2011 NEC Changes Part 1 (Homestudy)

North Carolina Electrical License

This course will review the first half of the most important National Electrical Code changes from the 2011 NEC. Changes in Articles 100 - 392 will be covered.

Course# 1071113 4 Homestudy Credit Hours $50.00

This course is currently approved by the North Carolina State Board of Examiners of Electrical Contractors under course number 1071113.

Completion of this continuing education course will satisfy 4.000 credit hours of course credit type 'Homestudy' for Electrical license renewal in the state of North Carolina. Course credit type 'Homestudy'. Board issued approval date: 7/1/2012. Board issued expiration date: 6/30/2016.

2011 NEC Changes Part 1 (Homestudy) - NC

Question 1: New Articles and Important Changes in the 2011 NEC.

Question ID#: 1.0

There are 3 new articles in the 2011 National Electrical Code (NEC):
[b]Article 399[/b]- Outdoor Overhead Conductors over 600 Volts.
[color=#000000][b]Article 694[/b]- Small Wind Electric Systems. [/color]
[b]Article 840[/b]- Premises-Powered Broadband Communications Systems. There is a new Annex I: Recommended Tightening Torque Tables from UL Standard 486A-B. The requirements for arc-fault circuit interrupter protection have been expanded. The ampacity tables in Article 310 have been reorganized and renumbered. Grounding and bonding terms for communications circuits in Chapter 8 have been changed to match terminology used throughout the NEC. Article 690, Solar Photovoltaic (PV) Systems, has been revised based on the growing number of PV installations. Also, additional requirements for field marking of equipment have been added. The 2011 NEC is easier to read and understand. There are fewer exceptions to general rules, references to other Code sections are more specific, lists are used instead of long paragraphs, and simple, positive language is used whenever possible.

[b][i][size= 9pt]The 2011 National Electrical Code has new Articles, a new Annex and easier to understand requirements.[/size][/i][/b]

Question 1: Which of the following statements about the 2011 NEC is true?

A: The 2011 NEC provides installation guidelines for new electrical technologies.
B: The 2011 NEC determines how electrical products will be built and tested.
C: The 2011 NEC is a "how-to" manual for electrical apprentices.
D: The 2011 NEC does not permit exceptions to standard installation procedures.

Question 2: Article 100 Definitions. Ampacity.

Question ID#: 4.0

The 2011 NEC defines Ampacity as follows: ***The maximum current, in amperes, that a conductor can carry continuously under the conditions of use without exceeding its temperature rating.*** The change is that the word ***maximum*** has been added.

Most installers already understood that the ampacity of a conductor was the maximum amount of current that it could carry, but the definition of ampacity is still basic to understanding the National Electrical Code.

- A conductor can carry a load continuously at its maximum rating and not damage the conductor insulation. Correctly sized conductors will not generate excessive heat over time. We increase the size of a wire for a continuous load to prevent heat build-up at the terminal, not in the wire.
- A conductor must stay within its maximum ampacity rating because excessive current flow in a conductor creates heat that can damage the conductor insulation.
- The 60Â°C, 75Â°C, and 90Â°C temperature ratings of conductors indicate how much heat the conductor's insulation can withstand without being damaged.
- The conditions of use (ambient temperature and the number of conductors in a raceway) can reduce the maximum amount of current a conductor can carry by limiting the cooling effect of the surrounding air.

Ampacity is the maximum amount of current a conductor can carry continuously without overheating.

Question 2: According to Table 310.15(B)(16), the maximum ampacity of a 1/0 cu. THWN conductor is 150 amps. If there are 3 current carrying conductors in a raceway or cable in an ambient temperature of 86Â°F, which of the following statements about the 1/0 THWN conductor is true?

A: The conductor cannot carry 150 amps under the conditions specified in the question.
B: After 3 hours or more the amount of current on the conductor will increase.
C: The temperature rating of the conductor is how much heat is generated in the copper conductor.
D: 150 amps flowing in the wire will not damage the conductor insulation if there are only 3 current carrying conductors in a raceway in an ambient temperature of 86Â° F.

Question 3: Article 100 Definitions. Bathroom.

Question ID#: 7.0

In the 2011 NEC a bathroom is: ***An area including a basin with one or more of the following: a toilet, a urinal, a tub, a shower, a bidet, or similar plumbing fixtures.***

The 2008 NEC defined a bathroom as an area that had a basin and at least one other plumbing fixture such as a toilet, tub, or shower.

Urinals and bidets are also found in bathrooms. A space is now classified as a bathroom if it contains a basin and either a toilet, urinal, tub or bidet. Adding ***or similar fixtures*** to the definition leaves room to classify an area as a bathroom if it is used for similar purposes and has a basin and other types of plumbing fixtures.

The definition of a bathroom has changed.

Question 3: Which of the following areas is not a bathroom?

A: An enclosed area with three urinals and no other plumbing fixtures.
B: An area with a toilet and sink.
C: An area with a basin, tub and toilet.
D: An area with a row of urinals on one wall and a row of sinks on the other wall.

Question 4: Article 100 Definitions. Separately Derived System.

Question ID#: 10.0

The revised definition in the 2011 NEC defines Separately Derived System as: ***A premises wiring system whose power is derived from a source of electric energy or equipment other than a service. Such systems have no direct connection from circuit conductors of one system to circuit conductors of another system, other than connections through the earth, metal enclosures, metallic raceways, or equipment grounding conductors.***

The 2008 NEC definition***: A premises wiring system whose power is derived from a source of electric energy or equipment other than a service. Such systems have no direct electrical connection, including a solidly connected grounded circuit conductor, to supply conductors originating in another system.***

This is an editorial change that recognizes there is a connection between the primary and secondary of a transformer, for example, through the metal covered cables and metal raceways between the two systems where connected to metal enclosures which are grounded and connected to a grounding electrode. However, there is no direct connection between the circuit conductors of the two systems.

Examples of separately derived systems are transformers, PV systems, fuel cell systems and small wind electric systems.

Question 4: Which of the following is the best description of the connections between a separately derived system and a service?

A: The grounded circuit conductor of a separately derived system has a direct connection to the grounded circuit conductor of the service.
B: The metal raceways and metal enclosure of a separately derived system are connected together, and they are connected to a grounding electrode system.
C: Separately derived systems include service conductors.
D: Separately derived systems have a direct electrical connection to the ungrounded conductors of the service.

Question 5: 110.14 Electrical Connections.

Question ID#: 16.0

Finely stranded conductors are required for some applications.

Fine-stranded conductors are used in photovoltaic systems, battery cables, welding cables, elevators, cranes, computer data cables, UPS cables, and other special applications.

Standard terminals, pressure connectors, and pressure splicing devices are not intended for fine-stranded conductors. Standard connectors are designed for class B and C stranded conductors. Using them to connect or terminate fine-stranded conductors often breaks some of the strands of fine-stranded conductors and results in a bad electrical connection.

The typical number of strands in a conductor is shown in new Table 10 in Chapter 9. A No. 12 AWG cu. conductor has 7 strands or 19 strands, depending on the class of conductor. A 1/0 AWG cu. conductor Class B has 19 strands. A 1/0 AWG conductor Class C has 37 strands.

Terminals and connectors that are used with conductors that have more strands than the conductors listed in Table 10 must be identified for use with those finely stranded conductors.

The revision to section 110.14: ***Connectors and terminals for conductors more finely stranded than Class B and Class C stranding as shown in Chapter 9, Table 10, shall be identified for the specific conductor class or classes and the number of strands.***

Question 5: How many strands are in a No. 4/0 AWG Class C copper conductor?

A: 19.
B: 30.
C: 35.
D: 37.

Question 6: 110.24 Available Fault Current.

Question ID#: 18.0

This new section requires the maximum available fault current to be field marked on service equipment, except at dwelling units. The field marking must be legible and able to withstand the environment where the service equipment is located. The field marking must include the date when the fault current calculation was performed.

The available fault current must be marked on service equipment at non-dwelling unit locations.

When the service equipment is modified, or when changes are made that might change the maximum available fault current, the fault current calculation must be recalculated and the equipment marked with the new values.

The maximum available fault current at a service can also be affected by changes made by the utility company. For example, available fault current is usually affected anytime the utility company changes a transformer supplying a facility. However, changes made by a utility remote from a facility such as relocating a substation to change the length of the primary supplying a facility can also affect the available fault current for all of the facilities supplied by the substation. The only way to ensure that changes made by a utility do not affect a facility is to maintain communication between the facility engineering and the utility, and to have engineering calculations done at the facility to determine maximum available fault current when changes are made on either side of the service point.

An exception allows industrial installations with qualified personnel to skip the field marking requirement.

This is a major change to the 2011 NEC. The available fault current at the terminals of the utility delivery point should be readily available from the utility. Marking it on the equipment with the date will make it easier to confirm the interrupting rating of the equipment is within the range of the available fault current and how long ago the calculation was made.

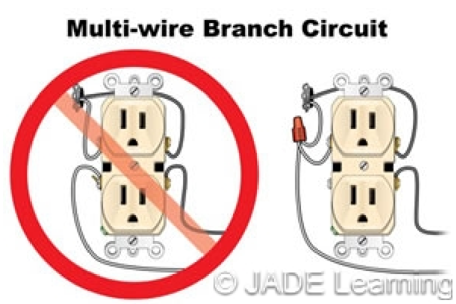
Question 6: Which of the following is an acceptable label to be posted on the service equipment showing the available fault current?

A: Maximum available fault current 98,600 amperes.
B: Maximum interrupting rating 17,210 amperes.
C: Maximum available fault current 42,517 amperes. August 14, 2010.
D: Maximum short circuit rating 11,280 amperes. August 8, 2010.

Question 7: 200.2(B) Continuity.

Question ID#: 23.0

An Informational Note has been added that references Section 300.13(B) for the continuity of grounded conductors used in multiwire branch circuits.



In multiwire branch circuits the grounded conductor must be continuous.

Section 300.13(B) Device Removal. ***In multiwire branch circuits, the continuity of a grounded conductor shall not depend on device connections such as lampholders, receptacles, and so forth, where the removal of such devices would interrupt the continuity.***

If a grounded conductor in a multiwire branch circuit is disconnected, the devices on each leg of the multiwire branch circuit downstream from the break may not work normally. Abnormal voltages can occur which can damage equipment supplied by receptacles downstream of the break. Even though the neutral is not present downstream of the break, the ungrounded conductors may still be energized and are a serious shock hazard for anyone troubleshooting the circuit.

Question 7: In a multiwire branch circuit that supplies 120 volt receptacle loads, what is the best way to connect the grounded conductors?

A: Tie the grounded conductors together and wire a pigtail to the receptacle screw terminal.
B: Install the grounded conductors in the holes in the back of the receptacle.
C: Wrap the grounded conductors around the brass colored receptacle screws.
D: Solder the grounded conductors to the receptacle screws.

Question 8: 200.4 Neutral Conductors.

Question ID#: 24.0

This new section prohibits the use of neutral conductors in more than one branch circuit, for more than one multiwire branch circuit, or for more than one set of ungrounded feeder conductors unless it is permitted in other areas of the Code.

A single neutral conductor can supply more than one feeder according to 215.4 if, when installed in a metallic raceway, all the conductors from each feeder are in the same raceway.

Sharing a single neutral conductor with more than a single feeder is almost never done in the field. This new section will restrict this practice even further.

A single grounded conductor cannot be shared with more than one multiwire branch circuit.

Question 8: If a circuit is installed in a single cable or raceway, which of the following installations is a Code violation?

A: Installing a multiwire branch circuit where a single neutral is shared with 2 ungrounded conductors on different phases.
B: Installing a branch circuit with a single neutral and 2 ungrounded conductors from the same phase.
C: Installing a feeder circuit on a 3-phase system with 3 ungrounded conductors, 1 per phase, and a single neutral conductor.
D: Installing a multiwire branch circuit with 3 ungrounded conductors from different phases and a grounded neutral.

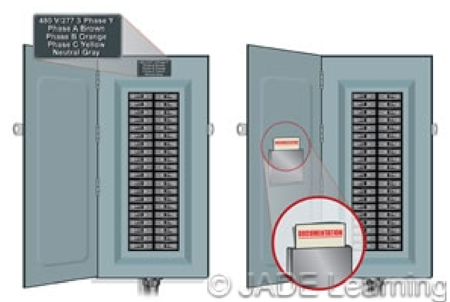
Question 9: 200.6(D) Grounded Conductors of Different Systems.

Question ID#: 25.0

When grounded conductors of different systems are installed in the same raceway, cable, box, auxiliary gutter or other type of enclosure, each grounded conductor must be identified by system.

For example, if a 480 volt, 4-wire feeder and a 208 volt 4-wire feeder were in the same conduit, the grounded conductor of the 480 volt feeder could be grey and the grounded conductor of the 208 volt feeder could be white.

The 2008 NEC required the color scheme or other means of identification used on the different systems to be permanently posted on the panelboards that are the source of the feeders.



The grounded conductors of different systems must be identified or documented by system.

The 2011 NEC provides an alternate method of displaying the means of identification besides permanently posting. If the means of identifying conductors of different systems is ***documented in a manner that is readily available,*** then permanent posting is not required. Documenting the means of identification could be having documentation available in an engineering office at the facility, or it could mean having a sheet inside the panelboard door that listed which colors were used for the grounded conductors of each system.

Question 9: If grounded conductors of different systems are installed in the same raceway:

A: The grounded conductors are not required to be identified separately.
B: The grounded conductors from each system must be separated by a physical barrier.
C: Documentation describing the color code used for each system grounded conductor shall be readily available or shall be posted in the panelboard.
D: The installing electrician must keep a record of the means of identification of the grounded conductors for 3 years.

Question 10: 210.8 Ground-Fault Circuit-Interrupter Protection for Personnel.

Question ID#: 28.0

GFCI protection for personnel must be readily accessible.

Ground-fault circuit-interrupter (GFCI) protection for personnel installed in all locations listed in 210.8 must be readily accessible. This includes GFCI protection installed in dwelling units, at dwelling unit boat hoists, and in all non-dwelling unit locations where GFCI protection for personnel is required.

A GFCI device should be tested regularly. If the GFCI receptacle is located in an area that is not readily accessible, it may never be tested. In a readily accessible location, the green indicator light on the GFCI outlet can be monitored to confirm the GFCI device is still providing GFCI protection. If installed behind an outdoor vending machine or on the ceiling beside an overhead garage door opener, the GFCI outlet would not be easily monitored or tested.

GFCI protection is required in areas where the shock hazard is the greatest. If a GFCI receptacle outlet is defective, and nobody knows that it is defective because it is not readily accessible and is not periodically tested, there is an increased risk of electrical shock.

Question 10: Which of the following locations for a GFCI type receptacle is a violation of the NEC?

A: Recessed into the backsplash above a kitchen countertop.
B: Outdoors, mounted 30 in. above grade.
C: Installed on a garage ceiling and used for the garage door opener in a dwelling unit.
D: Next to a bathroom sink.

Question 11: 210.8(A)(7) Ground-Fault Circuit-Interrupter Protection for Personnel. Dwelling Units. Sinks.

Question ID#: 29.0

A receptacle installed within 6 ft. of a sink in a dwelling unit requires GFCI protection.

GFCI protection is now required when receptacle outlets are installed within 6 ft. of the outside edge of a sink located anywhere in a dwelling unit, except in the kitchen.

The 2008 NEC listed outlets next to sinks in bathrooms, laundry, utility rooms and wet bar sinks as locations that required GFCI protection. Because other areas of dwellings such as a rear entry way or hobby room may have sinks, the 2011 Code now requires GFCI protection for receptacles located within 6 ft. of a sink, except in the kitchen.

The Code may not require an outlet to be installed within 6 ft. of a sink in a dwelling unit. But, if an outlet is installed within 6 ft. of a sink in any location other than a kitchen, it must be GFCI protected.

There is no change in the requirement for GFCI protection for kitchen countertop receptacles. Section 210.8(A)(6) requires all dwelling unit receptacles serving the kitchen countertop to be GFCI protected.

Question 11:   If a receptacle is installed, which location in a dwelling unit requires GFCI protection?

A: In a storage room within 6 ft. of an outside entrance.
B: In the attic if there is a washing machine outlet.
C: In a bedroom, if there is an adjoining bathroom.
D: Within 6 ft. of a sink in a sunroom used for gardening.

Question 12:   210.8(B)(5) Exception 2 to 5. Ground-Fault Circuit-Interrupter Protection for Personnel. Other Than Dwelling Units. Sinks.

Question ID#: 30.0

Receptacles within 6 ft. of a sink in a non-dwelling unit location require GFCI protection.

This exception exempts GFCI protection for receptacles in patient bed locations of general care or critical care areas of health care facilities, except for in bathrooms. The exception in the 2008 NEC was much broader and applied to all receptacles in patient care areas of health care facilities that were within 6 ft. of a sink.

The purpose of the exception is to permit non-GFCI receptacle outlets to supply critical loads in the patient care area, such as heart monitoring equipment or life support machinery. The patient's life would be in danger if any of these types of equipment were de-energized because a GFCI outlet tripped.

Limiting the scope of the exception to patient bed locations of general care or critical care areas of health care facilities means that receptacle outlets within 6 ft. of a sink in a doctor's or dentist's office will require GFCI protection. The equipment on a countertop next to a sink in a doctor's office is not used for life support and would not put the patient in danger if the GFCI tripped.

If a receptacle is installed within 6 ft. of the outside edge of a sink in a non-dwelling unit location it must be GFCI protected, unless it is in a patient bed location in a general care or critical care area of a health care facility.

Question 12:   Which of the following locations require GFCI protection?

A: A receptacle outlet located 4 ft. from a sink in a patient bed location in the general care area of a hospital.
B: A receptacle outlet located 5 ft. from a sink in a patient bed location in the critical care area of a hospital.
C: A receptacle outlet located 3 ft. from a sink in a dentist's office.
D: A receptacle outlet located 8 ft. away from a sink in an exam room in a 24 hour emergency clinic.

Question 13:   210.8(B)(6) Ground-Fault Circuit-Interrupter Protection for Personnel. Other Than Dwelling Units. Indoor Wet Locations.

Question ID#: 31.0

Indoor wet locations require GFCI protection.

Receptacle outlets in indoor wet locations are required to have GFCI protection for personnel.

Indoor wet locations such as car washes and food processing areas of facilities that manufacture food products have the same risks to users of portable appliances as outdoor locations.

Daily wash down of equipment in processing plants is done with high pressure, high temperature sprayers. Every surface is cleaned and left wet. Cleaning crews and machine operators using cord and plug connected equipment are subject to the same types of shock hazards that are present in any wet location.

Question 13: Where is GFCI protection required in the following non-dwelling installations?

A: For luminaires in a food processing plant where cleaning leaves standing water on the floor.
B: For receptacle outlets in a manufacturing facility where the processes leave standing water on the floor.
C: For receptacle outlets in a warehouse that stores automotive parts.
D: In an office reception area with a large aquarium tank.

Question 14: 210.8(B)(7) Ground-Fault Circuit-Interrupter Protection for Personnel. Other Than Dwelling Units. Locker Rooms.

Question ID#: 32.0

Locker rooms with showers require GFCI protection for receptacle outlets.

If a locker room has showering facilities, the receptacle outlets in the locker room must be GFCI protected.

People leaving the shower area are wet and walking with bare feet, carrying wet clothes or towels. Locker room floors are usually concrete or tile with metal drains set into the floor. The floors are usually wet from other people walking out of the shower area. In the locker room area, cord and plug connected hair dryers and electric shavers are often used.

This Code section says l***ocker rooms with associated showering facilities*** are required to have GFCI protection for receptacle outlets. Exactly which outlets need protection may be subject to interpretation by the Authority Having Jurisdiction, but since most locker rooms have showering facilities, many inspectors will require that receptacle outlets in locker rooms be protected by ground-fault circuit-interrupters.

Question 14: Which of the following is a true statement about receptacle outlets in locker rooms?

A: Receptacle outlets in all locker rooms require GFCI protection.
B: GFCI protected receptacle outlets are required only in the shower area of a locker room.
C: Receptacle outlets in a locker room must have GFCI protection if the locker room has a shower.
D: If a locker room does not have showering facilities, the receptacle outlets must be GFCI protected.

Question 15: 210.8(B)(8) Ground-Fault Circuit-Interrupter Protection for Personnel. Other Than Dwelling Units.

Question ID#: 33.0

Areas that service motor vehicles require receptacle outlets to be GFCI protected.

GFCI protected receptacle outlets are required in garages, service bays, and similar areas where electrical diagnostic equipment, hand tools, or portable lighting equipment are in use.

In commercial and industrial buildings, there are areas used that are used the way garages are defined in Article 100 even though the areas are not called garages by the people using them and were not identified as garages on blueprints. Often these areas are not classified as garages when the building is first built, and the receptacle outlets do not have GFCI protection. Regardless of how an area in a building was originally designated, if it is now used to service and maintain vehicles by personnel plugging drop-lights, power tools, and electronic diagnostic equipment into receptacle outlets, as far as the NEC is concerned, it is a garage. Personnel using this sort of equipment in these areas are exposed to shock hazards unless the receptacles are provided with GFCI protection.

With a concrete floor that can be wet from liquid spills, and cord and plug connected diagnostic equipment, hand tools and portable lighting being used, the shock hazard is similar to garages covered in Article 511, where GFCI protection for 125-volt, single-phase, 15- and 20-amp receptacles is required.

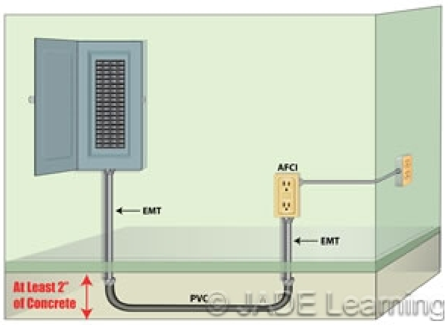
Vehicle storage areas and parking garages where power tools, portable lighting, and diagnostic equipment are NOT used do not require GFCI protected receptacle outlets.

Question 15: Which location requires GFCI protection for 125-volt, single-phase, 15- and 20-amp receptacles?

A: A storage area for engine oil and other maintenance supplies.
B: The office area of a car dealership.
C: A metered parking deck.
D: A separate building where maintenance and repairs are performed on company vehicles.

Question 16: 210.12(A) Ex. No. 1&2. Arc-Fault Circuit-Interrupter Protection. Dwelling Units.

Question ID#: 34.0



An outlet branch-circuit type AFCI breaker will be available during the 2011 Code cycle.

Exception No. 1 recognizes a new type of device which will become available during this Code cycle. An ***outlet branch-circuit Type*** Arc-Fault Circuit-Interrupter (***AFCI)*** looks similar to a GFCI receptacle. The AFCI receptacle is installed at the first outlet on a circuit and provides AFCI protection for the remaining portion of the circuit.

An AFCI receptacle can be used to provide AFCI protection only if the conductors from the panelboard to the device are installed in RMC, IMC, EMT, Type MC, or steel armored Type AC cables.

New Exception No. 2 permits conductors supplying AFCI receptacle outlets to be installed in any type of metallic or nonmetallic conduit or tubing from the panelboard to the first outlet if the conduit or tubing is encased in not less than 2 in. of concrete. There is no danger of nails or screws penetrating the conduit or tubing if it is encased in 2 in. of concrete.

Question 16: Which of the following statements about Arc-Fault Circuit-Interrupter Protection in dwelling units is true?

A: The only type of AFCI protection permitted by the NEC is a combination type circuit breaker.
B: When installed, AFCI receptacle outlets will provide AFCI protection for conductors downstream of the outlet.
C: AFCI receptacle outlets are permitted to be installed at any point in the circuit to provide the AFCI protection required by the NEC.
D: Aluminum Type AC cable is a permitted wiring method between the panelboard and an AFCI receptacle outlet.

Question 17: 210.12(B) Arc-Fault Circuit-Interrupter Protection. Branch Circuit Extensions or Modifications- Dwelling Units.

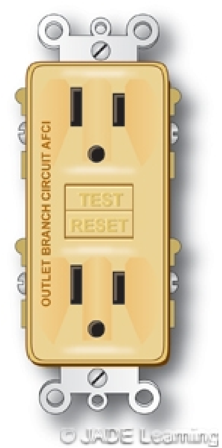
Question ID#: 35.0

If modifications are made in dwelling unit areas that now require AFCI protection, the new wiring must be AFCI protected.

If a residence was wired before arc-fault circuit-interrupters were required, or located in a part of the dwelling that did not require AFCI protection, and a circuit is extended or modified in an area that now requires AFCI protection, those areas that require AFCI protection under the 2011 Code must be AFCI protected. This is a major Code change.

AFCI protection can be provided by installing a listed combination type AFCI circuit breaker, or installing a listed outlet branch-circuit type AFCI receptacle at the first outlet on the existing branch circuit. The circuit conductors between the branch circuit overcurrent protective device and the AFCI receptacle must be installed in RMC, IMC, EMT, Type MC, or steel armored Type AC cables complying with the requirements for equipment grounding conductors listed in section 250.118.

Being able to install a listed outlet branch-circuit type AFCI is helpful, especially in older homes with a fuse panel or a circuit breaker panel for which AFCI circuit breakers are not available.



If a location in a dwelling unit requires AFCI protection, and the circuit is modified, AFCI protection is required.

Question 17: If a dwelling was built before AFCI protection was required and the house was completely rewired, which circuits must be AFCI protected?

A: Bedroom circuits.
B: Kitchen circuits.
C: Garage circuits.
D: Outdoor circuits.

Question 18: 210.52(A)(4) Dwelling Unit Receptacle Outlets. General Provisions. Countertop Receptacles.

Question ID#: 37.0

Countertop receptacles installed in kitchens, pantries, breakfast rooms, dining rooms and similar areas of dwelling units cannot be counted as a receptacle outlet required at the floor line.

Every wall space 2 ft. or more in width, and unbroken at the floor line by doorways, fire places and fixed cabinets, must have a receptacle outlet. No point measured along the floor line of any wall can be more than 6 ft. from a receptacle outlet.

If countertop receptacles are installed, as required by 210.52(C), they cannot be counted as one of the required wall receptacles. For example, a 3 ft. wall space at the end of a kitchen countertop requires a receptacle outlet at the floor line, even if there is a receptacle in the backsplash at the end of the countertop.

A kitchen countertop receptacle cannot be counted as a wall receptacle.

Question 18: A kitchen with receptacles installed for the countertops has a wall space at the end of one countertop that measures 4 ft. at the wall line. Which of the following is a true statement?

A: A receptacle installed at countertop height in the wall space 30 inches from the countertop can take the place of a required countertop receptacle.
B: If the distance from the last countertop receptacle to the end of the wall space measures no more than 6 ft., a receptacle is not required in the wall space.
C: A receptacle outlet is required in the wall space.
D: Receptacles are not required at the floor line in kitchens.

Question 19: 210.52(C)(5) Dwelling Unit Receptacle Outlets. Countertops. Receptacle Outlet Location.

Question ID#: 38.0

Receptacle outlet assemblies listed for the application shall be permitted to be installed in countertops in kitchens, pantries, breakfast rooms, dining rooms and bathrooms.

Receptacles cannot be installed face-up in countertops, but there are new types of listed assemblies that are mounted below the countertop and pop up out of the countertop when needed. Tombstone type receptacles mounted on the countertop are also permitted.

Mounting locations for countertop receptacles are (1) in the wall above the countertop or on the bottom of cabinets located above the countertop provided they are not more than 20 inches above the countertop, (2) below the countertop for island and peninsula countertops, but not more than 12 inches below, if there is no backsplash, or (3) on the countertop.

Because of the kitchen layout, countertop receptacle location is often limited. Having listed assemblies that are mounted in the countertop as a permitted method of providing countertop receptacles gives the installing electrician more options and flexibility.

A listed receptacle outlet assembly can be installed in a dwelling unit countertop.

Question 19: Where can required kitchen countertop receptacles be installed?

A: 15 in. below the countertop.
B: 21 in. above the countertop.
C: Face up in the countertop.
D: In the countertop provided it is part of an assembly listed for the installation.

Question 20: 210.52(E)(3) Dwelling Unit Receptacle Outlets. Outdoor Outlets. Balconies, Decks, and Porches.

Question ID#: 39.0

The exception to 210.52(E)(3) in the 2008 NEC that permitted balconies, decks, and porches with an area of less than 20 sq. ft. to omit a receptacle was deleted in the 2011 NEC. Now, a balcony, deck, and porch of any dimension is required to have at least one receptacle installed if the area is accessible from inside the dwelling.

Small balconies and porches are commonly used to display holiday lighting, or as a place to put radios, fans or other appliances. If an outlet is not installed on the balcony or porch, extension cords are often run through doorways and plugged into outlets that do not have GFCI protection.

Requiring balconies and porches that can be accessed from inside the dwelling to have a GFCI protected receptacle outlet, regardless of the size of the porch, will eliminate the double hazard of running extension cords through doorways and plugging appliances into outlets without GFCI protection.

Balconies, decks, and porches must have at least one receptacle if they are accessible from inside the dwelling unit.

Question 20: Which of the following dwelling unit locations requires a GFCI protected receptacle outlet?

A: A balcony that measures 6 ft. x 3 ft. with a door into the inside of the dwelling.
B: A balcony that measures 8 ft. x 6 ft. without a door leading into the dwelling.
C: A space that is accessible while standing on a fire escape.
D: A landing on steps used for access to a 2nd floor apartment.

Question 21: 210.52(G) Dwelling Unit Receptacle Outlets. Basements, Garages, and Accessory Buildings.

Question ID#: 40.0

Accessory buildings for single family dwellings require at least one 120 volt, 15- or 20-amp GFCI receptacle.

For single-family dwellings, at least one 120-volt, 15- or 20-amp, GFCI protected receptacle outlet must be installed in unfinished basements, garages, and accessory buildings with electric power. The outlet is in addition to those installed for specific equipment.

Accessory buildings have been added to basements and garages because many of the same activities are performed in accessory buildings that are performed in basements and garages. Accessory buildings may be used for storage or they may be used as a backyard shop or work space for outdoor equipment. If an accessory building has electric power, a GFCI protected receptacle outlet is required. This will eliminate the homeowner from running extension cords to the accessory building for power hand tools and other equipment from receptacles that may not be GFCI protected.

This requirement applies to single family dwellings and not to multifamily dwellings or duplexes.

Question 21: Which type of building requires a GFCI protected receptacle outlet?

A: A backyard tree house.
B: A greenhouse with water lines and natural light.
C: A storage shed with a single overhead electric luminaire.
D: A metal carport with skylights.

Question 22: 210.52(I) Dwelling Unit Receptacle Outlets. Foyers.

Question ID#: 41.0

Dwelling unit foyers greater than 60 sq. ft. require a receptacle located in each wall space 3 ft. or more in width.

Foyers that are not part of a hallway in accordance with 210.52(H) and that have an area that is greater than 5.6 m2 (60 ft2) shall have a receptacle(s) located in each wall space 3 ft. or more in width and unbroken by doorways, floor-to-ceiling windows, and similar openings.

New homes are being built with large foyers. Table lamps and other cord connected appliances, or holiday displays are often placed in foyers. If no receptacle outlets are installed, homeowners will use extension cords, sometimes run underneath rugs or carpet, to power lights and equipment.

In earlier Codes, a foyer would be defined as a hallway and if it was 10 ft. or more in length, a receptacle outlet would be required.

In the 2011 NEC, if the foyer is greater than 60 sq. ft., each wall space 3 ft. or more in width requires a receptacle outlet.

Question 22: Where is a receptacle outlet required to be installed in a dwelling unit foyer that is not part of a hallway?

A: In a foyer that measured 8 ft. x 6 ft. in an unbroken 4-ft. wall space.
B: In a foyer that measured 15 ft. x 10 ft. in an unbroken 3-ft. wall space.
C: In a foyer that measured 6 ft. x 6 ft. in an unbroken 6-ft. wall space.
D: In a foyer that measured 10 ft. x 10 ft. in a 2-ft. unbroken wall space.

Question 23: 225.18(5) Clearance for Overhead Conductors and Cables. Over Track Rails of Railroads.

Question ID#: 44.0

The clearance requirements for conductors mounted over railroad tracks has increased.

A new category of clearances for outside branch circuits and feeders has been added. Conductors that cross over railroad tracks must maintain a clearance of at least 24.5 ft.

In earlier Codes, the maximum clearance for outside branch circuits and feeders was 18 ft. This is not enough clearance for triple-decker automobile transporters and some other types of railroad cars.

The required clearance of outside conductors is measured from the lowest point of the span, so the attachment point on either end of the feeder or branch circuit would have to be higher than 24.5 ft. to allow for the sag in the middle.

Question 23: Which of the following is a true statement about branch circuit and feeder conductors passing over railroad tracks?

A: Conductors must be installed in a metallic raceway.
B: Conductors must be installed in a metallic sheath.
C: Conductors must be attached to supports at a height of 24.5 ft.
D: Conductors must maintain a clearance of at least 24.5 ft. at the lowest point.

Question 24: 225.27 Raceway Seal.

Question ID#: 45.0

<u>Where a raceway enters a building or structure from an underground distribution system, it shall be sealed in accordance with 300.5(G). Spare or unused raceways shall also be sealed. Sealants shall be identified for use with the cable insulation, shield or other components.</u>

<u>Underground raceways entering buildings must be sealed.</u>

Section 300.5(G) requires raceways to be sealed when it is possible for moisture to enter through the raceways and contact live parts. Moisture can enter an enclosure through an underground raceway or above grade raceways in a wet location.

It is also possible for small animals or reptiles to get into an underground conduit and reach live parts; this is prevented by sealing the raceways.

All raceways, including spare raceways, entering a building from underground must be sealed on either or both ends.

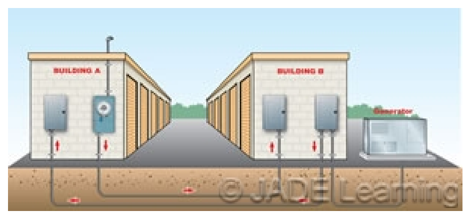
Question 24: Which of the following are examples of raceways that are required to be sealed?

A: An overhead service mast.
B: An aboveground horizontal raceway connecting two enclosures.
C: An underground feeder stubbed up for indoor switchgear.
D: A nipple between a meter base and a panelboard on the outside of the building.

Question 25: 225.30 Number of Supplies.

Question ID#: 46.0

A new requirement has been added for feeders or branch circuits that supply a second building. When a feeder or branch circuit supplies a second building, unless it is permitted by 225.30(A - E), only a single feeder or branch circuit is permitted to supply power from the second building back to the first building. This change considers a multiwire circuit to be a single circuit.



<u>Only a single feeder is permitted from Building A to Building B, or from Building B to Building A.</u>

Without this change, if Building A supplied Building B, an unlimited number of feeders or branch circuits could be installed from Building B back to Building A. This would be very confusing for maintenance staff and dangerous for anyone who had to quickly disconnect circuits in either building.

Being able to quickly locate a circuit's disconnecting means is an important safety feature. If a feeder supplies a distribution panel in Building B, only one circuit from that distribution panel in Building B can supply a circuit back to Building A.

Question 25: A legally required standby generator in Building B supplies a distribution panel in Building A. If the circuits are not permitted by 225.30(A - E), which of the following statements is true about circuits from the distribution panel in Building A?

A: The distribution panel in Building A can supply two or more standby circuits in Building B.
B: The distribution panel in Building A cannot supply two or more standby circuits in Building B.
C: The distribution panel in Building A cannot supply two or more standby circuits in Building A.
D: The distribution panel in Building A can supply two or more standby circuits in both buildings.

Question 26: 225.56 Inspections and Tests.

Question ID#: 48.0

This new section requires distribution systems operating at over 600 volts to be performance tested when first installed on-site and before they are energized. Each component of the system, including switching, protective, and control circuits, must be operated and tested to the satisfaction of the Authority Having Jurisdiction.

A test report covering the results of the pre-energization and operating tests must be delivered to the Authority Having Jurisdiction before energizing the equipment.

Complete acceptance tests are required after the station components are installed to verify the integrity of all the high voltage systems.

Distribution systems over 600 volts must be tested before being energized.

Question 26: When can a distribution system operating at over 600 volts be energized?

A: When the customer has signed off on the installation.
B: When the installation foreman is satisfied all the component parts are working correctly.
C: When the Authority Having Jurisdiction has reviewed the drawings.
D: When the Authority Having Jurisdiction has accepted the pre-energization and operating test report.

Question 27: 225.70 Substations.

Question ID#: 49.0

The requirements for warning signs on customer owned, not utility owned, substations are described in this new section. A substation on the load side of the service point is installed according to the National Electrical Code. Previous editions of the NEC did not include a section that described what type of signage was required for customer owned substations.

Substations on customer owned property must have warning signs.

Signs warning against operation of isolating equipment and replacing fuses when the circuit is energized must be posted.

"DANGER - HIGH VOLTAGE" signs are required at entrances, access points and cable trays containing high voltage conductors.

A different rule requires single-line diagrams to be posted within sight of the switchgear and points of connection to the high voltage system. This type of sign is required for switchgear because it is easily understood by qualified electricians. The single-line diagram is required to indicate all "***interlocks, isolation means, and all possible sources of voltage to the installation under normal or emergency conditions, including all equipment contained in each cubicle, and the marking on the switchgear shall cross-reference the diagram.***"

However, an exception to the general requirement exempts the requirement for single-line diagrams "Where the equipment consists solely of a single cubicle or metal-enclosed unit substation containing only one set of high-voltage switching devices...."

If a panel can only be serviced by the utility, a warning sign must state that access is limited to the serving utility or that access must be authorized by the serving utility.

Question 27: Without applying any exceptions, where are single-line diagrams required for equipment rated over 600 volts?

A: At a utility owned substation.
B: At the entrance to a vault containing a customer owned substation.
C: Within sight of customer owned metal-clad switchgear with voltage exceeding 600 volts.
D: At all entrances to electrical equipment vaults and electrical equipment rooms, areas, or enclosures.

Question 28: 230.24(A) Ex. No. 5. Clearances. Above Roofs.

Question ID#: 51.0

The clearance above a roof can be reduced to 3 ft. if the exceptions are used.

Service conductors are required to have a clearance of 8 ft. above the roof surface, and to maintain the clearance 3 ft. out from the edge of the roof. Three exceptions to this requirement reduce the clearance for service conductors operating at not more than 300 volts between conductors. If the roof has a slope of 4 inches in 12 inches, the clearance is reduced to 3 ft. If the overhead service conductors pass over only the overhanging part of the roof for 6 ft. or less, the clearance is reduced to 18 in.

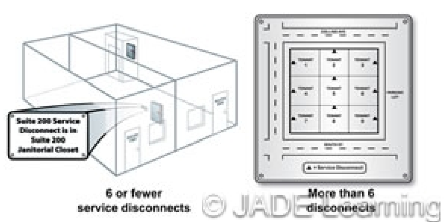
New exception No. 5 reduces the required clearance of overhead service conductors to 3 ft. if the voltage between conductors is not more than 300 volts and the roof area is guarded or isolated. If there are no ladders, steps or stairs leading to the roof, or if the area where the overhead service conductors pass over the roof is fenced or enclosed, the clearance over that part of the roof is reduced to 3 ft. because it would not be considered readily accessible.

Question 28: When is the clearance of overhead service conductors reduced to 3 ft. above the roof?

A: When the roof is not readily accessible.
B: When the roof is flat.
C: When a permanent ladder is installed.
D: When the roof has a slope of 3 inches in 12 inches.

Question 29: 230.40 Ex. No. 1. Number of Service-Entrance Conductor Sets.

Question ID#: 52.0



Service disconnects in a multi-occupancy building must be identified with a plaque.

New language has been added to 230.40 Exception No. 1 requiring signs to be posted at each service disconnect location in a multi-occupancy building.

Section 230.40 requires each service drop or service lateral to supply only one set of service-entrance conductors. Exception No. 1 permits multi-occupancy buildings to have a set of service-entrance conductors run to each occupancy.

The new language in the exception states that if there are not more than 6 service disconnects, each disconnect location must have a permanent plaque that identifies the location of the other service disconnects.

If there are more than 6 service disconnects, then one or more plaques that describe the location of all service disconnect locations must be posted in a readily accessible location as near as practicable to the point of entry or point of attachment of each set of service-entrance conductors.

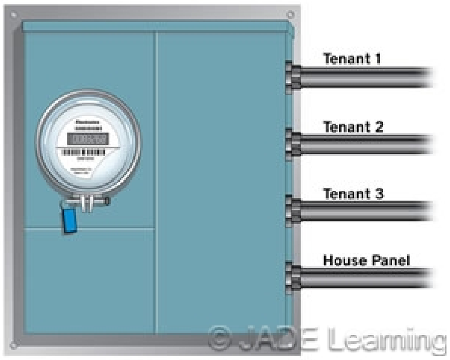
Question 29: A multi-occupancy building has a single service lateral that supplies 8 tenant spaces. Service-entrance conductors are run to each tenant space and the service disconnect for each tenant space is located in the tenant space. What is required on the plaque at the service point?

A: The voltage of the service lateral.
B: The location of all service disconnects.
C: The combined ampere rating of the service disconnects.

D: The interrupting rating of the service equipment.

Question 30: 230.40 Ex. 4 Number of Service-Entrance Conductor Sets.

Question ID#: 53.0



Service-entrance conductors for house panels are now permitted to provide power for common areas in multiple occupancy buildings.

A rewrite of exception No. 4 permits a separate set of service-entrance conductors to supply a house panel for common areas in a multiple occupancy building. The 2008 NEC allowed a separate set of service-entrance conductors for house panelboards in two-family dwellings and multifamily dwellings. Now multiple occupancy buildings are also included.

Section 210.25 prohibits branch circuits for lighting, central alarm, signal, communications, or other purposes for public or common areas of two-family dwellings, multifamily dwellings, or multi-occupancy buildings to be supplied by panelboards in individual dwelling units or tenant spaces.

Most multiple tenant commercial buildings have areas such as hallways, walkways and parking lots that are used by all tenants. These common areas can now be fed by a house loads panelboard that is supplied by a separate set of service-entrance conductors.

Question 30: Which of the following statements about common area branch circuits for multiple occupancy buildings is true?

A: A panelboard that feeds common area loads cannot be supplied by service-entrance conductors.
B: Common area loads are permitted to be supplied by branch circuits from a tenant space.
C: A house panel for common area loads can be supplied by service-entrance conductors.
D: A house panel for common area loads is required to be supplied by a disconnecting means downstream from the service equipment.

Question 31: 230.42(A)(1) Ex. Minimum Size and Rating.

Question ID#: 54.0

Grounded service-entrance conductors not connected to an overcurrent device are not required to be rated at 125% for continuous loads.

Ungrounded service-entrance conductors are sized at 125% for continuous loads. A new exception allows grounded conductors to be sized at 100% of the continuous load if the grounded conductors are not connected to an overcurrent device.

The 125% adjustment in size for ungrounded conductors supplying continuous loads helps prevent the overcurrent device from tripping. The larger wire acts as a heat sink to carry heat away from the overcurrent device. The larger wire size required for continuous loads is not because the conductor needs to be bigger to carry a load that increases over time. It is to prevent the overcurrent device from nuisance tripping.

If a grounded conductor is not connected to an overcurrent device, there is no need to increase the size of the wire for continuous loading. Most grounded conductors are not connected to overcurrent devices, and being able to select a conductor based on 100% of a continuous load, rather than 125% of the continuous load, will save money on the conductor, could reduce the size of the raceway, and will still provide a safe installation.

Question 31: A circuit breaker is the main disconnect for a service. The grounded conductor carries a 100-amp continuous load and is solidly grounded to a grounded neutral bar without overcurrent protection.
What is the minimum size copper THWN conductor, connected to 75 degree C terminals, permitted for the grounded conductor? Assume there are only 3 current carrying conductors in the raceway and the ambient temperature is 86 degrees F.

A: No. 3 AWG.
B: No. 2 AWG.

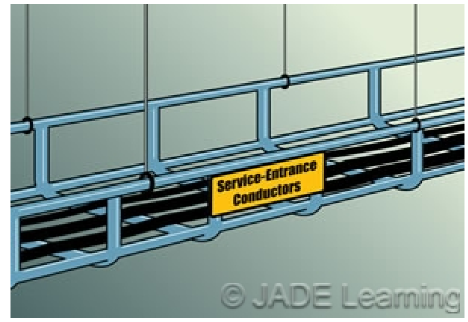
C: No. 1 AWG.
D: 1/0 AWG.

Question 32: 230.44 Cable Trays.

Question ID#: 55.0

A list of cable and conductor types permitted for use in cable trays has been added. They are:

- Type SE cable
- Type MC cable
- Type MI cable
- Type IGS cable
- Single thermoplastic-insulated conductors 1/0 and larger with Cable Tray (CT) rating



Labels are required to identify cable trays that contain service-entrance conductors.

Examples of thermoplastic-insulated conductors are: THHN, THHW, THWN, THWN-2. The CT rating required on these conductors indicates that the cable has passed a flammability test required for cables exposed in cable trays; it is a more rigorous test than is required for type SE Cables. Because they are less flammable, conductors bearing the CT mark are safer to install in buildings than those which are not marked CT.

If service-entrance conductors are installed in cable tray, permanent labels with the wording ***Service-Entrance Conductors*** must be located on the cable tray so they are clearly visible after installation. The labels must be positioned on the cable tray so it is possible to trace the service-entrance conductors along the entire length of the cable tray.

Question 32: Which types of conductor or cable is permitted for service-entrance conductors in cable tray?

A: Type AC cable.
B: Type FC cable.
C: 4/0 AWG THWN.
D: 2/0 AWG THHN-CT.

Question 33: 230.72(A) Exception. Grouping of Disconnects. General.

Question ID#: 57.0

Service disconnects must be grouped. The exception allows a separate disconnect for a fire pump to be mounted remotely, away from the other service disconnects.

A new sentence has been added to the exception that requires a plaque to be posted at the location of the grouped disconnects describing the location of the remotely mounted fire pump disconnect.

Service disconnects must be grouped and include a plaque to identify the location of a remotely mounted fire pump disconnect.

The fire pump disconnect is still required to be permanently marked to identify it as a service disconnect and labeled as a disconnecting means for the fire pump.

The new requirement mandates a plaque at the location of the grouped service disconnects that makes it clear where the fire pump disconnect is located. The plaque will tell emergency personnel and firefighters where the remotely mounted fire pump service disconnecting means is located.

Question 33: Which of the following statements about a remotely mounted service disconnect for a fire pump is true?

A: The disconnect for the fire pump must be grouped with other service disconnects.
B: A plaque is required to be posted at the fire pump showing where the grouped disconnects are located.
C: A plaque is required to be posted at the grouped disconnects showing where the fire pump disconnecting means is located.
D: Fire pumps are not permitted to have service disconnects.

Question 34: 230.82(9) Equipment Connected to the Supply Side of Service Disconnect.

Question ID#: 58.0

A new item has been added which can be connected on the supply side of the service disconnect. Connections for listed communications equipment under the exclusive control of the utility can be connected on the supply side of the service disconnect or disconnecting means if installed as part of a meter socket.

Listed utility communications equipment that is part of a meter socket is now permitted to be connected on the supply side of the service disconnect.

A new class of communications equipment can tell the providing utility if a customer's location has lost power. The communications equipment can be used to monitor a customer's power consumption and relay signals to equipment on the premises. Utility based communications can de-energize a location under emergency conditions and restart the power feed when conditions are back to normal. Utilities will have the option of turning power on or off without traveling to the site to disconnect the meter.

Broadband based communications, such as telephone service provided by the cable company, needs power to operate. Without power on the premises, an emergency 911 call cannot be placed on a phone that is powered from inside the occupancy.

Communication equipment connected to the supply side of the service will permit the utility to monitor their delivery of power at the point of connection to the customer locations.

Question 34: Where will utility communications equipment used to monitor a customer's location be installed?

A: On the supply side of the service disconnect.
B: On the load side of the service disconnect.
C: At the utility owned transformer.
D: Where a service drop connects to overhead service conductors.

Question 35: 230.205(A) Services Exceeding 600 Volts. Disconnecting Means. Location.

Question ID#: 59.0

In the 2008 NEC, if a customer owned service operating at over 600 volts was on private property, the service disconnecting means was permitted to be in a location that was not readily accessible.

Service disconnects rated more than 600 volts can be operated by mechanical linkage or remote control.

In 2011, a customer owned service disconnecting means over 600 volts on private property can be in a location which is not readily accessible only if the disconnect can be operated from a readily accessible location by mechanical linkage or by remote control.

Without the new condition for high voltage disconnects, the only way to disconnect a pole-top switch was from a bucket truck using a hot stick.

Mechanical linkage from the top of the pole to a position that could be operated standing on the ground can be locked so as not to be accessible to unqualified persons.

Question 35: Which installation is covered by the requirement for service disconnects over 600 volts to be in a readily accessible location?

A: Utility installations on a public right of way.
B: Utility installations on private property.
C: Customer owned service disconnect installations on private property.
D: Customer owned installations on public property.

Question 36: 240.24(E) Location in or on Premises. Not Located in Bathrooms.

Question ID#: 62.0

Branch circuit overcurrent protective devices are not permitted in bathrooms of dwellings, guest rooms, or dormitories.

Dormitories have been added to the list of occupancy bathrooms where branch circuit overcurrent protective devices are not permitted. Supplementary overcurrent devices are still permitted to be installed in bathrooms where installation of branch circuit overcurrent protective devices are prohibited by 240.24(E).

A dormitory bathroom is similar to dwelling unit bathrooms and bathrooms in guest rooms or suites because dormitory bathrooms usually have showering facilities. With a shower present, moisture and condensation are likely.

Dormitories are not defined in Article 100, but they are understood to be residences with many beds and rooms for individuals and groups.

Bathrooms in commercial locations, like office buildings or restaurants, usually do not have showers. Overcurrent devices are permitted in these locations.

Question 36: Where can branch circuit overcurrent devices be installed in bathrooms?

A: In a sleeping room in a hotel.
B: In a college dormitory.
C: In a retail shop.
D: In an apartment.

Question 37: 240.91(B) Protection of Conductors. Devices Rated Over 800 Amperes.

Question ID#: 64.0

In supervised industrial locations, the minimum ampacity of conductors protected by overcurrent devices rated over 800 amps is 95% of the rating of the overcurrent device.

This change permits the next standard size overcurrent device to be used on circuits rated over 800 amps under certain conditions and only applies to supervised industrial locations.Â

Supervised industrial locations have professional engineering and maintenance staffs.Â The NEC recognizes this closer supervision of electrical systems and permits installation procedures that are prohibited in other locations.Â Section 240.4(C) generally requires the overcurrent protection for circuits rated over 800 amps to use the next lower standard size overcurrent device.Â

In supervised industrial locations, if the overcurrent device is rated over 800 amps, the ampacity of the conductors must be equal to or greater than 95% of the rating of the overcurrent device.Â The conductors must be protected within recognized time vs. current limits for short circuit currents and all equipment in which the conductors terminate is required to be listed and marked for the application.

Question 37: A circuit in a supervised industrial location is protected by a 1200 amp overcurrent device. Which of the following can be protected by the 1200 amp overcurrent device?

A: Conductors with an ampacity of 1100 amps.
B: Conductors with an ampacity of 1124 amps.
C: Conductors with an ampacity of 1170 amps.
D: Conductors with an ampacity of 1000 amps.

Question 38: 250.2 Definitions. Bonding Jumper, Supply-Side.

Question ID#: 65.0

A supply-side bonding jumper is: ***A conductor installed on the supply side of a service or within a service equipment enclosure(s), or for a separately derived system, that ensures the required electrical conductivity between metal parts required to be electrically connected.***

Supply-side bonding jumpers ensure electrical conductivity between metal parts of separately derived systems that are required to be electrically connected.

The supply-side bonding jumper is different than the bonding jumpers defined in Article 100. Article 100 defines Bonding Jumper, Equipment Bonding Jumper, Main Bonding Jumper, and System Bonding Jumper.

In transformers supply-side bonding jumpers are installed between the source of a separately derived system and the first disconnecting means. In service equipment enclosures supply-side bonding jumpers bond all conductive metal parts of raceways and the enclosure together. For example, in a service enclosure a bonding bushing and a supply-side bonding jumper are used to ensure metal raceways for service conductors are bonded to the load side bonding jumper which is connected to the service enclosure and to the grounding electrode system.

Transformers are separately derived systems and overcurrent protection for the secondary of the transformer is commonly installed as the main circuit breaker for a panelboard. The metal enclosure of the transformer and the metal enclosure for the panelboard, as well as the metal raceway, are tied together by the conductor defined as the supply-side bonding jumper.

Since the supply-side bonding jumper has no overcurrent protection at the transformer, it must be sized from Table 250.66. Table 250.66 is used to select the ampacity of conductors on the supply side of the service or separately derived system, based on the size of the ungrounded conductors.

Question 38: In which of the following locations is a supply-side bonding jumper required?

A: In a metal switch box where a branch circuit load is connected.
B: In a fused disconnect for heat-pump supplied by a 30-amp feeder from a circuit breaker in the service equipment.
C: Connected as a jumper around a water meter to bond metal water pipe together.
D: In service equipment enclosures and in disconnects supplied by a separately derived system.

Question 39: 250.30 Grounding Separately Derived Alternating-Current Systems.

Question ID#: 68.0

Most transformers are separately derived systems. Generators however, are not separately derived systems if the grounded conductor is solidly connected to a service-supplied system grounded conductor.

A new Informational Note No. 1 says that on-site generators are not separately derived systems if the grounded conductor is solidly connected to a service-supplied system grounded conductor. If the transfer switch does not switch the grounded conductor, leaving it solidly connected to the service-supplied grounded conductor, the on-site generator is not a separately derived system.

Section 250.30(A) has been reorganized and reordered to better follow the sequence of installing grounding and bonding connections on a separately derived system. The new order is:

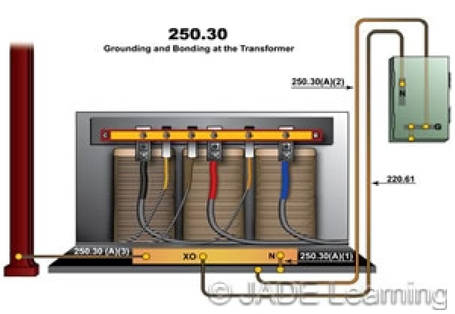
(1) System Bonding Jumper
(2) Supply-Side Bonding Jumper
(3) Grounded Conductor
(4) Grounding Electrode
(5) Grounding Electrode Conductor, Single Separately Derived System
(6) Grounding Electrode Conductor, Multiple Separately Derived Systems
(7) Installation
(8) Bonding

Question 39: Transformers are almost always separately derived systems. Depending on how the transfer switch handles the grounded conductors, a generator may or may not be considered a separately derived system. When is a generator a separately derived system?

A: When a grounding electrode is installed at the building or structure served by the generator.
B: When the generator frame is connected to the equipment grounding conductor at the generator.
C: When the generator grounded conductor is disconnected from the service-supplied grounded conductor by the transfer switch.
D: When the generator grounded conductor is solidly connected to the service-supplied grounded conductor.

Question 40: 250.30(A)(1)&(2). Grounding Separately Derived Alternating-Current Systems. Grounded Systems. System Bonding Jumper. Supply-Side Bonding Jumper.

Question ID#: 69.0



System bonding jumpers and supply-side bonding jumpers are installed at separately derived systems.

250.30(A)(1) System Bonding Jumper. The system bonding jumper shall remain within the enclosure where it originates. If the system bonding jumper is installed at the transformer, it connects the grounded conductor to the supply-side bonding jumper and the normally non-current-carrying metal enclosure. If the system bonding jumper is installed at the first disconnecting means, it connects the grounded conductor to the supply-side bonding jumper, the disconnecting means enclosure, and the equipment grounding conductors.

250.30(A)(2) Supply-Side Bonding Jumper. If the transformer and the first disconnecting means are in separate enclosures, the supply-side bonding jumper is installed with the circuit conductors from the transformer to the first disconnecting means. The size of the supply-side bonding jumper is selected from Table 250.66, but a supply-side bonding jumper never is required to be larger than the derived ungrounded conductors.

If the derived ungrounded conductors are larger than 1100 kcmil copper or 1750 kcmil aluminum, the minimum size of the supply-side bonding jumper is 12.5% of the largest ungrounded conductor.

For example, if the largest derived ungrounded conductor was 2000 kcmil copper, the size of the supply-side bonding jumper is required to be at least 12.5% of 2000 kcmil: 2000 kcmil X .125= 250 kcmil. A 250 kcmil conductor is the smallest conductor that is permitted to be used as a supply-side bonding jumper.

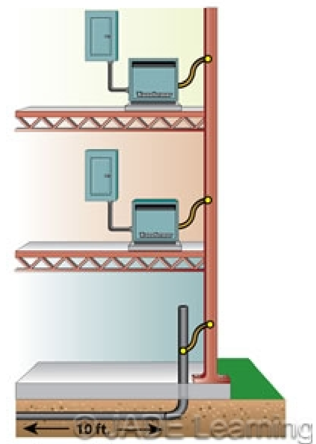
Question 40: What is the purpose of the system bonding jumper?

A: Connects the transformer enclosure and the enclosure of the first disconnecting means together.
B: Connects the grounded conductor to the transformer enclosure and the supply-side bonding jumper.
C: Connects the grounded conductor together at the transformer and the first disconnecting means.
D: Connects the grounded conductor to the grounding electrode.

Question 41: 250.30(A)(6)(a)(2) Grounding Electrode Conductor, Multiple Separately Derived Systems. Common Grounding Electrode Conductor.

Question ID#: 71.0

The common grounding electrode conductor that is used to connect grounding electrode tap conductors to multiple separately derived systems can now be the building steel itself, if the building steel is connected to earth. In the 2008 NEC the common grounding electrode conductor was required to be a 3/0 Cu. conductor or a 250 kcmil aluminum conductor.



Grounded structural steel is permitted as a common grounding electrode conductor for multiple separately derived systems.

For example, in a high rise building the transformers on each floor are required to be connected to a grounding electrode conductor. The building steel can be used as the common grounding electrode if the building is grounded according to 250.52(A)(2). Section 250.52(A)(2) allows building steel to be considered connected to earth if at least one structural metal member is in direct contact with the earth for 10 ft. or more. Another permitted way to connect the building steel to earth is to connect the hold-down bolts of a steel column to a concrete encased electrode that is located in the support footing or foundation.

Permission to use the building steel as a common grounding electrode conductor for multiple separately derived systems will mean a connection from the grounded conductor of each transformer to the building steel, which will serve to connect the separately derived systems to the grounding electrode system. If the building steel is not connected to earth, then it cannot be used as the actual grounding electrode but it can be used as a grounding electrode conductor to connect the multiple separately derived systems to an acceptible electrode.

Question 41: Which of the following methods of connecting a transformer to the grounding electrode system is a violation of the 2011 NEC?

A: Connecting a tap conductor from the grounded terminal of the transformer to a common 3/0 Cu. grounding electrode conductor.
B: Connecting a grounding electrode conductor from the grounded terminal of the transformer to building steel which is not connected to earth.
C: Connecting a grounding electrode conductor from the grounded terminal of the transformer to a concrete encased electrode in the support footing or foundation.
D: Connecting a grounding electrode conductor from the grounded terminal of the transformer to a metal underground water pipe which is in contact with the earth for 10 ft.

Question 42: 250.30(C) Grounding Separately Derived Alternating-Current Systems. Outdoor Source.

Question ID#: 72.0

If a separately derived system, such as a customer owned transformer or generator, is located outside the building, a connection to one or more grounding electrodes is required at the source.

The purpose of connecting the separately derived system to a grounding electrode at the source is to help protect the generator or transformer from lightning and transient voltage spikes. Just like at a service, a connection to one or more grounding electrodes can limit the voltage imposed by lightning or line surges and will stabilize the voltage to earth during normal operation.

All of the electrodes that are present at the source of the separately derived system must be bonded together to form the grounding electrode system.

Customer owned outdoor separately derived systems are required to be connected to a grounding electrode system.

Question 42: Which of the following statements is true if the source of a separately derived system is located outside the building or structure?

A: A grounding electrode is installed to direct fault current coming from the building into the earth.
B: A connection to a grounding electrode is not required if the utility service is grounded.
C: The grounding electrode is required to help balance the load between phases.
D: A connection to a grounding electrode outside the building helps prevent lightning from running into equipment inside the building.

Question 43: 250.32(B)(2) Buildings or Structures Supplied by a Feeder(s) or Branch Circuit(s). Grounded Systems. Supplied by Separately Derived System.

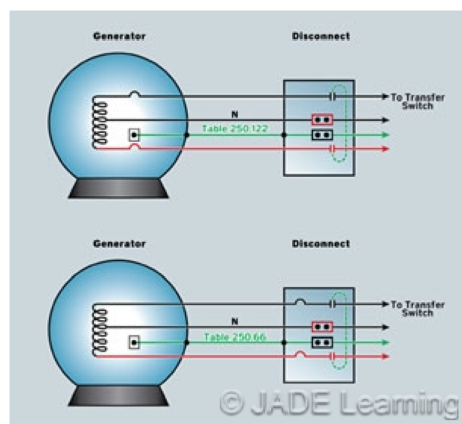
Question ID#: 74.0

A new section has been added on buildings that are supplied by a separately derived system. The separately derived system could be a customer-owned transformer or a generator.

If the feeder from the customer-owned transformer or generator has overcurrent protection at the source of the feeder, the size of the equipment grounding conductor that is installed with the feeder to the building is selected from Table 250.122. For example, if the ungrounded conductors in the feeder were protected at 200 amps, the minimum size of the required equipment grounding conductor is No. 6 AWG cu.

If the feeder from the customer-owned transformer or generator does not have overcurrent protection at the source, then the supply-side bonding jumper is selected from Table 250.66 and must be connected to the building or structure disconnecting means and to the grounding electrode. For example, if the ungrounded conductors in a feeder that did not have overcurrent protection at the source were 500 kcmil cu., Table 250.66 requires a 1/0 cu. supply side bonding jumper. If the phase conductors from the separately derived system are not provided with overcurrent protection at the source of power, and if the ungrounded conductors are larger than 1100 kcmil copper or 1750 kcmil aluminum, the grounded conductors cannot be smaller than 12.5% of the circular mil area of the largest set of derived ungrounded conductors.

Whether the feeder to a building supplied by a separately derived system has overcurrent protection or not, the purpose of the equipment grounding conductor and the supply-side bonding jumper is to return fault current from the building to the source of the separately derived system.



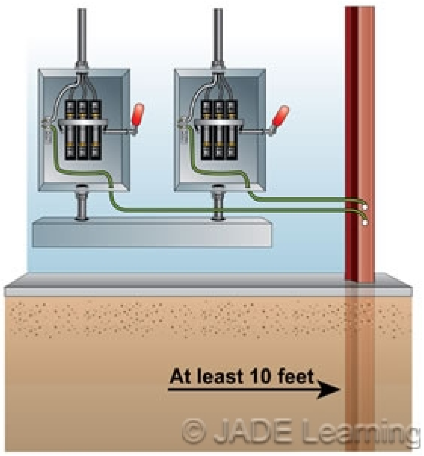
An equipment grounding conductor or supply side bonding jumper is sized from Table 250.66 or Table 250.122 depending on whether or not the feeder has overcurrent protection at its source.

Question 43:   A feeder from a 300 kW generator supplying a building is protected at its source by a 400 amp overcurrent device. The overcurrent protection is located at the generator. What is the minimum size cu. equipment grounding conductor?

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

Question 44:   250.52(A)(2) Metal Frame of the Building or Structure.

Question ID#: 76.0



The grounded metal frame of a building is permitted to be used as a grounding electrode.

The metal frame of a building is not a grounding electrode unless at least 10 ft. of a metal structural member is in contact with the earth, or the hold-down bolts of a steel column are connected to a concrete-encased electrode (rebar).

The 2008 NEC permitted a building to be grounded by connecting a driven ground rod or a plate electrode to the building steel with a No. 6 conductor. This is no longer allowed.

It doesn't make sense to require a 1/0 cu. grounding electrode conductor connection to the building steel for a 400 amp service that uses 500 kcmil ungrounded conductors, when the building steel itself was permitted to be connected to earth with a No. 6 conductor.

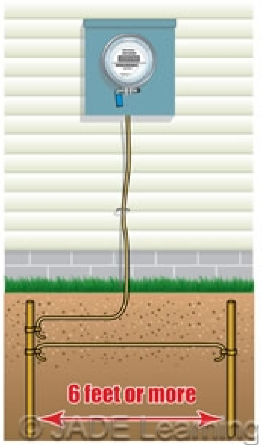
In order for the building steel to be considered a grounding electrode, a steel structural member must be in contact with the earth for at least 10 ft., or the hold-down bolts of a column must be connected to a concrete-encased electrode. The connection from the hold-down bolts to the concrete-encased electrode can be by welding, exothermic welding or using steel tie down wires.

Question 44:   Which of the following buildings is grounded?

A: A building with the hold-down bolts of a vertical steel column tied to an approved concrete encased electrode in the footing.
B: A building connected to earth by means of a driven ground rod connected to the building steel.
C: A building with the hold-down bolts buried 3 ft. in the concrete footing.
D: A building with a vertical column buried 8 ft. in the earth.

Question 45: 250.53(A)(2) Grounding Electrode Installation. Rod, Pipe and Plate Electrodes. Supplemental Electrode Required.

Question ID#: 78.0



Two ground rods are now required.

The general rule now requires that when a driven rod, pipe or plate electrode is used as a grounding electrode, a supplemental electrode is required. Any of the grounding electrodes listed in 250.52(A2 - A8) are permitted to be used as supplemental electrodes: underground metal water pipe, metal frame of building, a concrete encased electrode, a ground ring, a rod, pipe or plate electrode, another listed electrode, or another permitted underground metal system or structure. If a rod or pipe is used as the supplemental electrode, it is required to be spaced at least 6 ft. away from the first electrode.

The 2008 requirement that a supplemental electrode was necessary only if the resistance to ground was more than 25 ohms has been moved to an exception. The exception to the general rule says that a supplemental electrode is not required if the resistance to earth of the first rod, pipe or, plate electrode is 25 ohms or less.

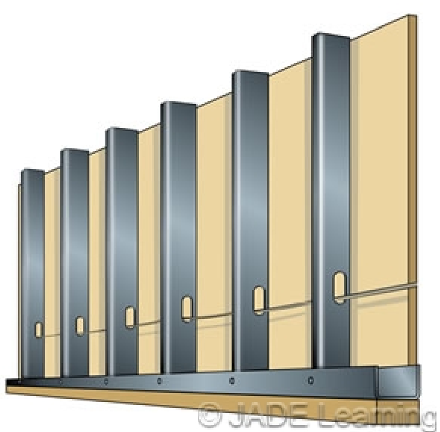
The new rule is clear. Unless the resistance to earth of the first rod, pipe, or plate electrode is 25 ohms or less, a supplemental electrode must be installed and the two electrodes bonded together. The second electrode may be bonded to the first electrode or connected to the grounding electrode conductor, the grounded service-entrance conductor, nonflexible grounded service raceway, or any grounded service enclosure.

Question 45: If ground rods are used for system grounding, which of the following statements is true?

A: The resistance to earth must be 25 ohms or less for ground rods to be used as grounding electrodes.
B: A supplemental electrode must be installed and bonded to the first ground rod unless the resistance to earth is 25 ohms or less.
C: A maximum of 3 ground rods must be installed in a triangle shape.
D: All required ground rods must be installed at least 8 ft. from each other.

Question 46: 250.64(B) Grounding Electrode Conductor Installation. Securing and Protection Against Physical Damage.

Question ID#: 79.0



Grounding electrode conductors are now permitted to be installed on or through framing members.

Grounding electrode conductors shall be permitted to be installed on or through framing members. In earlier Codes, in order to protect the grounding electrode conductor from physical damage when it was exposed, it was required to be securely fastened to the surface on which it was installed.

This revision which permits installing a grounding electrode conductor through a framing member protects it from physical damage. Even if wall covering is not used on the framing members, a grounding electrode conductor will be protected from physical damage when installed through studs or joists.

Some jurisdictions were not allowing this practice because it was not clearly permitted. In the 2011 NEC grounding electrode conductors can be installed through framing members.

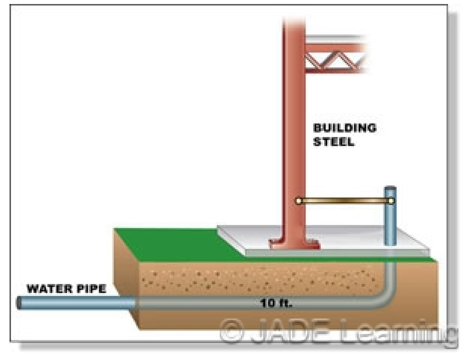
Question 46: Which of the following statements about installing grounding electrode conductors is true?

A: Exposed grounding electrode conductors are not required to be securely fastened to the surface on which they are run.
B: Grounding electrode conductors are not permitted to be installed on or through framing members.
C: Grounding electrode conductors are permitted to be installed on or through framing members.
D: If run through framing members, grounding electrode conductors must be installed in a raceway.

Question 47: 250.68(C) Grounding Electrode Conductor and Bonding Jumper Connection to Grounding Electrodes. Metallic Water Pipe and Structural Metal.

Question ID#: 81.0

This new section describes how metal water pipe and structural steel that is above ground can be used as a path to a grounding electrode or as a way to bond grounding electrodes into the grounding electrode system.



10 feet of buried metal water pipe is permitted to be used as a grounding electrode. That part of the metal water pipe which is above ground is not considered a grounding electrode.

A grounding electrode is a conducting object that is in direct contact with earth. The different types of grounding electrodes are described in section 250.52 of the NEC. Two effective and commonly used grounding electrodes are buried metal water pipe and structural steel. Both of these objects are considered to be grounding electrodes ***only when they are directly in contact with the earth***. Those parts of a water pipe or structural steel that are above earth and not in contact with the earth are NOT considered to be grounding electrodes. However, the NEC permits water pipe and/or structural steel that is above earth and not in contact with the earth to be used to connect a building's electrical system that are required to be grounded to those parts of the pipe or structural steel that is in direct contact with the earth.

For example, if 10-feet or more of a metal water pipe is buried, ***the buried part of the pipe is a grounding electrode***. But if that same pipe enters a building where it is exposed above ground, ***the part of the pipe that is above ground inside the building is not*** a grounding electrode. However, the interior piping within 5-feet of where the pipe enters the building is permitted to be used to connect the buildings electrical system to the buried pipe electrode that is outside the building.

Connection within 5-feet of the point where the pipe enters the building is not required for facilities where conditions of supervision and maintenance ensure the system is serviced by qualified persons.

Question 47: A single family dwelling is supplied by a 30 ft. metal water pipe; 20 ft. of the pipe is buried outside the building and 10-feet of the pipe extends into the building where it is exposed above grade and connected to the interior nonmetallic water pipe. Which of the following statements about that portion of the metal water pipe which is inside the building is correct?

A: It is not considered a grounding electrode.
B: It is a grounding electrode.
C: It cannot be used to bond together other grounding electrodes.
D: It cannot be used as a point of connection between the water pipe and structural building steel.

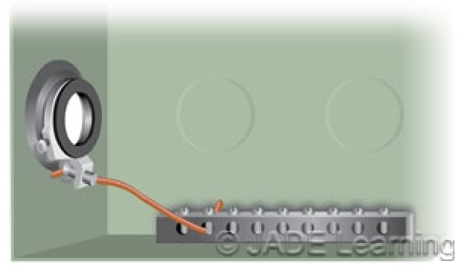
Question 48: 250.92(B) Services. Method of Bonding at the Service.

Question ID#: 82.0

The 2011 NEC now recognizes ***impaired connections*** at the service. Like impaired drivers, impaired connections are dangerous.

An impaired connection at the service is a raceway connection that uses reducing washers or connects a raceway to an enclosure through oversized, concentric or eccentric knockouts. Bonding jumpers are required at the service around impaired connections in order to create a reliable path for fault current.

Currently there are no regulations in the NEC for installing reducing washers. Reducing washers can be installed on top of concentric or eccentric knockouts or on top of painted surfaces. However, at the service, bonding jumpers are required around reducing washers, oversized, concentric or eccentric knockouts, because they are impaired connections and do not provide a reliable path which is capable of carrying fault current.



Bonding jumpers are required to bond around reducing washers, and/or oversized, concentric, or eccentric knockouts which are considered to be impaired connections.

Question 48: When connecting a raceway to an enclosure, which of the following is not considered an impaired connection?

A: A connection made with a reducing washer.
B: A connection made using a concentric knockout.
C: A connection made using an eccentric knockout.
D: A connection made to a threaded hub.

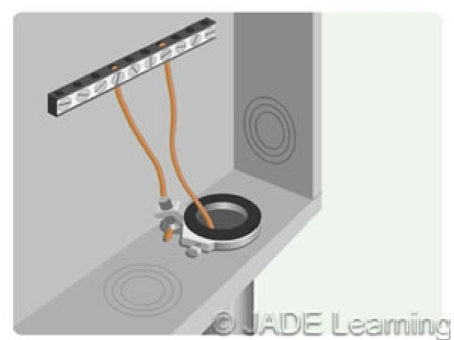
Question 49: 250.102(C) Bonding Conductors and Jumpers. Size. Supply-Side Bonding Jumper.

Question ID#: 83.0

What used to be called the bonding jumper on the supply side of the service is now called the supply-side bonding jumper. The supply-side bonding jumper is located ahead of the service equipment overcurrent protection and its purpose is to provide electrical conductivity between metal parts that are required to be connected together at the service. A supply-side bonding jumper is required where metal parts of the service equipment are connected and a loose connection between the separate parts might interrupt the conductivity.

New subheadings make it clearer how to select the proper size conductor for the supply-side bonding jumper. (1) Size for Supply Conductors in a Single Raceway or Cable requires the supply-side bonding jumper to be selected from Table 250.66, based on the largest ungrounded conductor in the raceway. For ungrounded conductors larger than 1100 kcmil copper or 1750 aluminum, the supply-side bonding jumper must have an area not less than 12.5 % of the area of the largest set of ungrounded supply conductors. (2) Size for Parallel Conductor Installations requires the supply-side bonding jumper to be selected from Table 250.66 also, but based on the size of the largest ungrounded conductors in each raceway.

When the supply-side bonding jumper is copper and the ungrounded conductors in a raceway are aluminum, the size of the supply-side bonding jumper is based on an assumed use of ungrounded copper conductors, with an ampacity equivalent to that of the installed ungrounded aluminum conductors.



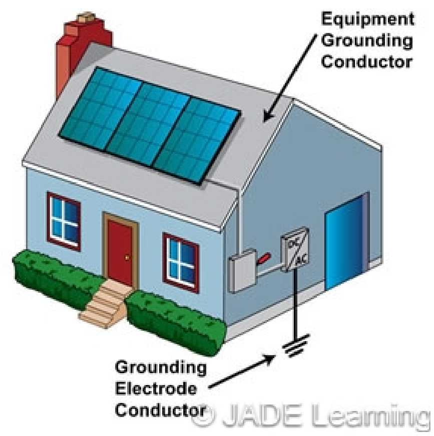
Supply-side bonding jumpers are bonding jumpers installed on the supply side of the service.

Question 49: An installation for service entrance conductors consists of two raceways, each containing a single set of 3/0 copper ungrounded conductors. What is the minimum size supply-side bonding jumper for each conduit?

A: No. 6 AWG copper.
B: No. 4 AWG copper.
C: No. 2 AWG copper.
D: 1/0 AWG copper.

Question 50: 250.121 Use of Equipment Grounding Conductors.

Question ID#: 85.0



An equipment grounding conductor is not permitted to serve as a grounding electrode conductor.

New section: ***An equipment grounding conductor shall not be used as a grounding electrode conductor.***

An equipment grounding conductor and a grounding electrode conductor are two completely different types of conductors. They serve different functions, they are installed differently, and are selected from different tables in the NEC. Before the 2011 NEC there was no rule that prohibited a single conductor from being used as both an equipment grounding conductor and as a grounding electrode conductor. Now a separate conductor is required for the equipment grounding conductor and for the grounding electrode conductor.

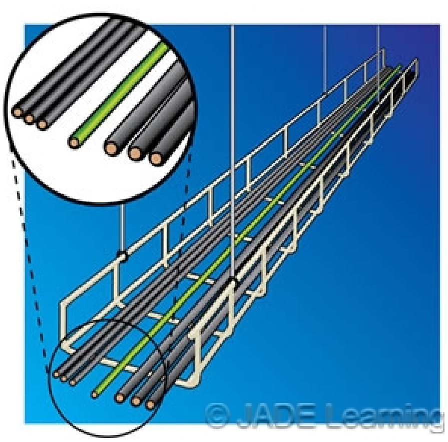
For example, an equipment grounding conductor is required to be installed with a feeder to a second building. A separate grounding electrode conductor is required to be installed at the second building and be connected to a grounding electrode. The equipment grounding conductor could not serve as both the equipment grounding conductor and the grounding electrode conductor.

Question 50: What Table is used to select the minimum size of an equipment grounding conductor?

A: Table 250.3.
B: Table 250.122.
C: Table 250.66.
D: Table 310.15(B)(16).

Question 51: 250.122(F) Size of Equipment Grounding Conductors. Conductors in Parallel.

Question ID#: 87.0



A single correctly sized equipment grounding conductor is permitted when paralleled conductors are installed in a single raceway or cable tray.

Conductors in parallel can be installed in parallel raceways or in a single raceway or cable tray.

The 2008 NEC stated that when conductors were run in parallel, the equipment grounding conductor was required to be run in parallel. This caused confusion when conductors were installed in parallel in a single raceway or cable tray. Some jurisdictions were requiring an equipment grounding conductor to be installed for each set of paralleled conductors, even though all the paralleled sets were in a single raceway.

The 2011 NEC states, ***Where conductors are installed in parallel in the same raceway, cable, or cable tray as permitted in 310.10(H), a single equipment grounding conductor shall be permitted. Equipment grounding conductors installed in cable tray shall meet the minimum requirements of 392.10(B)(1)(c).*** The reference to Article 392, Cable Trays, means single equipment grounding conductors shall be insulated, covered, or bare, and they shall be 4 AWG or larger.

Regardless of whether they are installed in two or more raceways or in a single raceway or cable tray, equipment grounding conductors are required to be sized in accordance with Table 250.122.

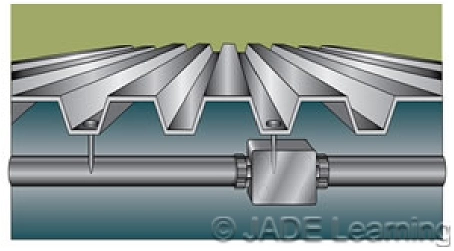
Question 51: In a large shopping mall a feeder consisting of 3 paralleled 500 kcmil copper conductors for each ungrounded phase conductor is installed in cable tray. The overcurrent protection for the circuit is 1000 amps. What is the minimum size of the copper equipment grounding conductor required in the cable tray?

A: 1/0 AWG copper.
B: 2/0 AWG copper.
C: 3/0 AWG copper.

D: 4/0 AWG copper.

Question 52: 300.4(E) Protection Against Physical Damage. Cables, Raceways, or Boxes Installed in or Under Roof Decking.

Question ID#: 89.0



Cables, raceways, and boxes must be protected from physical damage when installed below roof decking.

Boxes can be damaged if installed directly under metal-corrugated roof decking, just like cables and raceways can be damaged. Boxes, as well as cables and raceways, must now be protected from physical damage if they are installed in or under roof decking.

The distance from the lowest surface of the roof decking to the top of the cable, raceway or box, must be a minimum of 1 1/2 inches. The 2008 NEC said the 1 1/2 inch distance was measured from the nearest outside surface of the cable or raceway to the nearest surface of the roof decking. This caused some confusion so the wording was changed to clarify a 1 1/2 inch distance was required from the cable, raceway or box to the lowest surface of the roof decking.

When roofers repair a flat roof they use 1 inch or 1 1/4 inch screws to hold down the insulating and waterproofing material. Unless these distances are maintained, screws may penetrate the roof decking and damage electrical cables, raceways and boxes.

An exception permits rigid metal conduit and intermediate metal conduit to be installed directly below the roof decking.

Question 52: Which of the following is subject to physical damage and must be protected from screw or nail penetration?

A: Rigid metal conduit installed directly below (under) the roof decking.
B: Electrical metallic tubing (EMT) installed 3 inches below the roof decking.
C: AC cable tie wrapped to the ceiling joist 12 inches below the roof decking.
D: Electrical metallic tubing (EMT) installed directly below (under) the roof decking.

Question 53: 300.4(H) Protection Against Physical Damage. Structural Joints.

Question ID#: 90.0

Listed expansion fittings are required where raceways cross structural joints intended for expansion, contraction or deflection in structures.

Listed expansion fittings are now required where a raceway crosses a structural joint intended for expansion, contraction or deflection in buildings, bridges, parking garages or other structures.

These fittings are different than the thermal expansion fittings required in 300.7(B) for use in raceways to allow for seasonal changes in temperature.

A listed expansion fitting used on raceways at structural joints is intended to provide flexibility to raceways as buildings move due to earth movement, wind and other forces, or gravity as the building settles. If the raceway is damaged or pulled apart, the insulation on the conductors inside the raceway can be damaged, causing ground faults or short circuits and a loss of electrical continuity.

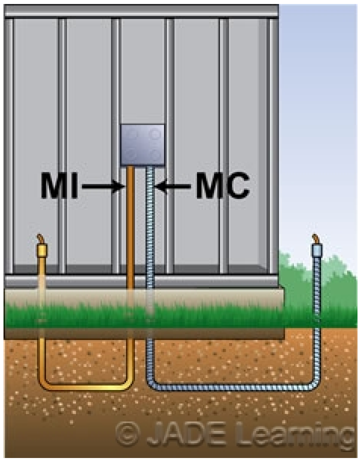
It is the responsibility of the engineer or architect to define all construction joints in the construction documentation.

Question 53: In new construction, which of the following does NOT require an expansion/deflection fitting?

A: A commercial building.
B: An underground feeder cable between a building and a detached parking garage.
C: A bridge.
D: A parking garage.

Question 54: 300.5(C) Exception 1&2 Underground Installations. Underground Cables Under Buildings.

Question ID#: 91.0



New Rules apply to MI and MC cable installed underneath buildings.

Mineral Insulated, Metal-Sheathed (MI) and Metal Clad (MC) Cable listed for direct burial or concrete encasement can be buried underneath a building without being in a raceway. Both MI and MC cable were permitted by the 2008 NEC to be direct buried. MI cable is covered by Article 332. Article 330 covers MC cable.

Both Articles require the cables to be protected from physical damage. When buried underneath a building, the cable is not subject to damage in the same way that it would be if installed in a trench underneath a highway or other outdoor location. Table 300.5 does not specify a minimum burial depth when MI or MC cables are buried beneath buildings.

Type MI cable can be embedded in plaster, concrete, fill, or other masonry, whether above or below grade. Type MC cable can be installed in wet locations if the metal covering on the outside of the cable or the jacket underneath the outside cover is water proof or if the insulation of the conductors is listed for a wet location. Now both types of cable can be direct buried underneath buildings without being protected from damage.

Question 54: Which of the following statements about MI or MC cable listed or identified for direct burial is true?

A: When installed underneath buildings they must be in a raceway.
B: When installed underneath buildings MI and MC cable are subject to physical damage.
C: MI cable cannot be embedded in concrete.
D: When installed underneath buildings MI and MC cable are not required to be installed in a raceway.

Question 55: 300.11(A)(2) Securing and Supporting. Secured in Place. Non-Fire-Rated Assemblies.

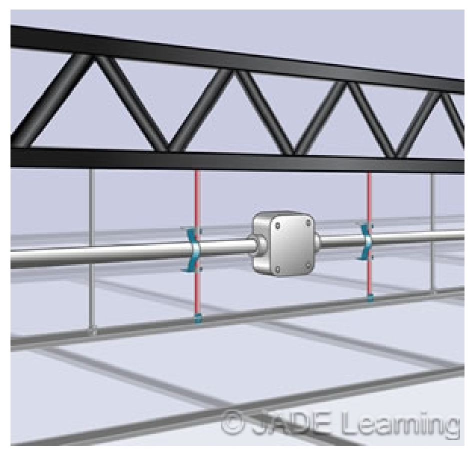
Question ID#: 93.0

The two types of ceilings are fire-rated and non-fire-rated. With this Code change, the requirements for securing and supporting wiring methods above the ceiling are identical for both types of ceilings.

Ceiling support wires cannot be used to secure wiring or equipment in the space above the ceiling. Independent support wires for raceways, boxes, luminaires, and other electrical equipment must be installed to secure all wiring in place. The independent support wires are secured to the building structure and can be attached to the ceiling grid.

In the 2011 Code these independent support wires in a non-fire-rated ceiling must be tagged or painted a different color to distinguish them from the ceiling support wires. This provides a quick way for inspectors or other personnel to confirm that independent support wires, not the support wires for the ceiling, have been used to support electrical cables, raceways, boxes and equipment.

An exception to the general rule permits the ceiling support system to support branch circuit wiring and associated equipment provided it is installed in accordance with the ceiling support system manufacturer's instructions.



Except when permitted by manufacturer's instructions, ceiling support wires cannot be used to secure wiring or equipment in the space above the ceiling.

Question 55: Type AC cable is installed in the cavity of a non-fire-rated ceiling. Without applying the exception, how is it required to be secured in place?

A: Secured to independent support wires which are painted to identify them as not ceiling support wires.
B: AC cable can lay on top of the ceiling grid without being attached to the grid or support wires.
C: Secured to existing ceiling support wires, if the ceiling support wires are painted so an inspector can tell they are supporting electrical cable.

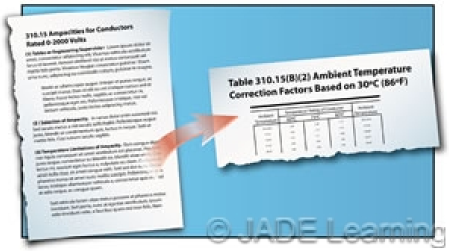
D: Attached to the ceiling grid with clips.

Question 56: Article 310 Conductors for General Wiring.

Question ID#: 96.0

Article 310 was reorganized into 3 Parts: Part I General, Part II Installation, Part III Construction Specifications. As part of the reorganization, all the tables have been renumbered.

The new standard for numbering Tables is to match a Table with a text section where the rule for the Table is described. For example, section 310.15 is ***Ampacities for Conductors Rated 0-2000 Volts***. Text section 310.15(B) is ***Tables***. All of the familiar Tables in Article 310, including Table 310.16, have been renumbered as Table 310.15(B)(16) through Table 310.15(B)(21). In the Table title the old table number is noted. For example, Table 310.15(B)(16) has a notation, (***Formerly Table 310.16***).



Article 310 has been reorganized, and all tables have been renumbered.

The new Table numbering scheme uses part of the number of the old Table. New Table 310.15(B)(17) is old Table 310.17; new Table 310.15(B)(18) is old Table 310.18; new Table 310.15(B)(19) is old Table 310.19.

Most of the technical requirements in Article 310 have not changed.

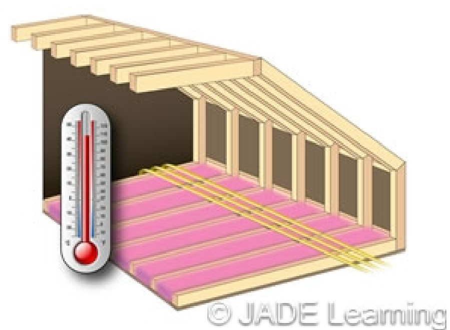
Question 56: From Table 310.15(B)(16) what is the ampacity of No. 8 AWG copper conductor with THWN insulation?

A: 35 amps.
B: 50 amps.
C: 65 amps.
D: 85 amps.

Question 57: Table 310.15(B)(2)(a) & Table 310.15(B)(2)(b) Ambient Temperature Correction Factors Based on 30 Degrees C (86 Degrees F). Ambient Temperature Correction Factors Based on 40 Degrees C (104 DegreesF).

Question ID#: 99.0

Ambient temperature is the temperature of the area in which an installation is located. The ampacity temperature correction factors that were at the bottom of Table 310.16 and Table 310.18 in the 2008 NEC have been moved to their own Tables. Both Tables have been expanded to include ambient temperatures that are colder and hotter than were in previous codes. For ambient temperatures of 69Â°F or colder the multiplier is always greater than 1.



Ambient Temperature Correction Tables now include ambient temperatures that are colder and hotter than were in earlier codes.

For conductors having insulation with the same temperature rating (60Â°C, 75Â°C, or 90Â°C), the same correction factor is used for all ambient temperatures of 50Â°F or less regardless of how cold it is. For example, from Table 310.15(B)(2)(a), if 75Â°C conductors are used in an ambient temperature of 32Â°F, the ampacity correction factor is 1.20; the correction factor would still be 1.20 even if the ambient temperature were -10Â°F.

How the Ambient Temperature Correction Tables are used has not changed. The ambient temperature is listed in a column on each side of the Table: Ambient Centigrade temperature is on the left; Fahrenheit is on the right. The values in the Tables are multipliers that are applied to the ampacity of conductors, from Table 310.15(B)(16) and 310.15(B)(18). For example, the ampacity correction multiplier for a 90Â° conductor operating in an ambient temperature of 110Â°F is .87. The ampacity correction multiplier for a 75Â°C conductor operating in an ambient temperature of 100Â°F is .88. The multipliers are used as correction factors to offset the heating or cooling effect the ambient temperature of the surrounding air has on the current-carrying capacity of conductors. The ampacity of a conductor is higher when installed in a cool or cold location, and its ampacity is lower in a warmer location.

Question 57: For ambient temperature correction factors based on 86Â°F, what is the ampacity correction multiplier for a 90Â°C conductor operating in an ambient temperature of 115Â°F?

A: .91.
B: .87.
C: .82.
D: .76.

Question 58: 312.8 Switch and Overcurrent Device Enclosures with Splices, Taps, and Feed-Through Conductors.

Question ID#: 102.0

This section was rewritten to clarify that splices, taps and feed-through conductors are permitted in cabinets, cutout boxes and meter enclosures, if the fill requirements are met. The total of all conductors installed at any cross-section of the wiring space cannot be more than 40% of the cross sectional area. The total of all conductors, splices and taps installed at any cross-section of the wiring space cannot be more than 75% of the cross sectional area.

A new rule was added that requires a warning label to be applied to the enclosure that identifies the closest disconnecting means for any feed-through conductors. Feed-through conductors remain energized even if the main overcurrent device in the enclosure is de-energized. This poses a clear shock hazard to anyone working in the enclosure. The warning label accomplishes two tasks. (1) It alerts the personnel to the fact that feed-through conductors are present, and (2) it describes where the location of the closest disconnecting means is for the feed-through conductors.

<u>Warning signs must be posted on enclosures with pass through conductors.</u>

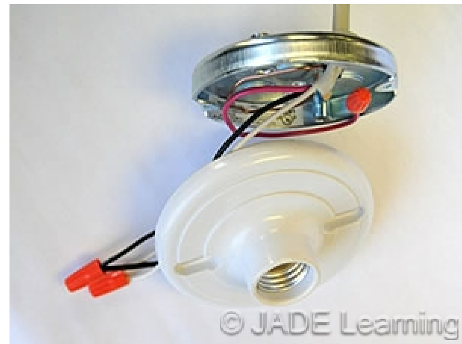
Question 58: The label for switch and overcurrent device enclosures with splices, taps, and feed-through conductors is required to indicate which of the following?

A: The circuit voltage and amperage.
B: That splices and taps are made in the enclosure.
C: The cubic inch capacity of the enclosure.
D: The location of the closest disconnecting means for enclosed feed-through conductors.

Question 59: 314.27(C) Outlet Boxes. Boxes at Ceiling-Suspended (Paddle) Fan Outlets.

Question ID#: 104.0

Where spare, separately switched, ungrounded conductors are provided to a ceiling mounted outlet box, in a location acceptable for a ceiling suspended (paddle) fan in single and multi-family dwellings, the outlet box or outlet box system shall be listed for sole support of a ceiling suspended (paddle) fan.



If separately switched, ungrounded conductors are installed to a ceiling mounted outlet box, the outlet box must be a listed ceiling fan box.

Homeowners love to replace ceiling mounted luminaires with ceiling fans. Many ceiling fans have been installed on nail-on plastic boxes which were never meant to support ceiling fans.

Newer homes are being built with multiple wired switches that accommodate the future installation of fans with luminaire kits. Supplying a ceiling box with two switches is common. An ungrounded conductor from one of the switches is connected to the luminaire, and the other ungrounded conductor is left unconnected. When the homeowner wants to replace the luminaire with a ceiling fan, the wiring is in place for the fan and light kit. If a standard ceiling outlet box is installed, rather than a box rated for a ceiling fan, the homeowner will use the ceiling luminaire outlet box, rather than installing a ceiling fan box.

The new requirement will prevent this situation from happening by making the installation of a ceiling fan rated box mandatory when two switches and spare ungrounded conductor(s) are installed for a ceiling luminaire outlet box.

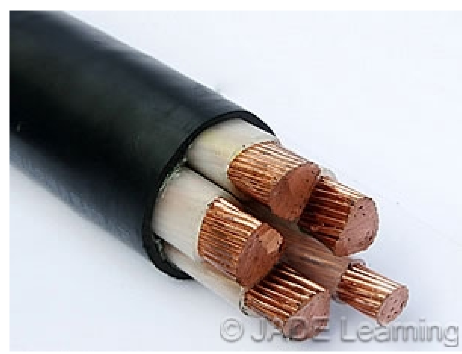
Question 59: Which of the following installations for ceiling outlet boxes is a Code violation?

A: A ceiling fan rated outlet box supplied by two switches with a spare ungrounded conductor.
B: A pair of 3-way switches supplying a standard ceiling luminaire outlet box.
C: Two single-pole switches supplying a standard ceiling luminaire outlet box with a spare ungrounded conductor installed to the outlet box.
D: A single-pole switch installed without spare conductors to a standard ceiling luminaire outlet box.

Question 60: 328.14 Medium Voltage Cable: Type MV. Installation.

Question ID#: 107.0

Type MV cable shall be installed, terminated and tested by qualified persons.



Medium Voltage type cable is required to be installed, terminated, and tested by qualified persons.

Medium Voltage (MV) cable is cable rated for voltages between 601 volts and 35,000 volts. MV cable is permitted in wet or dry locations, in raceways, in cable trays, direct buried, in messenger-supported wiring and in exposed runs. Above 2000 volts, generally, MV cable must be shielded.

Installing MV cable is very different than installing conductors for 600 volts and below. An MV cable that is not installed correctly can fail immediately, or in time fail prematurely because the damage to the cable has gone undetected. Critical factors in installing MV cable are cable-pulling tension, sidewall bearing pressures (how much stress the cable is put under in a conduit bend), and the bending radius of the cable. Terminating an MV cable and testing MV cable are all skills that require experience and expertise. Only qualified persons are permitted to install MV cable. Individuals who are qualified to install conductors or cable operating at 600 volts and below are not qualified to install Medium Voltage cable unless they have been trained in the required techniques and safe work practice methods for installing MV cable.

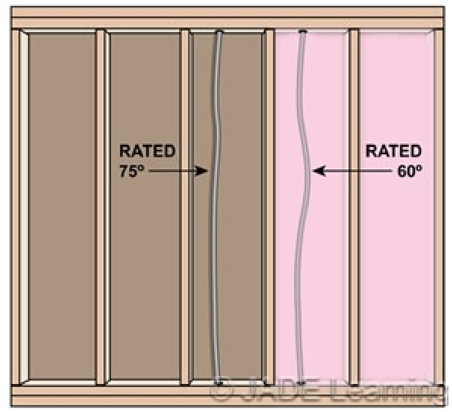
An Informational Note in section 328.14 indicates that IEEE document 576-2000 includes information that a person needs to be familiar with before installing, terminating, or testing MV cable.

Question 60: Who is qualified to install Medium Voltage cable?

A: An electrician with over 10 years experience.
B: An electrician working in an industrial location under engineering supervision.
C: An electrician with experience installing MV cable who has received appropriate installation and safety training.
D: An electrician who is qualified to work on electrical systems 600 volts and below.

Question 61: 338.10(B)(4)(a) Uses Permitted. Branch Circuits or Feeders. Installation Methods for Branch Circuits and Feeders. Interior Installations.

Question ID#: 109.0



Except when installed in thermal insulation, SE Cable is rated for 75Â°C.

By saying SE cable wiring is required to comply with the requirements of Part II of Article 334, except for 334.80 in interior installations, the ampacity of conductors used in Type SE service-entrance cable for interior wiring can now be rated 75Â°C (except when they are installed in thermal insulation). SE cable has a 75Â°C rating because the insulation permitted in SE and SEU cable are Types RHW, RHW-2, XHHW, XHHW-2, THWN, or THWN-2. In the 2008 NEC, the ampacity of conductors in Type SE cable were rated for 60Â°C.

Type SE cable is often used for interior wiring to connect heating and cooling equipment and as a feeder to subpanels. Using the 60Â°C ampacity rating for aluminum SE cable to feed a 100 amp subpanel meant selecting a 1/0 conductor. At the 75Â°C rating the size of the conductors can be reduced to a No. 1.

If SE cable is installed in thermal insulation, the 60Â°C rating must be used. The thermal insulation covering the cable will not allow the heat from current flow to be cooled by surrounding air. With less cooling, the conductors can carry less current and the ampacity must be selected from the 60Â°C rating of Table 310.15(B)(16). If the ampacity of the wires must be adjusted or corrected because the conductors are bundled or the ambient temperature is above 86Â°F, the 90Â°C rating of the XHHW conductors inside the cable can be used to apply the adjustments, but the final rating of the conductors cannot be greater than the 60Â°C rating from Table 310.15(B)(16).

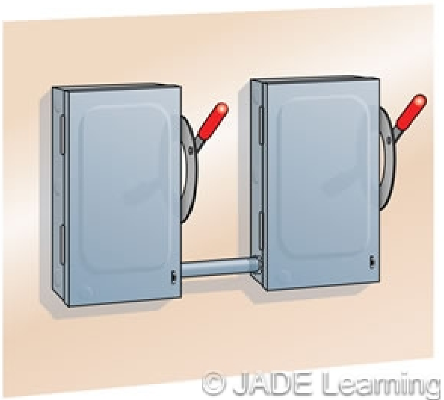
For example, if a No. 6 aluminum SE cable is installed in thermal insulation in an ambient temperature of 110Â°F, the correction factor is .87, based on a 90Â°C rating of the conductors. A 90Â°C rated aluminum conductor can carry 55 amps; 55 amps x .87 = 47.85 amps. The 60Â°C rating of a No. 6 aluminum conductor is only 40 amps. So, the corrected ampacity of the SE cable installed in thermal insulation in an ambient temperature of 110Â°F cannot be greater than 40 amps. Importantly, basing the ampacity correction on the 75Â°C rating when SE cable is installed in thermal insulation is permitted provided the calculated corrected ampacity does not exceed the 60Â°C ampacity of the conductor.

Question 61: If there are only three current carrying conductors in the cable and the ambient temperature is 86Â°F, what is the ampacity of a 2/0 aluminum Type SE cable not installed in thermal insulation?

A: 135 amps.
B: 120 amps.
C: 115 amps.
D: 100 amps.

Question 62: 342.30 Securing and Supporting.

Question ID#: 110.0



The support requirements for short sections of raceway have changed.

The section in the 2008 NEC that permitted short sections of raceway to be unsupported in lengths up to 18 inches has been deleted from Article 342 on IMC conduit. Similar sections in Article 344, RMC; Article 352, PVC; Article 355, RTRC; and Article 358, EMT have also been deleted.

With the sections on unsupported raceways up to 18 inches in length deleted, the support requirements for these raceways goes back to the required support distance from enclosures, or 36 inches. The reasoning was that if these raceways can go unsupported for the last 36 inches before an enclosure, the same types of raceways should be able to be unsupported if installed as short sections of raceway between two enclosures. This means that a short section of raceway between two enclosures can be unsupported in lengths up to 36 inches. Further, by deleting the section on unsupported raceways, it no longer matters if the nipple or short section of raceway is connected to the enclosure through a concentric or eccentric knockout or if the raceway consists of sections of conduit joined by a coupling. If the raceway is adequately secured to both enclosures, no additional support, such as a raceway strap, is required even if the conduit enters the enclosures through concentric or eccentric knockouts or if it includes a coupling.

Question 62: A 30 inch section of raceway is installed through eccentric knockouts between two enclosures. How many raceway straps are required?

A: 0.
B: 1.
C: 2.
D: 3.

Question 63: 392.18(H) Cable Tray Installation. Marking.

Question ID#: 117.0

Cable trays containing conductors rated over 600 volts must be marked.

Cable trays containing conductors rated over 600 volts shall have a permanent, legible warning notice carrying the wording "DANGER - HIGH VOLTAGE - KEEP AWAY" placed in a readily visible position on all cable trays with the spacing of warning notices not to exceed 10 ft.

The notice must be a warning, DANGER. The notice must say what the hazard is, HIGH VOLTAGE. The notice must give a command, STAY AWAY.

This section is in Part II, Installation, which means the warning notice must be put on the cable tray in the field. It cannot be installed on the cable tray at the factory. The manufacturer does not know how the sections of cable tray will be installed, or what the voltage of the conductors in the tray will be.

Cable trays are installed in locations which are accessible to qualified and unqualified persons. The warning notices will help protect people who work close to high voltage cable trays.

Warning notices on cable trays are required to be placed in a readily visible position so that no point is more than 10-feet from a notice. ***..For example***: if a cable tray is 19-feet in total length and is installed so that one side of the tray is visible, the minimum requirements of NEC section 392.18(H) are complied with by placing one warning notice in the middle of the visible side of the tray.

To determine the minimum number of notices required for cable tray that is more than 10-feet in length, you can divide the length of the tray by 10. ***One notice is required for each whole number resulting from the equation.***

For example: a 35-foot tray requires a minimum of 3 notices (35 ***Ã·*** 10 = 3 & 1/2 or 3.5: a minimum of 3 warning notices are required) and the 5 foot section left over would not require a label.

Example #2: if the tray were 46-feet long 4 notices would be required (46 ***Ã·*** 10 = 4 & 6/10 or 4.6: a minimum of 4 warning notices are required and the 6 foot section left over would not require a label.

Question 63: An 18-foot long open ladder type cable tray is installed between two enclosures; the tray contains conductors operating at over 600-V and is installed against a wall so that only one side is visible. What is the minimum number of warning notices required on the tray?

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

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

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1.) A B C D	**17.) A B C D**	**33.) A B C D**	**49.) A B C D**
2.) A B C D	**18.) A B C D**	**34.) A B C D**	**50.) A B C D**
3.) A B C D	**19.) A B C D**	**35.) A B C D**	**51.) A B C D**
4.) A B C D	**20.) A B C D**	**36.) A B C D**	**52.) A B C D**
5.) A B C D	**21.) A B C D**	**37.) A B C D**	**53.) A B C D**
6.) A B C D	**22.) A B C D**	**38.) A B C D**	**54.) A B C D**
7.) A B C D	**23.) A B C D**	**39.) A B C D**	**55.) A B C D**
8.) A B C D	**24.) A B C D**	**40.) A B C D**	**56.) A B C D**
9.) A B C D	**25.) A B C D**	**41.) A B C D**	**57.) A B C D**
10.) A B C D	**26.) A B C D**	**42.) A B C D**	**58.) A B C D**
11.) A B C D	**27.) A B C D**	**43.) A B C D**	**59.) A B C D**
12.) A B C D	**28.) A B C D**	**44.) A B C D**	**60.) A B C D**
13.) A B C D	**29.) A B C D**	**45.) A B C D**	**61.) A B C D**
14.) A B C D	**30.) A B C D**	**46.) A B C D**	**62.) A B C D**
15.) A B C D	**31.) A B C D**	**47.) A B C D**	**63.) A B C D**
16.) A B C D	**32.) A B C D**	**48.) A B C D**	

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