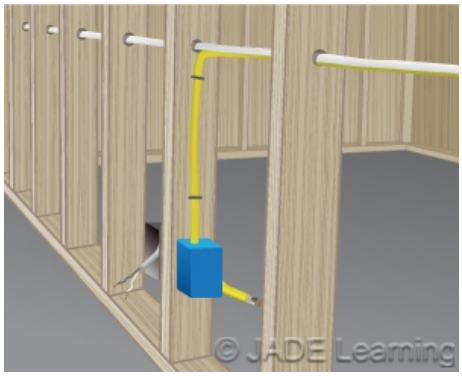
Question ID#: 680.0

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.

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.



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.

Question 18: 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 the closest metallic water piping which may be insulated from the grounding electrode system.
B: 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.
C: By connecting an equipment grounding conductor to any accessible point on the grounding electrode system.
D: By connecting an equipment grounding conductor from the receptacle grounding screw to the grounding terminal bar where the branch circuit originates.

Question 19: 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

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

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.

Question 19: Which of the following statements about rooftop receptacles on non-dwelling rooftops is true?

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

Question 20: 240.87 Arc Energy Reduction.

Question ID#: 669.0

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.

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

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 20: 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 instantaneous trip circuit breaker rated at 1000 amps.
C: An adjustable circuit breaker with a 1000 amp trip unit.
D: An adjustible trip circuit breaker rated at 800 amps.

Question 21: 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 21: When can the exception to Section 220.12 be used?

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

Question 22: 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.

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:

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

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.

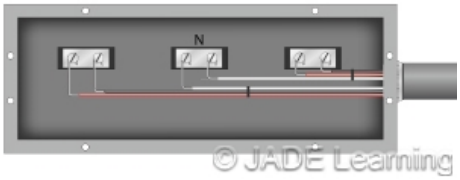
Question 22: Which of the following types of identification for ungrounded DC circuit conductors operating at more than 50 VDC is a Code Violation?

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

Question 23: 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.

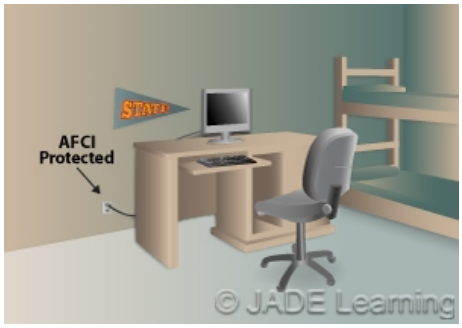
Question 23: When must neutral conductors associated with ungrounded conductors be grouped or marked within a junction box?

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

Question 24: 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.



AFCI protection is now required 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.

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

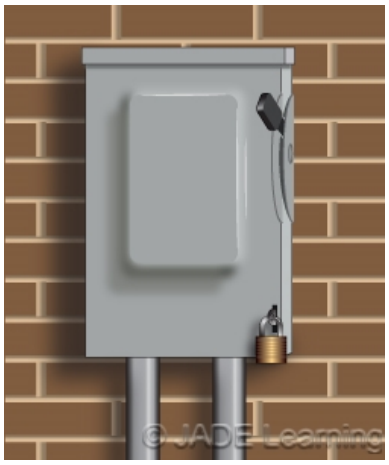
A: A common kitchen shared by residents that is not part of a specific dorm room.
B: A sleeping room in an individual dormitory unit.
C: A common dining room where all the residents eat.
D: A common reception room at the building entrance.

Question 25: 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 25: 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 general use switch.
B: A cord-and-plug connection.
C: A molded case switch.
D: A circuit breaker.

Question 26: 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 26: Which statement about Arc-Fault Circuit-Interrupter protection is true?

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

Question 27: 250.68(C) Grounding Electrode Connections.

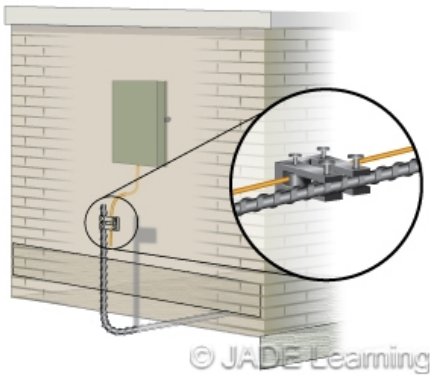
Question ID#: 676.0

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

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

Question 28: 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.

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.

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

Question 28: Which of the following items are required to undergo pre-energization tests after the initial installation is complete?

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

Question 29: 250.66 (A)&(B) Connections to a Rod, Pipe, or Plate and Concrete-Encased Electrode(s).

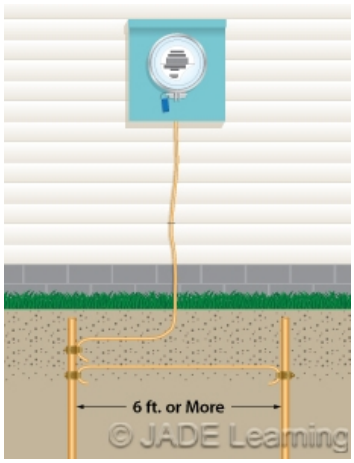
Question ID#: 675.0

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 29: 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. 4 AWG.
B: No. 6 AWG.
C: 1/0 AWG.
D: No. 8 AWG.

Question 30: 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.

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.

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

Question 30: 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, 30 amp dishwasher in a drive-thru coffee stand is required to have GFCI protection.
D: A 125-volt, 15 amp, dishwasher in an apartment is required to have GFCI protection.

Question 31: 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 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.

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

Question 31: Which of the following statements about the required receptacle outlet at a balcony, deck, or porch is true?

A: A receptacle outlet that is installed directly outside of a balcony railing is still counted as the required receptacle outlet.
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 must be installed within the perimeter of the porch.

Question 32: 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.

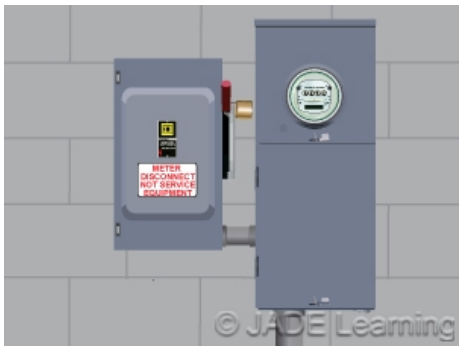
Section 230.82 specifies what types of equipment are permitted to be connected on the supply side of the service disconnect. In the 2011 NEC, meters, meter sockets, and meter disconnect switches connected on the supply side of the service were to be rated not more than 600 volts. Now the meters, meter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



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

Question 32: Which of the following meter disconnect installations would be acceptable to the Authority Having Jurisdiction?

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

Question 33: 210.12(B) Exception. Branch Circuit Extensions or Modifications - Dwelling Units.

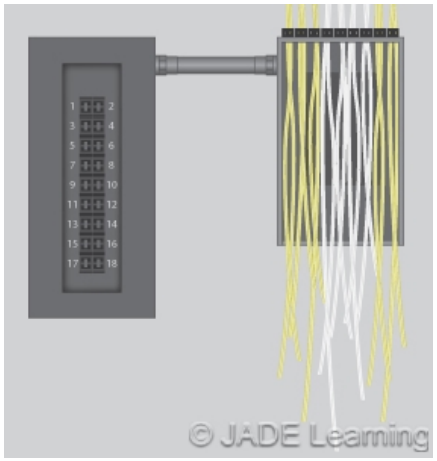
Question ID#: 645.0

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 33: Which of the following installations will require AFCI protection?

A: A 7 foot extension of an existing branch circuit to add a new receptacle in a family room.
B: A 7 foot extension of an existing branch circuit located in a bathroom to add an additional receptacle in the bathroom.
C: A 7 foot extension of an existing branch circuit serving an unfinished attic to add a new receptacle in the attic.
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 34: 250.166 Size of the Direct-Current Grounding Electrode Conductor.

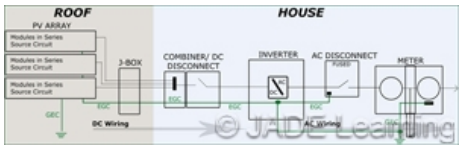
Question ID#: 681.0

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.

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.***



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

Question 34: 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: 350 kcmil cu.
B: No. 3/0 cu.
C: 500 kcmil cu.
D: 400 kcmil cu.

Question 35: 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 35: What is the MINIMUM number of receptacle outlets required for a three car garage in a one-family dwelling?

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

Question 36: 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***.

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.***

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

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.

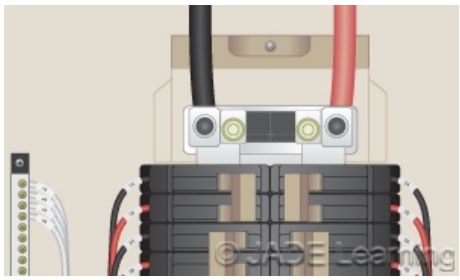
Question 36: How many different types of loads, other than electric vehicle chargers, are permitted on the electric vehicle charging circuit?

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

Question 37: 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 37: 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 multiwire branch circuit conductors are not required to be grouped if they are identified with wire-markers where the conductors are terminated.

B: The wire marker must be placed at the equipment grounding conductor termination.
C: The wire marker must be located nearest the point where the conductors enter the enclosure.
D: The wire markers must be placed where the conductors enter the enclosure and at the point of termination on the grounded bus.

Question 38: 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 38: What is required when a cable tray is used to support 350 kcmil copper service-entrance conductors?

A: The cable tray must have a CT rating.
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 barrier to separate service-entrance conductors from each other.
D: The service-entrance conductors must be labeled at ten foot intervals with the words "service-entrance conductors".

Question 39: 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 39: 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)?

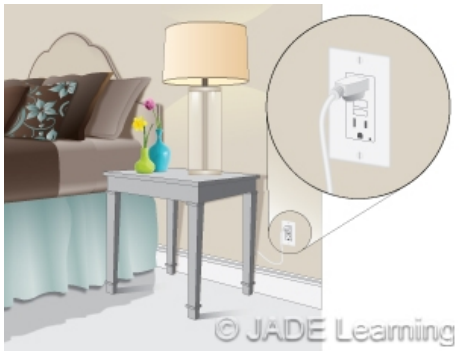
A: No. 4 THWN cu.
B: No. 6 THWN cu.
C: No. 8 THWN cu.
D: No. 3 THWN cu.

Question 40: 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 40: 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: 70 feet.
D: 60 feet.

Question 41: 250.122(B) Size of Equipment Grounding Conductors. Increased in Size.

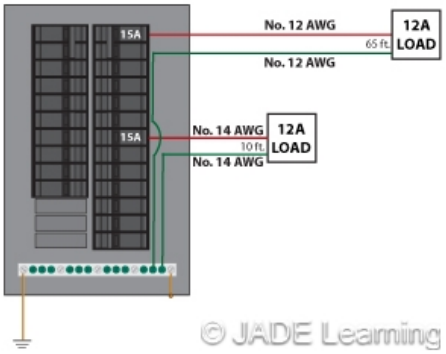
Question ID#: 679.0

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%.

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.



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.

Question 41: 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 size of the equipment grounding conductor must be increased to match the size of the grounding electrode conductor.
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 equipment grounding conductor is required to be increased in size by 25%.

Question 42: 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.

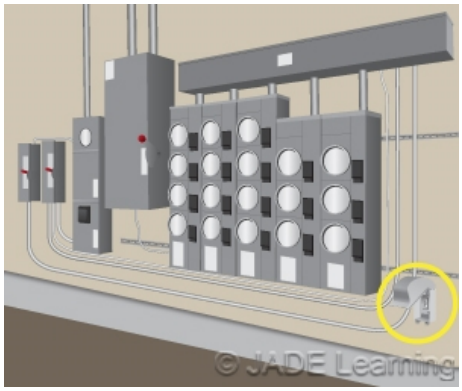
At least one 125-volt, single-phase, 15- or 20-ampere-rated receptacle outlet shall be installed within 50 ft. of the electrical service equipment.

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 42: 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 45 ft. from the electrical service area in a two family dwelling unit.
B: A 125-volt, single-phase, 15- or 20-ampere outlet installed 55 ft. from the electrical service area in a multifamily dwelling.
C: A 125-volt, single-phase, 15- or 20-ampere outlet installed 25 ft. from the electrical service area in a one-family 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 43: 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.

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

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

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

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

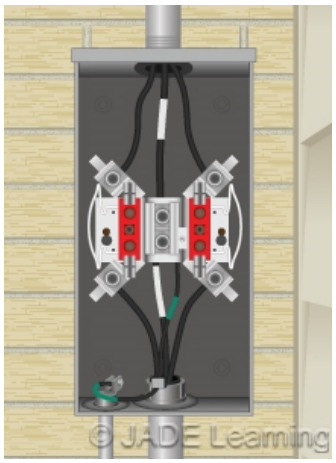
Question 44: 250.24(A)(1) Grounding Service-Supplied Alternating-Current Systems. System Grounding Connections. General.

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.

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.



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

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

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

Question 45: 210.13 Ground-Fault Protection of Equipment.

Question ID#: 647.0

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.

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.

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

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

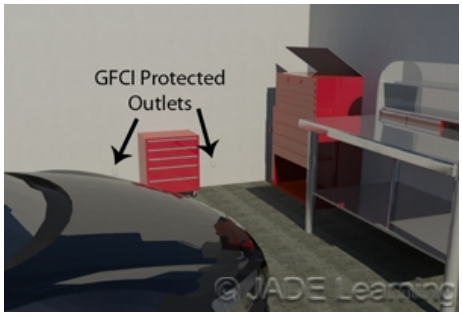
Question 46: 210.8(B)(8) GFCI Protection for Personnel. Other Than Dwelling Units. Garages.

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.

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.



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

Question 46: Which of the following receptacles does NOT require ground-fault circuit-interrupter protection?

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

Question 47: 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.

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).

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

Question 47: 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 48: 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.

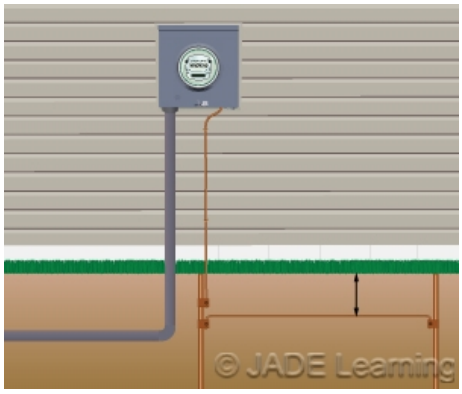


Table 300.5 does not apply to buried grounding electrode bonding jumpers.

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.

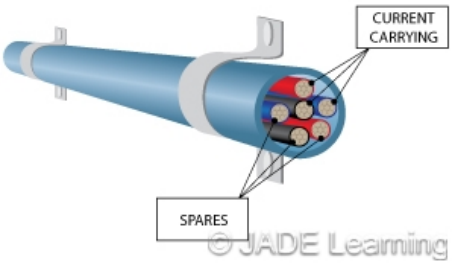
Question 48: What is the minimum burial depth required for a No. 4 AWG copper grounding electrode bonding jumper that connects two ground rods spaced 6 feet apart and not subject to physical damage?

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

Chapter 3

Question 49: Table 310.15(B)(3)(a) Adjustment Factors for More Than Three Current-Carrying Conductors.

Question ID#: 688.0



Spare conductors now must be included in the total number of current-carrying conductors in the raceway or cable.

Table 310.15(B)(3)(a) was revised to make provisions for spare conductors and allowances for those conductors that cannot be energized at the same time.

Section 310.15(B)(3)(a) provides requirements for adjusting the final allowable ampacity of conductors where more than 3 conductors are considered to be current-carrying and installed within a raceway, cable, or bundled in lengths exceeding 24 inches without maintaining spacing. A change to Section 310.15(B)(3)(a) removed the phrase "in a raceway or cable" from the heading.

An important change was made to Note 1 under Table 310.15(B)(3)(a). The revised text in Note 1 states that the number of conductors is the total number of conductors in the raceway or cable, including spare conductors. The count for current-carrying conductors does not include equipment grounding conductors, and if the neutral carries only the unbalanced load, does not include the neutral. The count shall not include conductors that are connected to electrical components that cannot be energized at the same time.

Based on the old Code language, spare conductors installed in a raceway for future use would not technically be considered "current-carrying". This type of a situation could create an issue in the future if the spare conductors are connected to an energized component. Conductors that carry current will generate heat and the existing conductors in the raceway were sized without taking the then spare conductors into account.

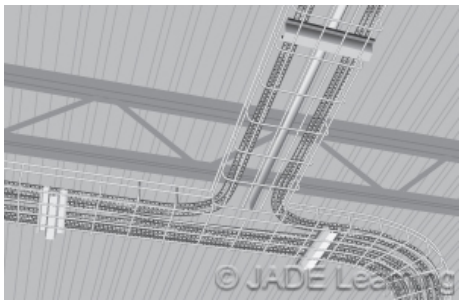
The last sentence in Note 1 allows conductors that cannot be energized simultaneously to be excluded from the ampacity adjustment requirements. As an example, it would be pointless to apply an 80% correction factor to four conductors in a raceway that are connected to a 4-way switch if there was never a possibility that more than two of them could be energized at the same time.

Question 49: According to Table 310.15(B)(3)(a), what percentage is required to be used when applying correction factors to 12 current-carrying conductors and 9 spare conductors within the same 10 foot length of electrical metallic tubing?

A: 80%.
B: 70%.
C: 50%.
D: 45%.

Question 50: 392.20(A)&(B) Multiconductor Cables Operating at 600 Volts or Less. Cables Operating at Over 600 Volts.

Question ID#: 710.0



Cables operating at 600 volts or less are permitted to be installed with those operating at over 600 volts if they are separated with a barrier.

Cables in cable tray or raceway are often ***operated at voltages less than the voltage rating of the cable***. A cable that is ***rated*** for 600 volts might be ***operated*** at 480 volts. A cable that is rated for 5000 volts might be operated at 2000 volts. There is a big difference between the voltage rating of a cable and the voltage at which the cable operates.

The revisions to this section changed the yardstick that is used to determine how multiconductor cable is installed in cable tray from the voltage rating of the cable to the circuit operating voltage.

Conductors that operate at over 600 volts must be separated from conductors operating at 600 volts or less if installed in the same cable tray. Either the cables operating at over 600 volts must be installed in MC cable, or a permanent barrier must be installed between the cables operating at 600 volts or less and the cables operating at over 600 volts.

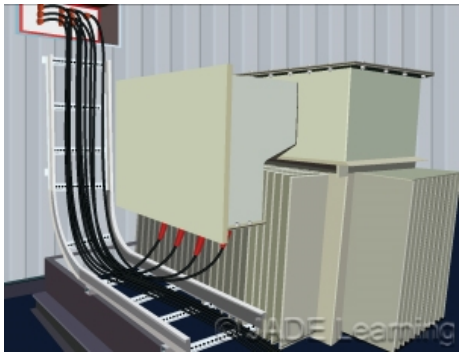
These requirements add cost and complexity to a job. Under the 2011 NEC, if some cables were rated for over 600 volts, even if the circuit voltage for all the cables in the cable tray was 480 volts, the cables that were rated for over 600 volts had to be separated from the cables with a 600 volt rating. Now, even if some of the cables in the cable tray have a voltage rating of more than 600 volts, and some of the cables have a voltage rating of 600 volts or below, if the operating voltage for all cables in the tray is 600 volts or below, the cables are not required to be separated.

Question 50: The OPERATING VOLTAGE for all cables in a cable tray is 480 volts. One cable in the tray is RATED for 2000 volts and the other is RATED at 600 volts. Which of the following statements is correct?

A: The cables may be installed in the cable tray without a fixed barrier.
B: The cables with different voltage ratings must be separated by a fixed barrier.
C: The cable with the higher voltage rating must be installed in MC cable.
D: Cables with different voltage ratings cannot be installed in the same cable tray.

Question 51: 300.38 Raceways in Wet Locations Above Grade.

Question ID#: 687.0



The interiors of raceways installed in wet locations above grade are considered wet locations. Wet location conductors exposed to sunlight need to be sunlight resistant.

New Section 300.38, Raceways in Wet Locations Above Grade, states that ***where raceways are installed in wet locations above grade, the interior of these raceways shall be considered to be a wet location. Insulated conductors and cables installed in raceways in wet locations shall comply with 310.10(C).*** The purpose of adding this new section is to make above ground installation requirements over 1000 volts consistent with the requirements in Section 300.9 for 1000 volts and less.

The interior of above ground raceways that are in wet locations require conductors that are listed for use in wet locations. It is possible that these raceways will gather moisture and in fact become filled with water at times.

Wet locations are defined in Article 100 as: ***Installations underground or in concrete slabs or masonry in direct contact with the earth; in locations subject to saturation with water or other liquids, such as vehicle washing areas, and in unprotected locations exposed to weather.***

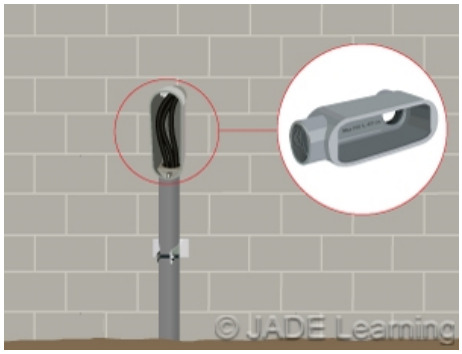
Conductors and cables for circuits over 1000 volts are required to be listed for wet locations, have a moisture-impervious metal sheath, or have an outer insulation which is type MTW, RHW, RHW-2, TW, THW, THW-2, THHW, THWN, THWN-2, XHHW, XHHW-2, ZW.

Question 51: Which of the following conductor insulation types could be used for an outdoor 480 volt feeder installed in a raceway?

A: FEP.
B: THHN.
C: XHH.
D: THWN.

Question 52: 314.28(A)(3) Pull and Junction Boxes and Conduit Bodies. Minimum Size. Smaller Dimensions.

Question ID#: 696.0



Smaller dimension conduit bodies will have to be marked to either show they have been evaluated or show the maximum number and size of conductors permitted.

Conduit bodies that have smaller dimensions than those required for angle pulls made in pull and junction boxes are now permitted if the conduit body is shaped in such a way that the radius of the curve of the conduit body matches the sweep of a conduit bent with a one-shot or full-shoe bender, per Table 2 of Chapter 9.

If the dimensions of the conduit body are less than what is required for angle pulls in boxes, then the conduit bodies must be marked to show they have been evaluated accordingly.

If the permitted combinations of conductors is less than the maximum raceway fill from Table 1 in Chapter 9, the conduit body must be permanently marked with the maximum number and maximum size of conductors permitted.

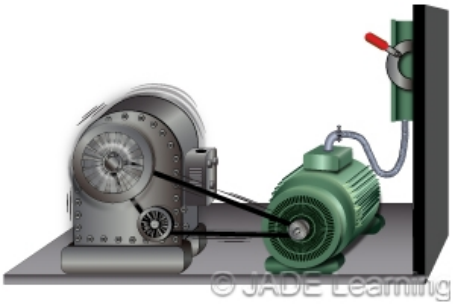
For example, if considering using an angle pull with 2 inch conduit and a pull box, and the rule in 314.28(A)(2) requires the distance from the entering raceway and the opposite wall of the box to be at least 12 inches (2 inch raceway X 6 = 12 inches to opposite wall). A smaller conduit body would be permitted to be used as long as it met the minimum dimensions for a one shot or full shoe bend listed in Table 2 of Chapter 9. This bending radius is no different than the minimum bending radius allowed for field bends made in IMC, RMC, or EMT. In some cases, it may be necessary to use a smaller conduit body where limited space prohibits making an angle pull with a large pull box.

Question 52: What is required of a 2 inch conduit body with dimensions less than those required for an angle pull in a pull box that is being used to enclose an angle pull with No. 4 AWG aluminum conductors?

A: It must have a radius of curve to centerline not less than that indicated in Table 2 of Chapter 9 for one-shot and full-shoe benders.
B: Since there are no splices in the conduit body, no marking is required.
C: The conduit body must have an area of 2.3 sq. in.
D: The conduit body must be marked to show that it has been specifically evaluated for at least a 8 1/4 inch bend per Chapter 9, Table 2.

Question 53: 330.30(D)(3) Securing and Supporting. Unsupported cables.

Question ID#: 699.0



There are now three conditions where type MC cable can be unsupported.

Section 330.30(D)(3) was added in the 2014 NEC and now allows metal clad cable (type MC) to be installed without support where flexibility is necessary.

For many Code cycles, type MC cable has been permitted to remain unsupported under the following two conditions:

- Where the cable is fished between access points through concealed spaces in finished buildings if supporting is impractical.
- Where the cable is not more than 1.8 m (6 ft.) in length from the last point of cable support to the point of connection to luminaires or other electrical equipment within an accessible ceiling.

An additional allowance has now been made in 330.30(D)(3) for the installation of MC cable where flexibility is important. The new Code change states that MC cable can remain unsupported if it is of the interlocked armor type in lengths not exceeding 900 mm (3 ft.). The 3 ft. is measured from the last point where it is securely fastened to the equipment where flexibility is necessary. MC cable can be in the form of a smooth metal sheath, corrugated metal sheath, or interlocking metal tape armor. Interlocking metal armor type MC cable has a similar sheath to that of flexible metal conduit and stands up well to movement or vibration.

Question 53: A section of interlocked type MC cable, used to supply an air compressor, can be unsupported from the last fastening point for what maximum distance?

A: 2 feet.
B: 3 feet.
C: 4 feet.
D: 6 feet.

Question 54: 310.15(B)(3)(c) Exception And Table. Raceways and Cables Exposed to Sunlight on Rooftops.

Question ID#: 689.0

A new exception exempts Type XHHW-2 insulated conductors from the ampacity adjustment for installations on rooftops.

The title of Table 310.15(B)(3)(c) was changed to ***Ambient Temperature Adjustment for Raceways or Cables Exposed to Sunlight on or Above Rooftops.*** The change eliminated the word â€œcircular,â€• recognizing the fact that some raceways installed on rooftops are not circular, and added the word â€œCables.â€•

Conductors in cables and raceways installed on rooftops in direct sunlight get much hotter than conductors installed inside cables or raceways in other locations.Â It is a fact that conduit installed on a rooftop is hot to the touch, and conductors installed inside raceways can be damaged by high temperatures.

Table 310.15(B)(3)(c) requires a temperature rise to be added to the ambient temperature for raceways and cables installed on rooftops.Â The closer the raceway or cable is to the roof, the greater the temperature adder is.Â For example, if the ambient temperature is 86Â°F, and a raceway is installed 4 inches above a roof, an additional 30Â°F must be added to the ambient temperature, making it 116Â°F.Â The ampacity adjustment to the conductors inside the conduit would be based on 116Â°F.

A study of XHHW-2 conductors installed in raceways on rooftops found they were not damaged by extreme heat.Â A new exception allows XHHW-2 conductors to be

used in raceways on rooftops without adding the increased temperatures of Table 310.15(B)(3)(c).

NFPA has issued corrections to ***Table 310.15(B)(3)(c) in an errata sheet***

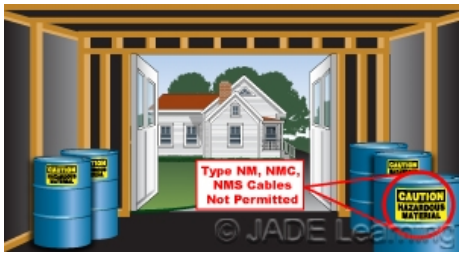
â€œTable 310.15(B)(3)(c). Revise second entry in the first column to read â€œAbove roof 13 mm (1â•„2 in.)â€“90 mm (3 1â•„2 in.).â€•

Question 54: What is the total ambient temperature that must be used for conductors (that are NOT type XHHW-2) in a raceway that is mounted 6 inches above a rooftop and the ambient temperature is 80Â°F?

A: 140Â°F.
B: 120Â°F.
C: 110Â°F.
D: 80Â°F.

Question 55: 334.10 Installation. Uses Permitted.

Question ID#: 700.0



Type NM, type NMC, and type NMS cables are permitted to be used in five conditions, except as prohibited in 334.12.

A revision has been made in Section 334.10 regarding the permitted use of nonmetallic sheathed cable in order to help clarify the limitations of these types of cables.

Section 334.10 provides 5 locations where nonmetallic sheathed cable is permitted to be used. In previous Code editions, the phrase "except as prohibited in 334.12" was only seen after subsections 2 and 3, leading the user to believe that the references to 334.12, Uses Not Permitted, were only valid if the installation was a multi-family dwelling or "other structure of types III, IV or V construction". A description of construction types is in Informative Annex E, Table E.1, E. 2, & E3 on pages 70-849 - 850 of the 2014 NEC.

Now the Code states that type NM, type NMC, and type NMS cables are permitted to be used in the following, except as prohibited in 334.12:

- ***One- and two-family dwellings and their attached or detached garages, and their storage buildings.***
- ***Multi-family dwellings permitted to be of Types III, IV, and V construction.***
- ***Other structures permitted to be of Types III, IV, and V construction. Cables shall be concealed within walls, floors, or ceilings that provide a thermal barrier of material that has at least a 15-minute finish rating as identified in listings of fire-rated assemblies.***
- ***Cable trays in structures permitted to be Types III, IV, or V where the cables are identified for the use.***
- ***Types I and II construction where installed within raceways permitted to be installed in Types I and II construction.***

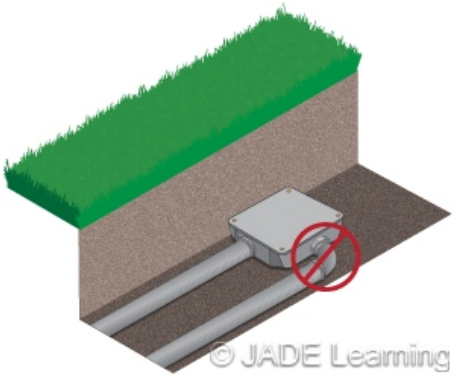
Changing the location of the phrase "except as prohibited in 334.12" to the introductory sentence in 334.10 makes it clear that these types of cables can be installed in any of the above 5 locations as long as none of the 5 locations conflict with the rules in 334.12 for uses not permitted. For example, type NM cable is permitted to be used as the wiring method for a storage building at a dwelling unit, but if the building contains corrosive products, then according to 334.12(B), this type of cable cannot be used. Prior to this Code change, this practice was not specifically prohibited.

Question 55: When is type NMC cable permitted to be used in a cable tray, installed in an office building of type IV construction?

A: When it has a 15-minute finish rating.
B: When it is installed above a suspended ceiling.
C: When it is identified for the use.
D: When it does not conflict with the requirements in 334.10.

Question 56: 350.42 Liquidtight Flexible Metal Conduit. Couplings and Connectors.

Question ID#: 704.0



Straight LFMC fittings are approved for direct burial where marked; angle fittings are not permitted.

Liquidtight Flexible Metal Conduit (LFMC) is approved for direct burial where it is listed and marked for the purpose. Now straight LFMC fittings are approved for direct burial where marked.

Only fittings which are listed for use with LFMC can be used. Angle connectors for LFMC conduit cannot be concealed. Since burying an LFMC angle connector would be concealing it, angle connectors are not permitted to be buried.

Section 350.42 Couplings and Connectors now reads:

Only fittings listed for use with LFMC shall be used. Angle connectors shall not be concealed. Straight LFMC fittings shall be permitted for direct burial where marked.

Straight, non-angle fittings can be buried only where marked, meaning that the manufacturer has used "suitable for direct burial" or equivalent wording on the fitting or on the packaging.

Liquidtight Flexible Nonmetallic Conduit (LFNC) fittings are not to be used with LFMC. The two wiring methods have a similar outward appearance, but LFNC does not have a metal sheathing under the outer liquid-tight jacket.

LFMC and LFNC are permitted for direct burial. Flexible metal conduit (FMC) and flexible metal tubing (FMT) are not permitted for direct burial, and misapplication of these wiring methods could require extensive rework or create a hazardous condition.

Question 56: Which of the following is permitted for direct burial?

A: Flexible Metal Conduit.
B: Flexible Metal Tubing.
C: Angle fittings listed for use with LFMC.
D: Straight LFMC fittings where marked for direct burial.

Question 57: Article 393 Low Voltage Suspended Ceiling Power Distribution Systems.

Question ID#: 711.0

Low-voltage suspended ceiling power distribution systems are permitted to supply listed utilization equipment in indoor dry locations, for residential, commercial, or industrial installations.

Low-voltage suspended ceiling power distribution systems use special ceiling grid rails as a bus to distribute low voltage power throughout a suspended ceiling. Luminaires and other low voltage equipment and sensors are electrically connected to the grid with special connectors. This system is well suited for LED luminaires.

With a low-voltage suspended ceiling power distribution system in place, luminaires can be easily repositioned when a building tenant wants to change the layout of a room. Without changing the grid, the luminaires can be moved around by simply connecting the luminaire to a different point on the grid. Operating voltages of 30 VAC or 60 VDC mean the risk of electric shock will be much less than with standard 120 or 277 AC voltages. Qualified electricians will install the low voltage bus that attaches to the ceiling grid. Other trades will install the ceiling grid.

A standard branch circuit will supply the listed Class 2 power supply for the ceiling grid bus. A power distribution cable or connector will connect the power supply to the busbar.

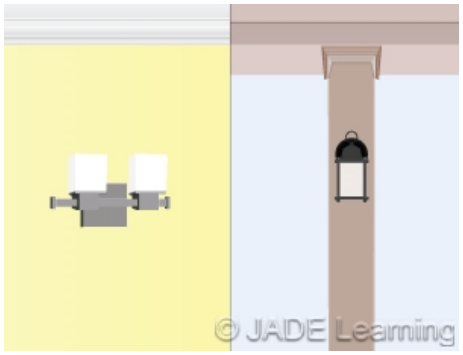
Low-voltage suspended ceiling power distribution systems are permitted to supply listed utilization equipment in indoor dry locations, for residential, commercial, or industrial installations, and in other spaces used for environmental air. The systems are NOT permitted in damp or wet locations, where subject to corrosive fumes or physical damage, in concealed or classified locations, for lighting in critical or general care areas of a health care facility, or as part of a fire-rated floor-ceiling or roof-ceiling assembly.

Question 57: Where can low-voltage suspended ceiling power distribution systems be installed?

A: In a battery room with corrosive fumes.
B: Inside an office building.
C: In a wet or damp location.
D: In a Class I, Division 2 location.

Question 58: 314.27(A)(1) Vertical Surface Outlets.

Question ID#: 694.0



The requirements for wall outlets have now been expanded to include all vertical surfaces.

The title and text of 314.27(A)(1) were changed to include a vertical surface that is not necessarily a wall. This is to recognize that luminaires or lampholders may be mounted on interior posts or columns that are not necessarily walls. The basic provisions of the section have not changed.

The section now reads: ***Boxes used at luminaire or lampholder outlets in or on a vertical surface shall be identified and marked on the interior of the box to indicate the maximum weight of the luminaire that is permitted to be supported by the box, if other than 50 pounds.*** Basically, the box requires the weight marking if it is unable to hold up a 50 pound luminaire. If it can support up to 50 pounds, then no weight marking is required.

The exception has been reworded to say, ***a vertically mounted luminaire or lampholder weighing not more than 6 pounds shall be permitted to be supported on other boxes or plaster rings that are secured to other boxes, provided the luminaire or its supporting yoke, or the lampholder, is secured to the box with no fewer than two number 6 or larger screws.***

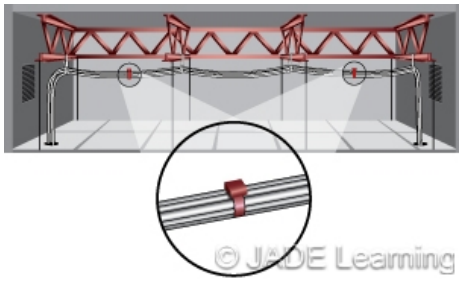
This editorial change means that the same rules for mounting outlet boxes in a wall now apply to any vertical surface, such as panels, posts, or columns.

Question 58: Which of the following installations is a Code violation?

A: A 5 lb. luminaire secured with No. 4 screws to a device box mounted on a vertical column.
B: A round metal box that is identified and marked on the interior of the box for support of a 20 pound luminaire mounted in the wall and used for a luminaire weighing 8 lbs. that is secured to the box with No. 8 screws.
C: A 5 lb. luminaire secured with No. 6 screws to a device box mounted on a vertical column.
D: A round metal box that is identified and marked on the interior of the box for support of a 20 pound luminaire mounted in the wall and used for a luminaire weighing 12 lbs. that is secured to the box with No. 10 screws.

Question 59: 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 59: Which of the following wiring methods is permitted to be installed in a plenum?

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

Question 60: 314.27(C) Boxes at Ceiling-Suspended (Paddle) Fan Outlets.

Question ID#: 695.0

The requirement for a box listed for support of a ceiling-suspended (paddle) fan now also applies to two-family dwellings.

The term "two-family" has been added to the second paragraph in section 314.27(C) which describes ceiling boxes that contain spare, separately switched, ungrounded conductors.

New provisions in the 2011 Code required that if spare, separately switched, ungrounded conductors were provided to a ceiling mounted outlet box, in a location acceptable for a ceiling-suspended (paddle) fan in single or multi-family dwellings, the outlet box or outlet box system had to be listed for the sole support of a ceiling suspended (paddle) fan. This requirement applied only to single- or multi-family dwellings and failed to mention two-family dwellings.

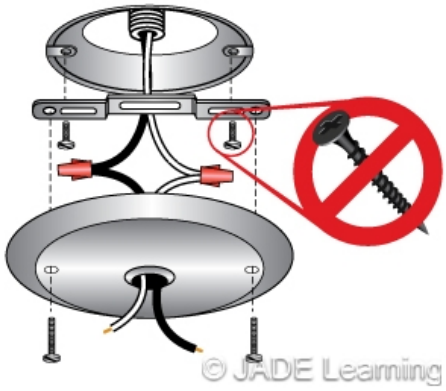
It has become a common practice during new home construction for a homebuilder to offer prewiring for future ceiling fans as part of an upgrade package to new homeowners. Prior to the 2011 Code, it was also commonplace to find that an electrician had provided spare separately switched ungrounded conductors to an unused ceiling box and placed a blank plate on it for future use. The requirement to install a listed ceiling fan box when spare, separately switched conductors were provided in the box was to prevent homeowners from installing ceiling fans at existing plastic ceiling boxes.

Question 60: Which of the following ceiling boxes are required to be fan rated?

A: A box installed in a two-family dwelling in the middle of a room and supplied with a spare, separately switched ungrounded conductor.
B: A box installed in a single-family dwelling over a doorway and supplied with a separately switched ungrounded conductor.
C: A box installed for future use in a single-family dwelling 7 feet above a bathtub.
D: A box installed for future use in a two-family dwelling 6 inches from a wall.

Question 61: 314.25 Covers and Canopies.

Question ID#: 693.0



Screws used for attaching covers to the box must be machine screws matching the thread gauge or whatever is required by the manufacturer's instructions.

New Code language in section 314.25 addresses a common Code violation regarding the use of incorrect screws to fasten canopies, covers, or lampholders to junction boxes.

Section 314.25 states that in completed installations, each box shall have a cover, faceplate, lampholder, or luminaire canopy, except where the installation complies with 410.24(B). Section 410.24(B) is for installations where a surface mounted fixture is installed and covers the junction box but the fixture is not physically attached to the box.

The new text in 314.25 requires that screws used for the purpose of attaching covers or other equipment to the box shall be either machine screws matching the thread gauge or size that is integral to the box or shall be according to the manufacturer's instructions.

It is all too common for an installer to use drywall screws or other screws that may be convenient when fastening a cover, faceplate, or fixture canopy to a junction box rather than using the correct machine screw for the application. Boxes that have had a drywall screw used for this purpose instead of the correct machine screw can be damaged by the screw threads. When this happens the correct machine screw can never be used in those boxes again.

Question 61: If a junction box is equipped with threaded holes with an 8-32 thread pitch for the purpose of securing the cover, what can be used to secure the cover to the box?

A: A self-threading sheet metal screw.
B: Standard drywall screws.
C: Machine screws that match the threads in the box.
D: A larger machine screw with an 10-24 thread pitch.

Question 62: 310.15(B)(7) 120/240-Volt, Single-Phase Dwelling Services and Feeders.

Question ID#: 690.0

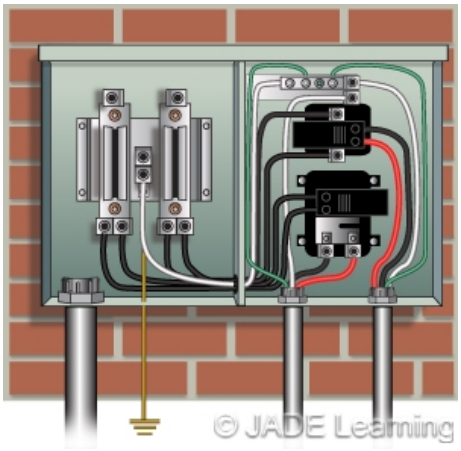


Table 310.15(B)(7) had been deleted, and now the sizes are calculated to be not less than 83% of the service or feeder rating.

Table 310.15(B)(7) has been deleted. One of the most frequently used tables in the NEC, the table was used to select the conductor sizes for 120/240-Volt, 3-Wire, Single-Phase Dwelling Services and Feeders for services and feeders rated 100 through 400 amperes.

In its place, a calculation must be done that determines the service and feeder conductors at an ampacity not less than 83% of the service or feeder rating. For example, the service conductors for a 100 amp service are required to carry not less than 83 amps.

Doing a calculation to determine the ampacity of service and feeder conductors at 83% of the service or feeder rating, rather than using the old Table 310.15(B)(7), does not make a difference in the size of the conductor. The wire sizes for both copper and aluminum, from Table 310.15(B)(16), when calculated at 83% of the service or feeder rating, are identical to the sizes in old Table 310.15(B)(7).

The conditions when the 83% calculation can be used are also the same as in 2011. It can be used for:

- Dwelling services and feeders that supply the entire load of the dwelling.
- 120/240-voltage rating.
- 3-wire.
- Single-phase.

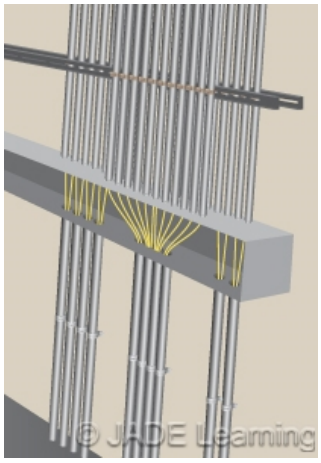
Because using the 83% calculation is limited to service conductors and feeders that supply the entire load, the service conductors that feed a one-family dwelling can be selected based on 83% of the rating of the service, but the feeder conductors that supply a subpanel that does not carry the total load of the dwelling must carry 100% of the load.

Question 62: What are the minimum size copper, THWN service conductors for a 200-amp service, 120/240 volt, 3-wire, single-phase, where the conductors carry the entire load of the dwelling? Assume 75 degree C terminals.

A: 3/0.
B: No. 1.
C: 1/0.
D: 2/0.

Question 63: 376.22(B) Number of Conductors and Ampacity. Adjustment Factors.

Question ID#: 706.0



Ampacity of conductors inside a metal wireway will be adjusted if there are more than 30 current-carrying conductors at any cross section of the wireway.

The ampacity of conductors inside a metal wireway will need to be adjusted if the number of current-carrying conductors inside the metal wireway exceeds 30 at any cross section of the wireway. Conductors for signaling circuits, conductors used only for starting a motor, and neutral conductors that carry only the unbalanced load are not considered current carrying conductors.

The 2011 NEC required the ampacity of conductors inside of a metal wireway to be adjusted if the total number of conductors inside the wireway was greater than 30. By adding "at any cross section of the wireway" the 2014 NEC will limit when ampacity adjustment factors will be required to be applied for metal wireways.

For example, if in a wireway there are a total of 50 wires, but no more than 25 wires at any cross section, no ampacity adjustment is necessary. This is important because the ampacity adjustment factors in Table 310.15(B)(3)(a) for 31-40 conductors is 40% and for 41 conductors and above the adjustment factor is 35%.

If for instance there are 38, No. 3 conductors, rated at 100 amps each from Table 310.15(B)(16), but no more than 12 conductors at any cross section, in the 2011 Code each conductor could only carry 40 amps (100 amps x 40%), but in the 2014 each conductor could carry the full 100 amps because no ampacity adjustment is required.

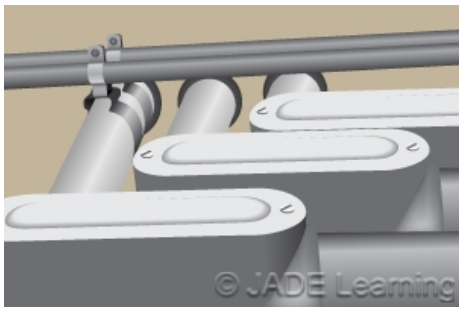
Another example: if there are 42 conductors at any cross section of a wireway, and each conductor is rated at 130 amps, the maximum amount of current each conductor can carry is 45.5 amps (130 amps x 0.35).

Question 63: How much current can a conductor which is rated for 65 amps carry if it is installed in a metal wireway with 35 other conductors, but there are never more than 20 conductors at any cross section of the wireway?

A: 26 amps.
B: 35 amps.
C: 52 amps.
D: 65 amps.

Question 64: 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 64: Which of the following is required for raceways to support luminaires?

A: The manufacturer says that the raceway is permitted to be used to support a luminaire.
B: The installation instructions indicate that the luminaire is permitted to be supported by a raceway.
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 65: 314.15 Damp or Wet Locations.

Question ID#: 692.0

Drainage openings not larger than 1/4 inch can be installed in boxes or conduit bodies listed for use in damp or wet locations.

Section 314.15 is about installing boxes, conduit bodies, and fittings in damp or wet locations. A Code change will now allow weep holes to be installed in the field to provide drainage for condensation that can form inside the box.

Drilling weep holes in weatherproof boxes has been a common practice among electricians for many years. Anyone performing service work that has opened a die-cast aluminum weatherproof junction box years after the initial installation has first-hand knowledge of what kind of damage and corrosion can occur when moisture is allowed to build up within the enclosure with no provisions for drainage.

Inspectors have been placed in a unique situation when asked to inspect a listed weatherproof box or conduit body that someone has modified by drilling holes in it to provide proper drainage. Do the holes void the listing of the product? Does the manufacturer approve the idea of drilling drain holes in the box? The new text added to 314.15 will now clearly permit drain holes to be drilled in boxes or conduit bodies in damp and wet locations.

Section 314.15 now states that: ***approved drainage openings not larger than 6 mm (1â•„4 in.) shall be permitted to be installed in the field in boxes or conduit bodies listed for use in damp or wet locations. For installation of listed drain fittings, larger openings are permitted to be installed in the field in accordance with manufacturer's instructions.***

Question 65: Which of the following installations meets the intent of section 314.15?

A: A 1/2 inch hole drilled into the bottom of a weatherproof junction box.
B: A 1/2 inch hole drilled into the bottom of a weatherproof junction box for an unlisted drain fitting.
C: A 1/4 inch hole drilled into the top of a weatherproof junction box.
D: A 1/4 inch hole drilled into the bottom of a weatherproof junction box.

Chapter 4

Question 66: 406.5(E) Receptacles in Countertops and Similar Work Surfaces.

Question ID#: 719.0

In the 2011 NEC, receptacles were not allowed to be installed in the face-up position in dwelling units. "Dwelling units" was deleted in the 2014 NEC for this section, and now receptacles cannot be installed in the face-up position in any location, unless they are listed as receptacle assemblies for countertop applications.

The same problems of having liquids, food, or other scraps fall into a receptacle that is mounted face-up exist in any location, not just in dwelling units.

There are listed assemblies for countertop applications where the receptacle pops up out of the counter, then can be pushed back down when not in use. In the down position the hole for the receptacle assembly is sealed against liquids and debris. In the up position, the receptacle face is perpendicular to the countertop surface.

Receptacles on a kitchen countertop and within 6 ft. of a sink are required to be GFCI protected. When a receptacle assembly listed for countertop applications is required to provide GFCI protection, the receptacle assembly is permitted to be listed as a GFCI receptacle assembly for countertop applications.

Listed receptacle assemblies for countertops solve an installation problem when there is not a backsplash on the counter and mounting a receptacle below the countertop is not practical.

Only listed receptacle assemblies can be installed for countertop applications.

Question 66: Which of the following statements about receptacles in countertops is true?

A: A listed receptacle assembly for countertop applications can be installed in a countertop.
B: If the countertop does not have a backsplash, the receptacle can be mounted in the face-up position.
C: Listed receptacle assemblies for dwelling unit kitchen countertops are not required to be GFCI protected.
D: If the countertop has a backsplash, using a listed receptacle assembly is prohibited.

Question 67: 406.4(D) General Installation Requirements. Replacements.

Question ID#: 718.0

Replacement receptacles for arc-fault and ground-fault circuit-interrupter type receptacles must now be installed in a readily accessible location.

From the 2011 NEC, when a receptacle outlet is located in an area that requires GFCI protection, the replacement receptacle must be GFCI protected. When a receptacle outlet is located in an area that requires AFCI protection, the replacement receptacle must be AFCI protected. In the 2014 NEC, those replacement receptacles must be readily accessible.

The reason for the new rule is to give the occupant a way to test the devices, as required by the manufacturer, and to reset them if they have tripped. In the long run, this requirement will cut down on service calls to reset a tripped device.

Readily accessible means the device can be reached quickly without removing obstacles or using ladders. An example of a GFCI type receptacle that must be readily accessible is the garage door opener at a dwelling. Outlets in garages are required to be GFCI protected, but a GFCI type receptacle cannot be mounted in the ceiling because that is not readily accessible.

AFCI and GFCI replacement receptacles need to be readily accessible.

Question 67: Which of the following locations may be considered readily accessible?

A: Behind a large appliance fixed in place.
B: Eight feet above the floor.
C: Behind a wall-mounted electric drinking fountain.
D: Some walk-in clothes closets.

Question 68: 422.5 Appliances. Ground-Fault Circuit-Interrupter (GFCI) Protection.

Question ID#: 734.0

All GFCI devices that are required by Article 422 for appliances must be readily accessible.

Section 422.5 states that the device providing GFCI protection shall be readily accessible. According to Article 100 definitions, readily accessible means ***capable of being reached quickly for operation, renewal, or inspections without requiring those to whom ready access is requisite to actions such as to use tools, to climb over or remove obstacles, or to resort to portable ladders, and so forth.***

Similar requirements can be found in section 210.8 for dwelling and non-dwelling locations. Making sure that the GFCI is readily accessible ensures that the device can easily be reached for routine testing to confirm proper operation.

Placing a GFCI receptacle behind a large vending machine or behind a cord-and-plug connected electric drinking fountain makes it difficult for those who are troubleshooting the circuit and now is a Code violation. Many installers remedy the situation by using a GFCI circuit breaker located in a readily accessible panelboard rather than a GFCI-type receptacle which may be considered readily accessible up until the time that a large vending machine gets delivered and installed in front of the device.

GFCI devices required by Article 422 must be readily accessible.

Question 68: Which of the following receptacles is required to be readily accessible?

A: A receptacle that provides power for a vending machine that has its own GFCI built into the appliance cord.
B: A receptacle that is supplied by a GFCI breaker in a panelboard.
C: A receptacle that does not require GFCI protection.
D: A GFCI-type receptacle that supplies power to a drinking fountain.

Question 69: 404.2(C) Switches Controlling Lighting Loads.

Question ID#: 714.0

In the 2011 NEC, a grounded circuit conductor was first required at the switch location for a switch controlling lighting loads that are supplied by a grounded general-purpose branch circuit. The reason for the requirement is to provide a grounded conductor for an electronic control device, like an occupancy sensor, that needs a grounded conductor for the device to operate.

Two conditions where the grounded circuit conductor is not required to be provided at the switch location have been carried over from the 2011 NEC. Five new conditions have been added that would make a grounded conductor at the switch location unnecessary.

A grounded circuit conductor is not required at the switch location for lighting loads:

(1) Where the conductors enter the switch box through a raceway.

(2) Where the switch box is accessible for additional cable without removing finish materials.

(3) Where the switch has an integral enclosure, such as those used for doorjamb switches.

(4) Where a switch does not serve a habitable room or bathroom, such as in an attic.

(5) Where there is more than one switch location, such as for 3-way or 4-way switches, and the entire floor area of the room is visible from a single or combined switch locations.

There are now seven situations where a grounded circuit conductor is not required at the switch location.

(6) Where the lighting in the area is controlled by automatic means, such as a ceiling mounted occupancy sensor.

(7) Where a switch controls a receptacle load.

One reason for requiring a grounded neutral conductor at a switch location is to provide for occupancy sensors. Therefore, it makes sense to omit a grounded conductor if there is already an occupancy sensor installed in the ceiling, if only travelers run between switch locations, such as when using a 4-way switch, and if the room with the switch is not habitable, like a closet or attic.

Question 69: Assume the switches are wired with NM-Cable not installed in a raceway and that the switch boxes will be enclosed in a finished wall.
When is a grounded conductor required at a switch location for a lighting load?

A: When the switch controls lighting in a storage closet.
B: When the switch controls switched receptacles in a motel.
C: When the switch is installed in the living room in a dwelling.
D: When a ceiling mounted occupancy sensor automatically controls the lighting in the room.

Question 70: 445.18 Disconnecting Means Required for Generators.

Question ID#: 748.0

Working on generator installations should be safer for maintenance personnel because of the changes made to 445.18.

Generators must be equipped with a disconnecting means which is lockable in the OFF position unless cord-and-plug connected or the driving means can be shut down and not restart and not arranged to operate in parallel.

Generators must be equipped with a disconnecting means which is lockable in the OFF (open) position and which will disconnect all of the circuits supplied from the generator. Portable generators are not included in this requirement because cords that are plugged into the generator can simply be removed from the receptacles mounted on the generator. Also, a portable generator that is connected to a flanged inlet device can easily be unplugged.

A generator disconnecting means is not required if both of the following conditions are met:

- The driving means for the generator can be readily shut down, is rendered incapable of restarting, and is lockable in the OFF position in accordance with 110.25.
- The generator is not arranged to operate in parallel with another generator or other source of voltage.

Requiring the driving means for a generator to be shut down, locked out, and prevented from automatically restarting will mean working on generators in the field will be safer for personnel.

It is important to remember that the requirements in 445.18(2) are not the same as the disconnecting requirements found in 700.12, 701.12, and 702.12, which apply to the disconnection of conductors supplied by an outdoor generator. These requirements allow the generator to keep running as long as the conductors supplied by the generator that serve or pass through a building can be disconnected whereas the requirements in 445.18(2)(a) require that all circuits supplied by the generator be shut down completely by a disconnecting means that can be locked in the OFF position.

Question 70: Which of the following types of generators is NOT required to be equipped with a lockable disconnect switch?

A: A generator on wheels that only has provisions for cord-and-plug connected loads.
B: A generator that is permanently installed and wired in parallel with another generator.
C: A generator that is permanently installed and capable of being re-started from 3 different remote locations in the event that the generator turns off.
D: A generator on wheels that only has lug terminals for hardwired connections.

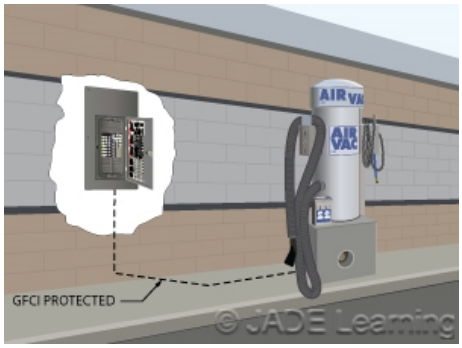
Question 71: 422.23 Tire Inflation and Automotive Vacuum Machines.

Question ID#: 737.0

A new section has been added to Article 422 in order to provide an additional level of protection for the public.

Section 422.23 requires tire inflation and automotive vacuum machines provided for public use to be protected by a ground-fault circuit-interrupter (GFCI).

Tire inflation and automotive vacuum machines are heavily used and abused.Â Â Â Â They are located outdoors and exposed to all weather conditions.Â The electrical components can become damaged from constant use.Â The areas around the machines can be wet and a person could be standing in water while using the equipment.Â Â



Tire inflation and automotive vacuum machines need GFCI protection.

The Consumer Product Safety Commission reported a patron was killed while operating an automotive vacuum machine.Â Ground-fault circuit-interrupter protection has proved to be an effective way to protect people while using appliances, especially when used in wet locations.

Note that the new requirement for GFCI protection is not voltage specific nor does it specify that the GFCI protection be in the form of a receptacle at the equipment or a GFCI breaker where the circuit originates.

The following is a partial list of locations where GFCI protection is currently required:

- Bathrooms (125-volt,15-and 20-amp) receptacles)
- Dwelling unit garages & accessory buildings (125-volt, 15- and 20-amp receptacles)
- Outdoors (125-volt, 15-and 20-amp receptacles)
- Dwelling unit crawl spaces (125-volt, 15-and 20-amp receptacles)
- Unfinished basements in dwellingsÂ (125-volt, 15-and 20-amp receptacles)
- Kitchens (125-volt, 15-and 20-amp receptacles)
- Within 6 feet of a sink (125-volt, 15-and 20-amp receptacles)
- Boathouses (125-volt, 15-and 20-amp receptacles)
- Rooftops (125-volt, 15-and 20-amp receptacles)
- Indoor wet locations (125-volt, 15-and 20-amp receptacles)
- Locker rooms with associated showering facilities (125-volt, 15-and 20-amp receptacles)
- Repair garages and aircraft hangars where electric hand tools are used (125 volt, 15-and 20-amp receptacles)
- Dwelling unit boat hoists (up to 240 volts)
- ***Tire inflation and vacuum machines for public use (any voltage)***
- Circuits supplying floor heating cables (any voltage)
- Agricultural buildings
- Receptacles on portable generators 15 kw or smaller (125-volt, 15-and 20-amp receptacles)

- Elevator pits (125-volt, 15-and 20-amp receptacles)
- Pool lighting
- Single-phase 15- or 20-amp 120- or 240-volt swimming pool pump motors
- Electric pool covers
- Spas, hot tubs, hydromassage and therapeutic tubs
- Floating buildings

Â

Question 71: Which of the following types of equipment require ground-fault circuit-interrupter protection?

A: An automotive vacuum installed for public use.
B: All automotive vacuum machines.
C: Air compressors rated at 240 volts inside a dwelling unit garage.
D: All tire inflation machines.

Question 72: 406.3(E) Receptacle Rating and Type. Controlled Receptacle Marking.

Question ID#: 717.0

Nonlocking receptacles rated 125-volts, 15- and 20-amperes, that are controlled by an automatic control device like an energy management system, a timer, or an occupancy sensor, must be marked with the symbol shown below. Switched receptacles that are controlled by a wall switch and provide one of the required room lighting outlets permitted by 210.70 are not required to have the marking.

Nonlocking-type 125-volt, 15- and 20-ampere receptacles that are controlled by an automatic control device must be marked with the new symbol.

Energy management codes, like ASHRAE 90.1, require that up to 50% of 125-volt 15- and 20-ampere receptacles are automatically controlled. If a receptacle is being turned off or turned on automatically, the user needs to be able to identify which receptacles are being controlled.

Automatic control of lighting and HVAC loads is common. Most people know and understand that an automatic system can turn the lights off in a building and control the heating and cooling systems.

Automatically controlling a receptacle is less certain because a number of different type loads can be connected to a receptacle outlet. Table lamps are plugged into receptacle outlets and can be controlled automatically. Some types of electronic equipment, like computers, will still consume power in sleep mode and will save energy if completely turned off.

Marking receptacle outlets that are controlled by an energy management system will be a convenience for users who may see luminaires or appliances unexpectedly turn on or turn off.

Question 72: Which receptacles are required to have the controlled receptacle marking?

A: Receptacles that are in common areas of buildings.
B: Receptacles in dwellings that are controlled by a wall switch.
C: Receptacles that provide power to air conditioning units.
D: Receptacles that are controlled by an energy management system.

Question 73: 406.9(B)(1) Receptacles of 15 and 20 Amperes in a Wet Location.

Question ID#: 722.0

"Extra duty" covers are now required for 15- and 20-ampere receptacles in wet locations at dwelling and non-dwelling locations. In earlier Codes the extra duty covers were only required at non-dwelling locations if the receptacle was supported from grade. In the 2014 NEC the extra duty covers are required at dwellings and non-dwelling locations if the receptacle is installed in a wet location, whether it is mounted directly to the building or supported from grade by another structure.

In an independent study, the "in use" covers used in residential applications had a 90% failure rate. With the slightest contact the "in use" cover broke off and left the receptacle exposed to the weather.

The requirement for the extra duty cover only applies to 15 and 20 ampere rated receptacles in a wet location. In addition, 15 and 20 amp, 125 volt through 250 volt receptacles in a wet location must be of the listed weather-resistant (WR) type. WR type receptacles will hold up better in a wet location, but without a cover that protects the receptacle, the receptacle will be exposed to rain, sleet, or snow, which will shorten the life of the receptacle.

According to Article 100, a wet location is an unprotected location exposed to the weather. A damp location is protected from the weather and not subject to saturation with water or other liquids but subject to moderate degrees of moisture.

The extra duty covers required in residential, commercial, and industrial locations will protect the receptacle from the elements whether or not the attachment plug cap is inserted.

"Extra duty" covers are now required for 15- and 20-ampere outlets in wet locations at dwelling units.

Question 73: Which of the following types of receptacles when installed in a wet location require an extra duty cover?

A: 250-volt, nonlocking-type, 30 amp.
B: 125-volt, locking-type, 30 amp.
C: 125-volt, nonlocking-type, 30 amp.
D: 250-volt, nonlocking-type, 15 amp.

Question 74: 400.7(A)(11) Flexible Cords and Cables. Uses Permitted.

Question ID#: 713.0

New text added in Section 400.7(A)(11) states that:

400.7(A)(11) Between an existing receptacle outlet and an inlet, where the inlet provides power to an additional single receptacle outlet. The wiring interconnecting the inlet to the single receptacle outlet shall be a Chapter 3 wiring method. The inlet, receptacle outlet, and Chapter 3 wiring method, including the flexible cord and fittings, shall be a listed assembly specific for this application.

There are listed products, like Legrand's Flat Screen TV Cord and Cable Power Kit, that are available to connect wall-mounted flat screen TVs without wires showing on the outside of the wall.

Do-it-yourself homeowners were using extension cords installed inside a wall to connect a wall-mounted flat screen TV to an existing receptacle outlet, so that cords did not show outside the wall. This is a clear violation of section 400.8, Uses Not Permitted for flexible cords and cables.

A listed power and cable kit, consisting of a cable installed inside the wall that connects a flanged inlet to an existing receptacle, will now be one of the uses permitted for flexible cords and cables.

The inlet, receptacle outlet, and wiring method need to be a listed assembly specific for the application.

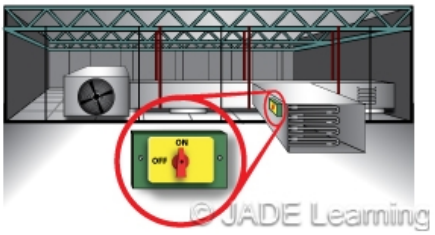
Question 74: When connecting a wall-mounted flat screen TV to a receptacle outlet which of the following methods is not permitted?

A: Plugging the TV cord into an existing outlet with the cords on the outside of the wall.
B: Installing a listed cord and cable power kit assembly.
C: Installing a standard extension cord inside the wall between the TV and an existing outlet.
D: Installing a new receptacle outlet directly behind the flat screen TV.

Question 75: 424.66(A)&(B) Duct Heaters. Installation. General and Limited Access.

Question ID#: 741.0

There are new requirements for working space around duct heaters installed above a suspended ceiling.



There are new requirements for access to duct heaters installed above a ceiling including a minimum working space width of 30 inches.

In the past, this type of heater was often installed above suspended ceilings with little regard for providing access to the equipment or safe working conditions for individuals who would service the equipment after the installation was complete. In earlier editions of the NEC, Section 424.66(A) included a note telling the reader to "See 110.26." However, it did not require that the installation comply with the minimum working space clearances given in Section 110.26. Previously, 424.66 just stated that "sufficient clearance" was to be provided for servicing the equipment without specifying minimum working space requirements.

424.66(B) Limited Access

When electric duct heaters are installed in a space above a ceiling, the following requirements apply:

- They are required to be accessible through access panels or by removal of suspended ceiling panels.
- The working space must be 30 inches wide or the width of the equipment, whichever is greater.
- Access panels and doors on the equipment are required to open 90 degrees or more.
- The minimum depth of working space in front of the equipment is to comply with the requirements of Table 110.26(A)(1).

Question 75: An electric duct heater that measures 28 inches wide is installed in a limited access space above a ceiling. Which of the following statements is correct?

A: The width of the required work space is 30 inches.
B: The width of the required work space is 28 inches.
C: The width of the required work space is 40 inches.
D: The width of the required work space is 48 inches.

Question 76: 408.4(B) Field Identification Required. Source of Supply.

Question ID#: 726.0

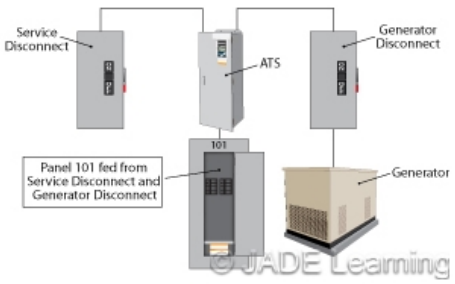
All switchboards, switchgear, and panelboards supplied by a feeder(s) in other than one- or two-family dwellings shall be marked to indicate each device or equipment where the power originates.

The change is that now ***each*** device or equipment where the power originates must be marked on a switchboard, switchgear, or panelboard.

Optional standby systems and legally required or emergency systems are very common in commercial and industrial systems. They are a second source of power for electrical distribution systems. Also, storage batteries, a second utility service, or alternate energy systems, like solar PV or wind generators, can be connected to switchboards, switchgear, and panelboards.

When there is more than one source of power to a distribution network, every source must be marked to indicate not only where the normal source originates, but any additional sources.

The more detail that is included on the sign, the more helpful it will be. The requirement says "each device or equipment" must be identified, so a general description of where the source is located is not good enough. A sign that says, "Circuit 3A fed from Standby Generator," is not as good as a sign that says, "Circuit 3A fed from Standby Generator Located in Basement Electrical Room." Likewise, a sign that says, "Circuit 4B fed from PV Disconnect Switch Located East End Building 1" is better than a sign saying "Circuit 4B fed from PV System."



Switchboards, switchgear, and panelboards must be marked to indicate where the power originates, in other than one- or two-family dwellings.

Question 76: Which of the following is the best example of a sign which is located at a switchboard that is supplied by a service disconnect and an optional standby system?

A: Standby generator located rear of building on the first floor.
B: Service disconnect located in electrical room on ground floor.
C: Switchboard supplied from service disconnect located west wall in electrical room. Switchboard also supplied by generator located next to loading dock.
D: Switchboard supplied from panelboard in electric room.

Question 77: 410.23 Covering of Combustible Material at Outlet Boxes.

Question ID#: 731.0

Section 410.23 addresses installations where a luminaire is surface mounted over an outlet box that has been recessed into a combustible wall or ceiling finish and the edge of the luminaire housing extends beyond the opening for the outlet box. The revised text states that ***any combustible wall or ceiling finish exposed between the edge of a luminaire canopy or pan and an outlet box having a surface area of 1160 mm2 (180 sq. in.) or more shall be covered with noncombustible material***. Previous editions of the NEC required the combustible wall covering between the opening for the outlet box and the edge of the canopy to be covered with noncombustible material in all cases.

Sheetrock is the most common material used for wall and ceiling finishes but some installations involve mounting the luminaire over an outlet box that has been recessed into combustible surfaces such as wood wall paneling, tongue and groove wood ceilings, and even decorative wooden beams. According to the Code change, these types of installations would require the exposed combustible surface under the canopy of the luminaire to be covered with noncombustible material if the surface was 180 sq. in. or more.

Section 410.6 requires all luminaires to be listed. Canopy-type luminaires that have been listed by a nationally recognized testing laboratory have been tested and found

A combustible surface area of 180 sq. in. or more must be covered with noncombustible material.

to be suitable to be surface mounted over an exposed combustible surface less than 180 sq. in. without subjecting the combustible surface to more than 90Âº C per section 410.11. Anything larger than that has not been evaluated by a testing lab, and the exposed combustible surface must be covered with noncombustible material.

Question 77: Which of the following installations requires a wall finish to be covered with noncombustible material?

A: A luminaire installed over an outlet box, recessed in wood paneling, where a 12 inch X 15 inch section of the wood surface is exposed under the luminaire canopy.
B: A luminaire installed over an outlet box, recessed in wood paneling, where less than 180 sq. in. of the wood surface is exposed under the luminaire canopy.
C: A luminaire installed over an outlet box, recessed in a noncombustible surface, where 200 sq. in. of the surface is exposed under the luminaire canopy.
D: A luminaire installed over an outlet box, recessed in wood paneling, where a 13 inch X 13 inch section of the wood surface is exposed under the luminaire canopy.

Question 78: 410.130(G) Disconnecting Means.

Question ID#: 732.0

Fluorescent luminaires with double-ended lamps and ballasts require a disconnecting means either inside or outside each luminaire. For existing luminaires without disconnecting means, a disconnecting means must be installed when the ballast is replaced.

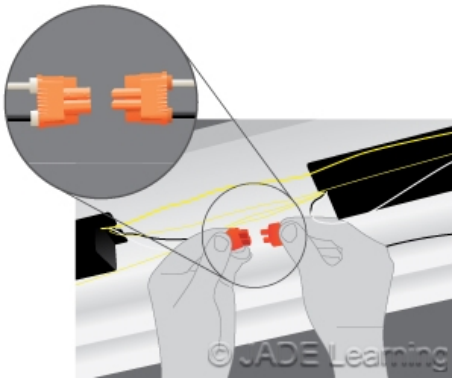
The 2011 NEC had an exception for industrial establishments with qualified persons to service the luminaires. The 2014 NEC has deleted that exception.

The arguments to delete the exception and require fluorescent luminaires in industrial locations to have disconnecting means were about providing the same level of protection to qualified persons when servicing luminaires as was required elsewhere.

The popular inline disconnects used with fluorescent luminaires have made installing them in existing luminaires quick and relatively inexpensive.

The remaining 4 exceptions to 410.130(G) are:

- Luminaires in hazardous locations do not require a disconnecting means.
- Emergency lighting, including exit signs, do not require a disconnecting means.
- Cord-and-plug connected luminaires are considered to already have a disconnecting means if the plug and receptacle are accessible.
- If there is more than one luminaire in a space, and there is a way to disconnect the luminaires so that the space cannot be left in total darkness, then each luminaire is not required to have a disconnecting means.



Industrial locations now also require that fluorescent luminaires with double-ended lamps and ballasts have a disconnecting means.

Question 78: Which of the following luminaires require a disconnecting means for each luminaire?

A: A fluorescent luminaire in an industrial facility.
B: An LED luminaire in an office conference room.
C: A fluorescent luminaire in a hazardous location.
D: An HID luminaire in a big box retail store.

Question 79: 422.51 Vending Machines.

Question ID#: 739.0

New requirements for ground-fault circuit-interrupter protection (GFCI) at vending machines have been added to Section 422.51. Now vending machines that are directly wired, as well as those that are cord-and-plug connected, are required to be GFCI protected.

Vending machines that are hardwired must be connected to a GFCI protected circuit.

422.51(A) is similar to the vending machine section in the 2011 NEC, but requires a ground-fault circuit-interrupter that is a part of the attachment plug to be identified for portable use. Cord-and-plug connected vending machines that are manufactured or remanufactured on or after January 1, 2005, must include a ground-fault circuit-interrupter identified for portable use as an integral part of the attachment plug or be located in the cord within 300 mm (12 in.) of the attachment plug if it is not built into the plug itself. Older vending machines manufactured or remanufactured prior to January 1, 2005, must be connected to a GFCI protected outlet. The GFCI protection can be provided by using a GFCI-type receptacle or installing a GFCI breaker ahead of the branch circuit in the panelboard.

422.51(B), which is new in the 2014 NEC, states that vending machines not utilizing a cord-and-plug connection shall be connected to a GFCI protected circuit. The same hazard exists for vending machines that are hardwired as for those that are cord-and-plug connected. Vending machines are often installed in damp or wet locations and subject to heavy use or abuse by the general public. In the event of an electrical malfunction, it is important that GFCI protection be present for the vending machine whether the machine is cord-and-plug connected or directly wired to the branch circuit without the use of a receptacle. It is also important that the GFCI device is readily accessible according to 422.5.

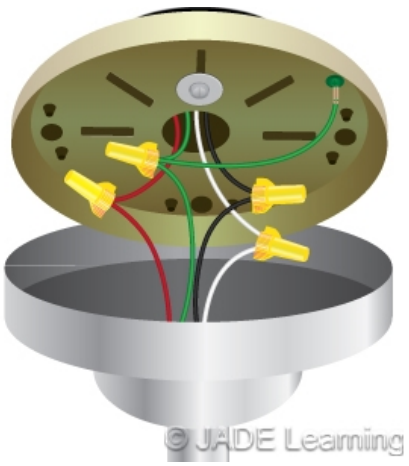
Question 79: Which of the following is true of vending machines that are not cord-and- plug connected?

A: They must be connected to a receptacle that is GFCI protected.
B: They must be equipped with a GFCI that is integral to the attachment plug.
C: They must be connected to a circuit that is GFCI protected.
D: They must be connected to a GFCI-type receptacle.

Question 80: 422.19,422.20,422.21 Requirements for Outlet Boxes.

Question ID#: 736.0

New sections 422.19, 422.20, and 422.21 have been added to provide specific requirements for ceiling-suspended paddle fans.



Canopies and outlet boxes must provide sufficient space for the conductors and their connecting devices.

Section 422.19 now permits the cubic inch capacity of a ceiling suspended (paddle) fan canopy and the outlet box to be added together to provide sufficient space for conductors and their connecting devices. It is important that there is enough space within the box and canopy of a ceiling fan to make all the needed connections. Sometimes a ceiling fan box becomes a junction box for other conductors besides those for the actual fan. This practice is allowable as long as the box complies with Section 314.16 and has sufficient space for all conductors within the box.

Section 422.20 states that in a completed installation, each outlet box shall be provided with a cover unless covered by means of a ceiling-suspended (paddle) fan canopy. Similar language is found in 410.22 which allows a luminaire, lampholder, or receptacle to be used for this purpose but does not include a ceiling fan as an acceptable way to cover the box.

Section 422.21 requires any combustible ceiling finish exposed between the edge of a ceiling-suspended (paddle) fan canopy or pan and an outlet box to be covered with noncombustible material. This is important for installations where a ceiling fan is mounted over an outlet box that has been recessed into a combustible ceiling such

as wood paneling or a tongue and groove wood finish. It is common for the canopy of a ceiling fan to be significantly larger than the outlet box that it covers thus leaving an exposed combustible surface present next to the wiring splices. These surfaces are now required to be covered with noncombustible material.

Question 80: What is the purpose of providing sufficient space within an outlet box and a ceiling fan canopy?

A: To provide enough room for conductors and splicing devices.
B: To allow space for devices such as remote control fan receivers.
C: To provide enough room for future conductors.
D: To provide enough room for future connections.

Question 81: 445.11 Generators. Marking.

Question ID#: 747.0

Major revisions have been made to the marking requirements for generators. Some re-organizing now requires that the marking requirement for power factor, subtransient and transient impedances, insulation system class, and time rating is only for nameplates of generators larger than 15 kW.

The most significant change to this section is the new requirement that marking shall be provided by the manufacturer to indicate whether or not the generator neutral is bonded to the generator frame. Since generators are permitted to be installed either as a separately derived system or not, this change will greatly assist installers and inspectors as they try to determine proper bonding requirements, transfer switch application, and signage required by 700.7, 701.7, and 702.7.

Generators now must be marked to indicate whether or not the generator neutral is bonded to the generator frame.

In many installations, the generator supplier will install the generator and an electrical contractor will provide all wiring methods from the generator through the transfer switch and on to the loads served by the generator. Since the electrician is contracted only to install the wiring methods, it is quite common for the electrician to have no idea if the generator is equipped with a system bonding jumper. Prior to this Code change, it was very common for the electrical inspector to request that the generator enclosure be dismantled in order to verify if the generator contained a system bonding jumper. Based on the findings, the inspector could then inspect the generator as either a separately derived system or a system that is not separately derived.

The last part of this Code change specifies that where the bonding of a generator is modified in the field, additional marking shall be required to indicate whether or not the generator neutral is bonded to the generator frame.

Question 81: When the bonding of a generator has been field modified, additional marking shall be required to indicate which of the following?

A: Whether or not the generator neutral is bonded to the grounded conductor.
B: Whether or not the generator equipment grounding conductor is bonded to the generator frame.
C: Whether or not the generator neutral is bonded to the generator frame.
D: Whether or not the generator neutral is bonded to the grounding electrode.

Question 82: 406.12 Tamper-Resistant Receptacles.

Question ID#: 723.0

Tamper-resistant receptacles are required for nonlocking type 125-volt, 15- and 20-ampere receptacles in dwellings, guest rooms and guest suites of hotels and motels, and child care facilities.
There are four exceptions where tamper-resistant receptacles are not required:

- Receptacles located more than 5 Â½ ft. above the floor.
- Receptacles that are part of a luminaire or appliance.
- A single receptacle or a duplex receptacle for two appliances located within dedicated space and not easily moved.
- Nongrounding receptacles used for replacements.

Receptacles in dwelling units, hotel guest rooms, and child care facilities must be tamper-resistant unless covered by one of the 4 exceptions.

The exceptions cover locations where children cannot reach the receptacle, and there was no reason why these receptacles would be more accessible to children in hotels or motels or child care facilities than in dwellings.
It should be noted that for hotels and motels, the requirement for tamper resistant receptacles only applies within the guest rooms or guest suites. Receptacles located in the hotel/motel office, lobby, breakfast area or other common areas outside of a guest room or guest suite are not required to be tamper resistant.

Exceptions 1 and 2 cover receptacles that are out of reach of a child.Â Exception No. 3 recognizes that a child could not move an appliance that was large enough to be in a dedicated space.Â Exception No. 4 acknowledges that nongrounding type receptacles are not available as tamper-resistant.

Question 82: Which location does NOT require tamper-resistant receptacles?

A: The kitchen in a dwelling.
B: The lobby of a motel.
C: The sleeping area in a hotel guest room.
D: The reception area of a day care facility for children.

Question 83: 480.9 Battery Locations.

Question ID#: 754.0

A number of new requirements have been added for battery locations:

480.9(C) Spaces About Battery Systems
Minimum 1 inch clearance between a battery and a wall on the side that does not require maintenance. Work space is measured from the edge of the battery cabinet, rack, or tray.

480.9(D) Top Terminal Batteries
When batteries with terminals on the top are installed on racks, the required working space between the batteries and the row or ceiling above the batteries is per the manufacturer's instructions.

480.9(E) Egress
The personnel doors for entrance to or egress from the battery room must open in the direction of egress and be equipped with panic hardware.

480.9(F) Piping in Battery Rooms
No gas piping is permitted in a dedicated battery room.

480.9(G) Illumination
Illumination must be provided in a battery room unless the battery room is lit from an adjacent light source. Lighting cannot be controlled by automatic means only.

A personnel door(s) intended for entrance to, and egress from, rooms designated as battery rooms shall open in the direction of egress and shall be equipped with listed panic hardware.

Lighting cannot expose personnel servicing the luminaires to energized battery components.

Question 83: How is battery system working space to be measured?

A: From battery terminals.
B: From the edge of the battery cabinet, racks, or trays.
C: From the edge of the battery.
D: From the center of the battery.

Question 84: 450.10(A) Grounding. Dry-Type Transformer Enclosures.

Question ID#: 750.0

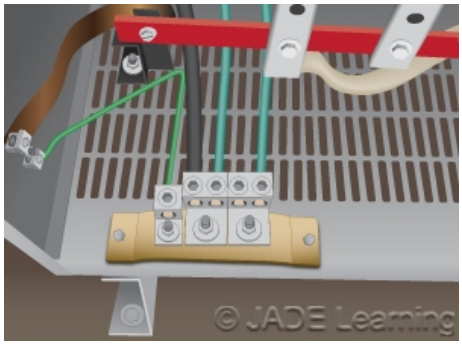
There are new requirements for grounding dry-type transformer enclosures. Connections for equipment grounding conductors and supply-side bonding jumpers must now be made at a terminal bar that is mounted inside the transformer enclosure.

The terminal bar must be bonded to the enclosure and cannot be installed on or over any vented portion of the enclosure.

There is an exception that permits the grounding and bonding connections for dry-type transformers with wire-type leads to be made with pressure connectors, fasteners, or any of the other methods in 250.8.

When a terminal bar is mounted to the transformer enclosure, it is important that the terminal bar or the conductors connected to it do not block the vents that provide air flow around the transformer coils.

A terminal bar will ensure that all of the grounding and bonding connections made at the transformer have a common point and do not depend on the metal transformer enclosure to tie the connections together.



Where separate equipment grounding conductors and supply-side bonding jumpers are installed, a terminal bar for all grounding and bonding conductor connections shall be secured inside the transformer enclosure.

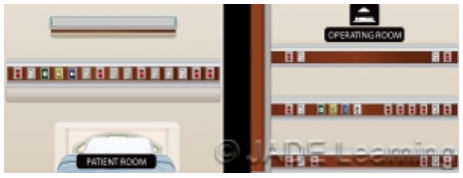
Question 84: When can the grounding and bonding connections be made at a dry-type transformer without using a terminal bar?

A: When the transformer is mounted 8 ft. or more above the floor.
B: When the transformer is equipped with wire-type connections.
C: When the transformer is equipped with vented openings.
D: When the transformer is connected as a step-down transformer.

Chapter 5

Question 85: 517.19(B) and (C) Patient Bed Location Receptacles and Operating Room Receptacles.

Question ID#: 765.0



A specific number of receptacles are required at patient bed locations and operating rooms.

Major changes have occurred in the minimum number of receptacles required at patient bed locations. There is also a new requirement detailing the minimum number of receptacles required to serve an operating room.

In section 517.19(B), the previous edition of the Code required critical care areas to have at least 6 receptacles serving the patient bed location. Now there must be at least 14 receptacles serving the patient bed location in critical care areas, and at least one of them is required to be supplied from either (1) the hospital normal system branch circuit or (2) a critical branch circuit supplied by a different transfer switch than the other receptacles at the location.

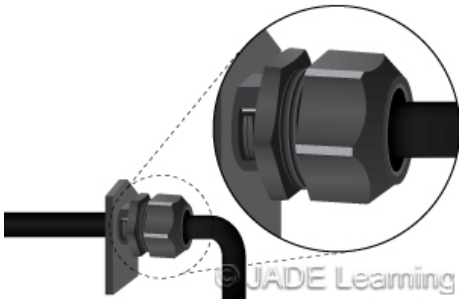
Receptacle requirements for operating rooms have never been addressed by the NEC prior to this new Code cycle. Each operating room will be required to be equipped with a minimum of 36 receptacles. At least 12 of the receptacles shall be connected to either of the following: (1) The normal system branch circuit required by 517.19(A); or (2) A critical branch circuit supplied by a different transfer switch than the other receptacles at the same location.

Question 85: Of the following receptacle configurations, which installation complies with the minimum number of receptacles required at a patient bed location in a critical care area? (Assuming that the normal system and critical branch are fed from different backup power transfer switches). A duplex receptacle counts as two receptacles.

A: Six duplex receptacles fed from the critical branch and one single receptacle fed from the normal system branch circuit.
B: Twelve duplex receptacles fed from the equipment branch circuit.
C: Twelve single receptacles fed from the critical branch and one single receptacle fed from the normal system branch circuit.
D: Six duplex receptacles fed from the critical branch and one duplex receptacle fed from the normal system branch circuit.

Question 86: 590.4(I) Termination(s) at Devices.

Question ID#: 772.0



Fittings need to be listed for the purpose of connecting flexible cords and cables to boxes.

In temporary installations, when a flexible cord or cable enters an enclosure that has devices where conductors are terminated, the fittings for the flexible cord or cable must be listed for connecting the flexible cords and cables to boxes.

In the 2011 NEC, the fittings that connected the cord or cable to the box had to be "designed for the purpose." The stronger language in the 2014 NEC will increase the safety of the installation by requiring fittings that have passed a round of testing by 3rd party testing labs.

Temporary installations are subject to abuse by workers of all trades. Temporary wiring is often removed and re-installed in another location. If a flexible cord or cable is connected to a device box where the conductors are terminated, and the cord or cable comes loose from the enclosure, the conductors can pull out of the terminations and create a ground fault. Listed fittings for flexible cord and cable keep the cord secure inside the fitting by different clamping mechanisms that are designed for the shape of the cord or cable. Using a fitting which is not listed to connect a flexible cord or cable to an enclosure means the cord or cable will not be as securely attached to the enclosure.

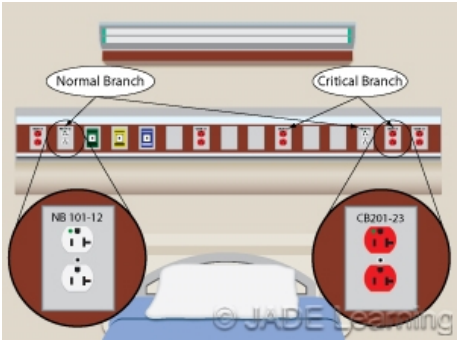
Using an NM connector as a fitting to secure a round cord to a device box is an example of using a fitting which is not listed for the purpose and would be a clear Code violation.

Question 86: In a temporary installation, when a flexible cord is connected to a box, which of the following statements is true?

A: The fittings used with flexible cords cannot be connected to boxes with eccentric knockouts.
B: When connecting flexible cords to boxes, an anti-short bushing must be installed.
C: Non-metallic fittings are not permitted to be used with metallic boxes.
D: The fittings used must be listed for connecting flexible cords and cables to boxes designed for the purpose.

Question 87: 517.18(A) & (B) Patient Bed Location and Receptacles.

Question ID#: 764.0



Patient bed locations shall be supplied by at least two branch circuits; receptacles supplied from the critical branch shall be readily identifiable.

Section 517.18(A) and (B), which apply to general care areas within health care facilities, have seen significant revisions regarding branch circuit identification and minimum number of receptacles required at patient bed locations.

Section 517.18(A) deals with the minimum number of branch circuits required to serve patient bed locations and requires each patient bed location to be supplied by at least two branch circuits, one from the ***critical branch*** and one from the normal system. The term "emergency system", which was used in previous Code editions, has been replaced with the term "critical branch". A new requirement in this section requires that the electrical receptacles or the cover plate for receptacles supplied from the critical branch have a distinctive color or marking so as to be readily identifiable. The receptacles or cover plates shall also indicate the panelboard and branch-circuit number supplying them.

Section 517.18(B) specifies the minimum number of receptacles required to serve patient bed locations in general care areas. In order to correlate with the new rules found in NFPA 99 ***Health Care Facilities Code,*** the previous requirement of at least four receptacles has been increased to eight. The revised text states that each patient bed location shall be provided with a minimum of eight receptacles. They shall be permitted to be of the single, duplex, or quadruplex type or any combination of the three. A duplex receptacle is counted as 2 receptacles, and a quad receptacle is counted as 4 receptacles.

All receptacles shall be listed "hospital grade" and shall be so identified. As part of the listing process, receptacles that are listed as "hospital grade" are required to be identified by the green dot on the front of the receptacle as well as marked "Hospital Grade" or "Hosp. Grade", typically on the back of the receptacle where visible during installation.

Question 87: Receptacles in general care areas that serve patient bed locations must be marked so that they are readily identifiable in order to make it evident that they are supplied from what branch?

A: Emergency.
B: Critical.
C: Normal.
D: Essential.

Chapter 6

Question 88: 690.5(A) Ground-Fault Protection. Ground-Fault Detection and Interruption.

Question ID#: 789.0

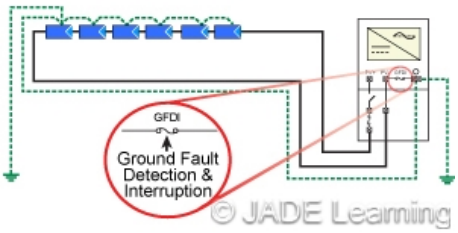
Ground-fault detection equipment in grounded photovoltaic (PV) systems is now required to detect a ground-fault in the PV array DC conductors, including grounded and ungrounded conductors. The 2011 NEC did not say the ground-fault detection equipment had to be capable of detecting a ground-fault in the DC grounded conductor.

Ground-fault detection equipment for PV systems must also be listed, so from now on listed ground-fault detection equipment must be capable of detecting a ground-fault in both grounded and ungrounded DC conductors.

Older style ground-fault detection equipment had trouble detecting ground-faults in the grounded conductor. These undetected ground-faults were the cause of a number of rooftop fires where PV systems were installed. Newer style ground-fault detection equipment for PV systems will be able to sense ground-faults in both grounded and ungrounded conductors, and will have lower trip settings than older models.

Also, one of the exceptions to this section in the 2011 NEC has been deleted. The old exception permitted ground-fault protection to be omitted on non-dwelling locations if the equipment grounding conductor was sized at twice the size required by Table 250.122. Increasing the size of the equipment grounding conductor was found not to make a significant difference in preventing fires.

In addition to being listed and capable of detecting ground-fault currents in grounded and ungrounded conductors, ground-fault detection for PV systems must interrupt the flow of fault current and indicate a ground-fault is present.



Ground-fault protection devices must detect a ground fault in the PV array, interrupt the flow of fault current, provide indication of the fault, and be listed.

Question 88: Which of the following statements about ground-fault protection for grounded DC PV arrays is correct?

A: Ground-fault protection is not required for any PV array system installed for a single-family dwelling unit.
B: Devices installed to provide ground-fault protection for grounded DC PV arrays are required to be listed.
C: Devices installed to provide ground-fault protection for grounded DC PV arrays are required to provide both a visible and audible indication that the device has detected a ground-fault.
D: Ground-fault protection for DC PV arrays is required to protect people from electrical shock hazards.

Question 89: 680.21(C) Motors. GFCI Protection.

Question ID#: 782.0

According to Section 680.21(C) in the 2011 NEC, GFCI protection was required for all 15- and 20- amp, single-phase 120-, 208-, and 240-volt branch circuits that supplied pool pump motors that were hardwired or cord-and-plug connected. Under this rule, a 120-volt 20-amp branch circuit was required to be GFCI protected, but a 120-volt pump supplied by a 25- or 30-amp branch circuit was not required to be GFCI protected. From a safety stand-point, this didn't make sense.

The 2014 NEC corrected this problem by deleting the language that limited the requirement for GFCI protection to pumps supplied by 15- and 20- amp branch circuits. Under the 2014 NEC, cord-and-plug connected as well as hardwired pumps supplied by single-phase 120 to 240 volt branch circuits, regardless of their ampacity, are required to be GFCI protected.

All single-phase, 120 through 240 volt branch circuits that supply pool pump motors are required to be GFCI protected.

Question 89: Which of the following branch circuits for a swimming pool pump motor is required to be GFCI protected?

A: A 20-amp, 3-phase, hardwired, 208 VAC branch circuit.
B: A 15-amp, 3-phase, 230 VAC branch circuit, cord-and-plug connected.
C: A 30-amp, 3-phase, hardwired, 230 VAC branch circuit.
D: A 25-amp, 1-phase, hardwired, 230 VAC branch circuit.

Question 90: 694 Wind Electric Systems.

Question ID#: 798.0

The title and scope of Article 694 was revised to include the requirements for wind electric systems regardless of their rated output. Article 694 now covers Wind Electric Systems both below and above 100 kW. It was recognized that the rated output of a wind turbine electric system did not affect the requirements for installing the turbine.

Article 694 is no longer limited to wind electric systems 100 kW or less.

The word "small" has been deleted from the title to Article 694 and at every place it was used in the Article. Now the NEC covers all wind electric system generators regardless of their size. UL standards which cover wind electric systems do not have a dividing line between systems 100kW or less and systems over 100kW, and now the NEC does not make a distinction either.

In addition to changes affecting the size of the systems that the NEC covers, two changes in 694.7 affect the installations of these systems.

Section 694.7(E) which permits the installation of a receptacle supplied by the wind electrical system for maintenance and data acquisition was revised; now, all 125- volt single-phase, 15- and 20- amp receptacles have to be provided with GFCI protection.

Section 694.7(F) was revised to permit the towers that support wind generators and alternators to be used as raceways if evaluated for that purpose when listed.

Question 90: Which of the following statements about wind electrical systems is correct?

A: Wind electrical systems with a rated output in excess of 10 kW are not covered by the NEC.
B: Wind electrical systems with a rated output in excess of 100 kW are not covered by the NEC.
C: Wind electrical systems are covered by the NEC regardless of their rated output.
D: Only interactive wind electrical systems are covered by the NEC.

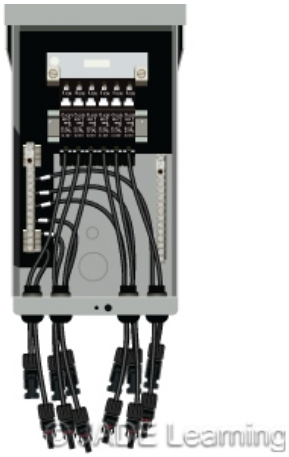
Question 91: 690.15(C) Direct-Current Combiner Disconnects.

Question ID#: 793.0

Disconnects are now required for the outputs of DC combiners that are mounted on the roofs of dwellings or other buildings. The load break disconnecting means must be located in the combiner or within 6 ft. of the combiner. The disconnecting means can be remotely operable but must be capable of being operated manually if the control power is off.

A new definition of Direct-Current (DC) Combiner is in 690.2. ***A device used in the PV source and PV output circuits to combine two or more DC circuit inputs and provide one DC circuit output.*** The DC combiner takes multiple inputs from solar PV panels (PV source) and combines them into a single DC output circuit. It is the single DC output that must be capable of being disconnected.

Having a disconnecting means for the PV modules on the roof of a building will allow firefighters and first-responders to quickly disconnect the PV system at the source. In an emergency this will disconnect PV wiring in the walls of the structure as well as de-energize PV conductors anywhere downstream from the combiner boxes. This will mean that firefighters on the roof won't come in contact with energized conductors as they fight the fire on the roof or make roof penetrations if the fire has spread to the inside of the structure.



DC combiner disconnects must be in the combiner box or within 6 ft.

Question 91: Where are direct-current combiner disconnects required?

A: On the roofs of dwellings.
B: For PV systems that use micro-inverters.
C: For PV systems mounted on wood structures on the ground.
D: On pole-mounted PV systems.

Question 92: 690.12 Rapid Shutdown of PV Systems on Buildings.

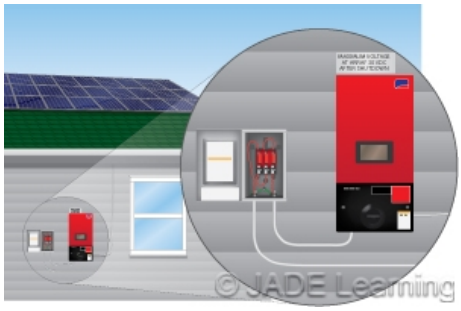
Question ID#: 792.0

When a building is on fire, energized conductors pose an additional risk to firemen and other first responders. Solar photovoltaic systems will continue to generate power as long as the sun is shining. If the PV modules are mounted on the roof, and the manual DC disconnect is mounted at grade level, the conductors from the PV combiner boxes on the roof to the DC disconnect will remain energized, even if the DC disconnect is shut off.

A new requirement in 690.12 requires an automatic rapid shutdown of PV systems installed on or in buildings. The rapid shutdown must reduce the voltage on PV conductors that are more than 5 ft. in length inside the building or more than 10 ft. from a PV array. The voltage on the PV conductors must be reduced to not more than 30 volts within 10 seconds of when the rapid shutdown starts.

If the building with the PV modules also has a utility service, a permanent plaque must be posted with the words, PHOTOVOLTAIC SYSTEM EQUIPPED WITH RAPID SHUTDOWN.

Exactly how the rapid shutdown of the PV system is accomplished is not spelled out. Sensors embedded in the combiner boxes or in the modules themselves are a possibility. Until such systems are commercially available, the authority having jurisdiction may not enforce this requirement.



PV systems installed on buildings will now need to be capable of a rapid shutdown.

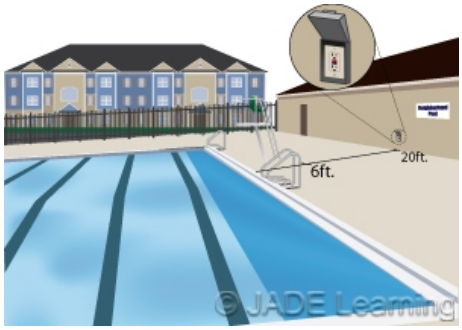
Question 92: Which of the following installations would require a rapid shutdown method be provided for PV system conductors?

A: Rooftop PV array conductors that have a length of 20 feet from the array to an inverter.
B: Pole-mounted PV source circuit conductors that have a length of 4 feet.
C: Rooftop source circuit conductors that enter the building for 4 feet and have a total length of 10 feet.
D: Rooftop PV array conductors with a length of 10 feet from the array to an inverter.

Question 93: 680.22(A)(1) and (2) Receptacles. Required Receptacles, Location. Circulation and Sanitation System, Location.

Question ID#: 783.0

In the 2011 NEC, Section 680.22 required that permanently installed pools at dwellings have at least one GFCI protected, 125-volt, 15- or 20-amp receptacle connected to a general purpose branch circuit installed near the pool. This receptacle was required to be at least 6 feet from the pool but not more than 20 feet from the inside wall of the pool and not more than 6 feet, 6 inches above the grade or deck level surrounding the pool.



A receptacle outlet needs to be not less than 6 ft. and not more than 20 ft. from the inside wall of a permanent pool.

The change to this section is to broaden the requirement to all locations, not just dwelling units. Public pools, hotel pools, and neighborhood pools are now all required to have at least one GFCI protected, 125-volt, 15- or 20-amp receptacle connected to a general purpose branch circuit installed at least 6 feet from the pool but not more than 20 feet from the inside wall of the pool and not more than 6 feet, 6 inches above the grade or deck level surrounding the pool.

The reason for requiring this receptacle was to prevent people from using extension cords plugged into non-GFCI protected outlets and bringing the devices close to the edge of the pool. If such a practice was dangerous at dwelling units, it is equally dangerous at other locations. In the 2014 NEC, a receptacle on a general-purpose branch circuit is required at all permanently installed pools, not just at dwelling pools.

Also, a change at 680.22(A)(2) did away with the requirement for a pool pump motor to be connected to a locking type receptacle. Receptacle outlets for circulation and sanitation pump motors still must be of the grounding type, consist of a single receptacle, and be GFCI protected, but they are no longer required to be of the locking type.

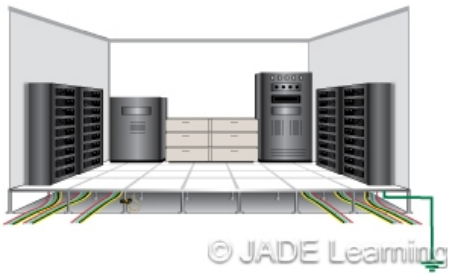
Question 93: Which locations require at least one GFCI protected, 125-volt, 15- or 20-amp, receptacle outlets installed near a swimming pool?

A: Inflatable pools only.
B: Dwelling units only.
C: Dwelling unit or public pools.
D: Public pools only.

Question 94: 645.14 & 645.15 System Grounding & Equipment Grounding and Bonding.

Question ID#: 778.0

Section 645.15, Grounding, in the 2011 NEC has been divided into System Grounding in 645.14 and 645.15, Equipment Grounding and Bonding, in the 2014 NEC. Important clarifications have been made in both sections.



Auxiliary grounding electrode conductors for IT equipment must comply with 250.54.

The first sentence in 645.14 states that separately derived power systems shall be installed in accordance with the provisions of Parts I and II of Article 250. Simply put, if a separately derived system is used in conjunction with IT equipment, it must comply with the same rules as other separately derived systems installed in ordinary locations. The remainder of 645.14 is a mirror image of existing requirements in section 645.15 and states that power systems derived within listed IT equipment that supply IT systems through receptacles or cable assemblies supplied as part of this equipment shall not be considered separately derived for the purpose of applying 250.30.

A new sentence has been added to 645.15 and states that any auxiliary grounding electrode(s) installed for information technology equipment shall be installed in accordance with 250.54. Section 250.54 makes it clear that auxiliary grounding electrodes can be used, but the earth can never be used as an effective ground-fault current path. Section 250.54 also says auxiliary ground rods are not required to be bonded to the grounding electrode system, or have a resistance to ground of 25 ohms or less.

This is commonly violated when isolated ground-type receptacles are installed in an IT setting and the equipment grounding conductor is connected only to an auxiliary grounding electrode that has no direct connection back to the service or derived system, thus using the earth as a ground. At some point, equipment grounding conductors for branch circuits and feeders used for IT equipment are required to terminate directly at an equipment grounding conductor terminal of the applicable derived system or service. See 250.146(D) and 408.40 Exception for more information.

Question 94: A power system derived within listed IT equipment that supplies IT systems through a cable assembly supplied as part of the equipment is NOT _____?

A: Separately derived.
B: Code compliant.
C: Grounded.
D: Isolated.

Question 95: Article 625 Electric Vehicle Charging System.

Question ID#: 777.0

Article 625, Electric Vehicle Charging Systems, has been reorganized, new definitions have been added, and a number of changes have been made.Â

Article 625 is now organized into 3 parts:

Part IÂ Â Â Â Â Â Â Â Â Â General

Part II Â Â Â Â Â Â Â Â Â Â Equipment Construction

Part IIIÂ Â Â Â Â Â Â Â Â Installation

New definitions have been added for Cable Management System (Electric Vehicle Supply Equipment), Output Cable to the Electric Vehicle, and Power-Supply Cord.Â The definition of a power-supply cord is, ***An assembly of an attachment plug and length of flexible cord that connects the electric vehicle supply equipment (EVSE) to a receptacle.***Â

A power-supply cord includes the attachment plug and flexible cord that connects the electric vehicle supply equipment (EVSE) to a receptacle.

The new definition of power-supply cord is important because some jurisdictions were only approving EVSE equipment that was hardwired and not approving EVSE equipment that was connected to a receptacle.Â

Section 625.17 limits the length of the power-supply cord to 12 inches if the personnel protection system is located within the enclosure of the supply equipment or charging system.Â The power-supply cord (not the output cable to the electric vehicle) can be between 6 ft. and 15 ft. long if the personnel protection system is located at the attachment plug, or within the first 12 inches of the power-supply cord.Â Â Â

EVS equipment is permitted to be cord-and-plug connected in accordance with 625.44. Only non-locking, grounding type receptacles are permitted to be used. Section 625.44 permits EVSE equipment to be connected to 125-volt, single-phase, 15- and 20-ampere non-locking receptacle outlets.Â EVSE equipment rated for a maximum of 250 V is permitted to be connected to 2-pole, 3-wire and 3-pole, 4-wire grounding-type nonlocking receptacle outlets rated not more than 50 amperes.Â Connections can also be made to a supply of less than 50 volts DC.Â All other electric vehicle supply equipment not mentioned above must be hardwired with a permanent connection.

Question 95: Which one of the following receptacle types is permitted to supply cord-and plug- connected electric vehicle supply equipment?

A: A 125-volt, single-phase, 15-ampere, non-grounding type, non-locking receptacle.
B: A 125-volt, single-phase, 15-ampere, grounding-type, locking receptacle.
C: A 250-volt, single-phase, 50-ampere, grounding-type, non-locking receptacle.
D: A 250-volt, single-phase, 60-ampere, grounding-type, non-locking receptacle.

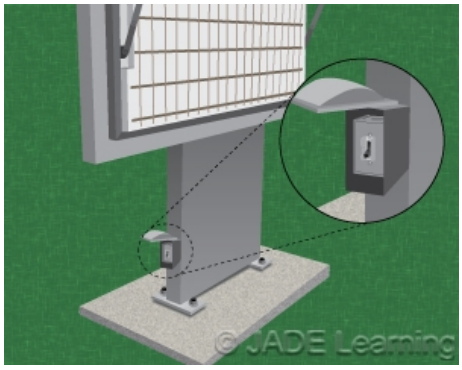
Question 96: 600.6(A)(1) Disconnects. At Point of Entry to a Sign Enclosure.

Question ID#: 775.0

Disconnects for electric signs and outline lighting must now be located at the point where the feeder or branch circuit enters the sign enclosure or pole.

In the 2011 NEC, the disconnect could be located anywhere on the sign enclosure. This meant that the feeder or branch circuit could enter the sign enclosure at one end of the sign and the disconnect could be at the other end of the enclosure. Line-side conductors inside the sign would remain energized even if the disconnect was in the off position, posing a serious shock hazard to the sign technician.

Requiring the disconnecting means at the point where the feeder or branch circuit enters the sign, or where the conductors enter the pole that supports the sign, will mean that when the disconnect is off all conductors inside the sign will be de-energized.



A sign disconnect is required at the point the feeder circuit or branch circuit(s) enters the sign enclosure.

Exception: A disconnect shall not be required for branch or feeder circuits passing through the sign where enclosed in a Chapter 3 listed raceway.

For a sign that has an integral disconnect switch, it is common for individually insulated branch circuit conductors feeding the sign to be routed up inside the support pole or sign body before ever reaching the line side of the disconnecting means. Even when the disconnect switch is turned off, there are still live conductors inside the sign which can be dangerous for those servicing the sign who assume the sign has no power. Requiring the disconnecting means to disconnect the conductors at the point where the conductors enter the sign enclosure will ensure that there are no conductors within a sign pole or enclosure that are still live after the switch is opened. The exception allows conductors in listed raceways to pass through the sign enclosure without the need of a disconnect switch. It is important to understand that this will only apply if the conductors pass through the sign and do not terminate within the sign enclosure.

Question 96: Which of the following conductors are required to be disconnected at the point where the conductors enter a sign enclosure?

A: Circuit conductors that supply a convenience receptacle that happens to be secured to the sign post but does not enter the sign.
B: Feeder conductors passing from one section to another within a sign but are enclosed in liquidtight flexible nonmetallic conduit.
C: Circuit conductors that supply a time clock mounted on the sign post but do not enter the sign enclosure.
D: Branch circuit conductors entering a sign pole from an underground raceway stubbed into the pole base.

Question 97: 680.42(B) Outdoor Installations. Bonding.

Question ID#: 787.0

A self-contained spa or hot tub now does not require an equipotential bonding grid. The 2014 NEC has incorporated a Tentative Interim Amendment from the 2011 NEC that permits a self-contained spa or hot tub to be installed on or above grade without a connection to an equipotential bonding grid.

In order to install a spa or hot tub without an equipotential bonding grid underneath the perimeter surfaces, the spa or hot tub must meet the following conditions:

- It must be self-contained and listed for aboveground use.
- It cannot be identified for indoor use only.
- It must be installed according to the manufacturer's instructions.
- The top rim of the tub must be a minimum of 28 inches above any surface that extends up to 30 inches horizontally from the spa or hot tub.

In certain instances, an aboveground spa or hot tub does not require equipotential bonding of perimeter surfaces.

Requiring an equipotential bonding grid around a hot tub that was installed above ground usually meant cutting the concrete around the spa or hot tub and installing a bare No. 8 AWG copper conductor. This added considerable expense and a lot of extra work to the installation.

There had not been any reported incidents of people getting shocked in an aboveground spa that could be tied to the lack of an equipotential bonding grid. Without proof that installing an equipotential bonding grid around a spa or hot tub reduced the shock hazard and increased safety for the general public, the NEC Code panels decided to do away with the requirement for an equipotential bonding plane for self-contained spas or hot tubs installed above ground.

Question 97: Which of the following is one of the conditions that would permit a spa to be installed without equipotential bonding for the perimeter surfaces?

A: The spa is identified as suitable for indoor use only.
B: The top rim of the spa is 26 inches above the perimeter surface.
C: The spa is installed outdoors and listed for above ground use.
D: The spa is installed in the ground rather than above ground.

Chapter 7-9

Question 98: Chapter 9, Table 4 & 5.

Question ID#: 815.0

The column headings for both Table 4 and Table 5 in Chapter 9 have been re-arranged to make the tables easier to use.

Table 4 lists the area in square inches and the internal diameter for 12 different types of conduit or tubing. Table 4 is used to select the size of conduit, based on the square inch area permitted for 1 wire, 2 wires, or over 2 wires in the conduit or tubing. The most common column used to select the proper size conduit is "Over 2 Wires 40%." In the 2011 NEC, this was the far right column. It was easy to make a mistake reading all the way across the table. In the 2014 NEC, the "Over 2 Wires 40%" column has been moved to the first column on the left, after the column for the standard trade sizes of conduit.

Table 5 gives the approximate area and approximate diameter of different wire types and gauges. The approximate area of a conductor is used to calculate how many conductors can fit inside conduit or tubing. In the 2011 NEC, the approximate area of a conductor was located on the far right side of the table. In the 2014 NEC, the approximate area of a conductor has been moved to the first column on the left after the size of the conductor in AWG or kcmil. This change will make Table 5 easier to use.

TABLE 4 Article 342 - Intermediate Metal Conduit (IMC)

Trade Size	> 2 Wires 40% sq. in.	60% sq. in.	1 Wire 53% sq. in.	2 Wires 31% sq. in.
1/2 inch	.0137	.205	.181	.106
3/4 inch	.235	.352	.311	.182
1 inch	.384	.575	.508	.297
1 1/4 inch	.659	.988	.873	.510
1 1/2 inch	.890	1.335	1.179	.690
2 inches	1.452	2.178	1.924	1.125
2 1/2 inches	2.054	3.081	2.722	1.592
3 inches	3.169	4.753	4.199	2.456
3 1/2 inches	4.234	6.351	5.610	3.281
4 inches	5.452	8.179	7.224	4.226

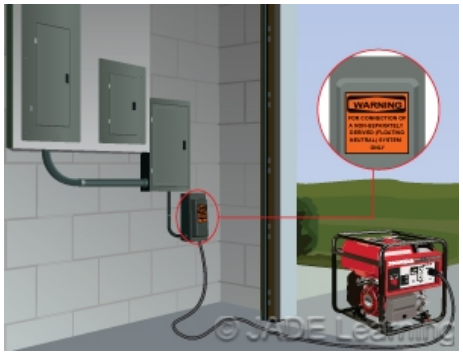
Tables 4 and 5 have been reorganized to make them easier to use.

Question 98: What is the approximate area in sq. in., over 2 wires 40%, for 1 1/2 inch Intermediate Metal Conduit (IMC)?

A: .510 sq. in.
B: .890 sq. in.
C: .659 sq. in.
D: .873 sq. in.

Question 99: 702.7(C) Optional Standby Systems. Signs. Power Inlet.

Question ID#: 802.0



A warning sign is required at the power inlet temporary connection to a portable generator.

A sign is now required at a power inlet used to connect a portable generator to a premises wiring system. The sign must say what type of generator will be connected to the power inlet based on the wiring in the transfer switch.

Portable generators can be one of two types: (1) A separately derived system with the neutral bonded to the frame of the generator. (2) A non-separately derived system where the neutral conductor is not bonded to the frame of the generator.

When the neutral is bonded to the frame of the generator the sign must say, WARNING: FOR CONNECTION OF A SEPARATELY DERIVED (BONDED NEUTRAL) SYSTEM ONLY.

When the neutral is not bonded to the frame of the generator the sign must say, WARNING: FOR CONNECTION OF A NON-SEPARATELY DERIVED (FLOATING NEUTRAL) SYSTEM ONLY.

A transfer switch for a separately derived system where the neutral from the generator is bonded to the frame of the generator has a separate pole for the neutral conductor and transfers the neutral from the generator to the premises wiring system. A transfer switch for a non-separately derived type of generator does not transfer the neutral to the premises wiring system. The neutral connection from the utility is used when the generator is supplying power to the transfer switch.

The type of generator must match the type of transfer switch. If, for example, the generator has the neutral bonded to the generator frame making it a separately derived system type of generator, the transfer switch must disconnect the neutral from the utility and reconnect the neutral from the generator. If there is a mismatch,

and the grounded conductor from the utility remains connected to the generator neutral, parallel ground currents will circulate on the premises wiring system.

Question 99: Where is the warning sign required for a portable generator used for an optional standby system?

A: At the power inlet used to connect a portable generator to the premises wiring.
B: At the generator.
C: At the utility meter.
D: At the transfer switch.

Question 100: 800.24 Mechanical Execution of Work.

Question ID#: 811.0

There have been problems with installing communications (telephone) cables in a neat and workmanlike manner for a number of years. Most communications cabling is installed above the ceiling, and there have been many jobs where the telephone cables were laid on top of the ceiling tiles without any support. Section 800.24 clearly requires telephone cables to be supported by the building structure using straps, staples, cable ties, hangers, or fittings that will not damage the cable.

A new section now requires the support fittings to be low smoke producing when installed in plenums or other spaces used for environmental air.

Nonmetallic cable ties and other non-metallic cable accessories used to secure and support cables in other spaces used for environment air (plenums) shall be listed as having low smoke and heat release properties.

Any material that will burn and produce smoke is limited when installed in plenums or above a dropped ceiling that is used as an air return. When the space above a ceiling is used for environmental air, the air gets distributed to other areas in the building. If there is a fire above the ceiling, the smoke produced by the fire can be deadly to building occupants throughout the building. Even material as small as a cable tie, when installed in other space used for environmental air, must have low smoke and heat release properties.

A similar requirement has been added at 770.24, for Optical Fiber and Raceways; 820.24, for Community Antenna Television and Radio Distribution Systems; and 830.24 for Network-Powered Broadband Communications Systems.

Nonmetallic cable ties and accessories used to secure and support cables in plenums need to be listed as having low smoke and heat release properties.

Question 100: Which of the following statements about installing communications circuits is correct?

A: Communications circuits cannot be bundled or installed in hangers as long as they are listed as having low smoke properties.
B: Communications cabling and support accessories shall be listed as having low smoke and heat release properties when installed in the space above a ceiling that is used for environmental air.
C: Nonmetallic cable ties are not permitted to be installed above a ceiling that is used as an air return.
D: Communications circuits cannot be installed in other space used for environmental air.

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

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1.) A B C D	21.) A B C D	41.) A B C D	61.) A B C D	81.) A B C D
2.) A B C D	22.) A B C D	42.) A B C D	62.) A B C D	82.) A B C D
3.) A B C D	23.) A B C D	43.) A B C D	63.) A B C D	83.) A B C D
4.) A B C D	24.) A B C D	44.) A B C D	64.) A B C D	84.) A B C D
5.) A B C D	25.) A B C D	45.) A B C D	65.) A B C D	85.) A B C D
6.) A B C D	26.) A B C D	46.) A B C D	66.) A B C D	86.) A B C D
7.) A B C D	27.) A B C D	47.) A B C D	67.) A B C D	87.) A B C D
8.) A B C D	28.) A B C D	48.) A B C D	68.) A B C D	88.) A B C D
9.) A B C D	29.) A B C D	49.) A B C D	69.) A B C D	89.) A B C D
10.) A B C D	30.) A B C D	50.) A B C D	70.) A B C D	90.) A B C D
11.) A B C D	31.) A B C D	51.) A B C D	71.) A B C D	91.) A B C D
12.) A B C D	32.) A B C D	52.) A B C D	72.) A B C D	92.) A B C D
13.) A B C D	33.) A B C D	53.) A B C D	73.) A B C D	93.) A B C D
14.) A B C D	34.) A B C D	54.) A B C D	74.) A B C D	94.) A B C D
15.) A B C D	35.) A B C D	55.) A B C D	75.) A B C D	95.) A B C D
16.) A B C D	36.) A B C D	56.) A B C D	76.) A B C D	96.) A B C D
17.) A B C D	37.) A B C D	57.) A B C D	77.) A B C D	97.) A B C D
18.) A B C D	38.) A B C D	58.) A B C D	78.) A B C D	98.) A B C D
19.) A B C D	39.) A B C D	59.) A B C D	79.) A B C D	99.) A B C D
20.) A B C D	40.) A B C D	60.) A B C D	80.) A B C D	100.) A B C D

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