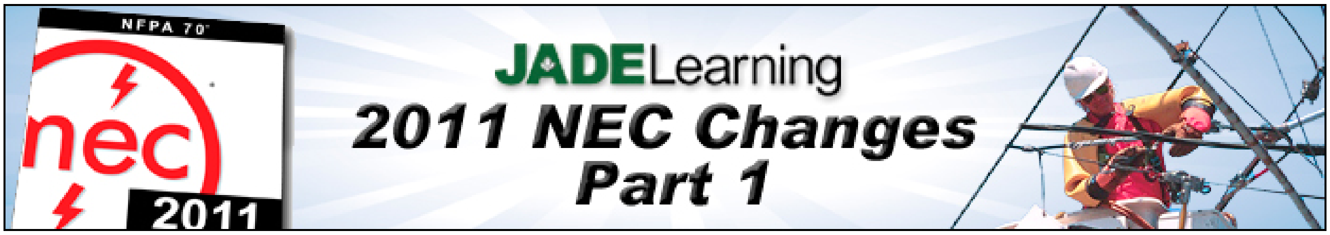


2011 NEC Changes Part 1 (Homestudy)

Wisconsin Electrical License

This course will review the first half of the most important National Electrical Code changes from the 2011 NEC. Changes in Articles 90 - 406.12 will be covered.

Course# 12405   8 CEI, IJE, J, M, UDC Credit Hours $85.00

This course is currently approved by the Wisconsin Department of Safety and Professional Services under course number 12405.

Completion of this continuing education course will satisfy 8.000 credit hours of course credit type 'CEI, IJE, J, M, UDC' for Electrical license renewal in the state of Wisconsin. Course credit type 'CEI, IJE, J, M, UDC'. Board issued approval date: 2/9/2011. Board issued expiration date: 2/9/2016.

2011 NEC Changes Part 1 (Homestudy) - WI

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

Question ID#: 1

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: 90.2(B)(5) Scope. Not Covered. Installations Under the Exclusive Control of an Electric Utility.

Question ID#: 2

The National Electrical Code does not cover installations under the exclusive control of an electric utility.

The National Electrical Code does not apply to installations under the exclusive control of an electric utility. Wiring for utility installations in established easements or rights-of-way is not governed by the NEC if public service or utility commissions agree utility wiring is permitted in these areas.

In 2011 another area has been included that will be under the exclusive control of the electric utility, and not subject to the requirements of the National Electrical Code. If "other written agreements" are made between the utility and a customer, utility installations that are not required to be installed according to the National Electrical Code are installed according to the National Electrical Safety Code (NESC).

The written agreements are limited to installations for the purpose of communications, metering, generation, control, transformation, transmission, or distribution of electric energy. Any written agreement is further limited to federal lands, Indian reservations, military bases, state property and lands owned by railroads.

Question 2: Which of the following is a true statement about installations under the exclusive control of the utility?

A: If area lighting is fed from a commercial building, the installation does not have to meet the requirements of the NEC when maintained by the utility.
B: Installations on federal lands that are part of a written agreement between the utility and a customer, recognized by a utility commission, are covered by the NEC.
C: Installations on federal lands that are part of a written agreement between the utility and a customer, recognized by a utility commission, are not covered by the NEC.
D: If the installation is on public property and the customer agrees, the utility is not required to use the NEC.

Question 3: 90.5(C) Explanatory Material. 90.5(D) Informative Annexes.

Question ID#: 3

Informational Notes and Informative Annexes do not contain mandatory material.

Fine Print Notes are no more. Now they are called Informational Notes. Fine Print Notes were always informational and not mandatory, but changing the name to Informational Notes makes their purpose more clear.

In legal documents and contracts, consumers are always cautioned to read the fine print, which can add additional conditions to the document. The Fine Print Notes in the National Electrical Code were never used in that way, and the new name, Informational Notes, is more in line with their intended purpose. Informational Notes are not enforceable.

Informative Annexes in the back of the Code book are also not mandatory. The Informative Annexes are:

- Informative Annex A: Product Safety Standards.
- Informative Annex B: Application Information for Ampacity Calculation.
- Informative Annex C: Conduit and Tubing Fill Tables for Conductors and Fixture Wires of the Same Size.
- Informative Annex D: Examples.
- Informative Annex E: Types of Construction.
- Informative Annex F: Availability and Reliability for Critical Operations Power Systems.
- Informative Annex G: Supervisory Control and Data Acquisition (SCADA).
- Informative Annex H: Administration and Enforcement.
- Informative Annex I: Recommended Tightening Torque Tables from UL Standard 486 A-B.

Question 3: Which Informative Annex would have a table showing the maximum number of No. 10 THHN conductors that could be installed in 3/4 in. EMT?

A: Informative Annex A.
B: Informative Annex C.
C: Informative Annex E.
D: Informative Annex H.

Question 4: Article 100 Definitions. Ampacity.

Question ID#: 4

The 2011 NEC defines Ampacity as follows: ***<u>The maximum current, in amperes, that a conductor can carry continuously under the conditions of use without exceeding its temperature rating.</u>*** 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 4: 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 5: Article 100 Definitions. Arc-Fault Circuit-Interrupter (AFCI).

Question ID#: 5

Arc-Fault Circuit Interrupter (AFCI) protected circuits continue to be a requirement for dwelling units.

The definition of arc-fault circuit interrupter (AFCI) was moved from Article 210 to Article 100. The definition has not changed. When a term is used in two or more articles the definition is placed in Article 100. The term arc-fault circuit interrupter is used in Article 210, Article 406, and Article 440.

An arc-fault circuit interrupter (AFCI) is defined as:

A device intended to provide protection from the effects of arc faults by recognizing characteristics unique to arcing and by functioning to de-energize the circuit when an arc-fault is detected.

Arc-fault circuit interrupter protection was controversial when it was first required in 2005 for 120-volt, single phase, 15- and 20-ampere branch circuits in dwelling unit bedrooms. There was more heated discussion in 2008 when AFCI protection was extended to dwelling unit family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways or similar rooms. Some jurisdictions limited the requirement for AFCI protection to the bedroom in 2008. In 2011, AFCI protection has been extended again. If a branch circuit located in an area that requires AFCI protection is modified, replaced or extended, AFCI protection must be provided.

Requirements for AFCI protection have been in the NEC for three Code cycles.

Future editions of the Code will most likely further extend and expand AFCI protection.

Question 5: In the 2011 NEC, the requirements for arc-fault circuit interrupter protection:

A: Have been cut back to the way they were in 2005.
B: Are now required in dwelling unit kitchens, garages and outdoors.
C: Are the same as they were in 2008.
D: Now cover circuit modifications in existing dwelling units.

Question 6: Article 100 Definitions. Automatic and Non-Automatic.

Question ID#: 6

An automatic device does not need human intervention to operate.

The 2011 NEC defines Automatic as follows: ***Performing a function without the necessity of human intervention.***

The 2008 definition of Automatic was: ***Self-acting, operating by its own mechanism when actuated by some impersonal influence, as, for example, a change in current, pressure, temperature, or mechanical configuration.***

The new definition is much more straightforward and easier to understand.

The new definition of Non-automatic is: ***Requiring human intervention to perform a function.***

Question 6: Which of the following types of equipment is considered automatic?

A: A time clock used to control a pump.
B: A snap-switch.
C: An emergency stop pushbutton.
D: A touch screen display used to control a manufacturing process.

Question 7: Article 100 Definitions. Bathroom.

Question ID#: 7

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 7: 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 8: Article 100 Definitions. Grounding Conductor. [Deleted]

Question ID#: 8

The term Grounding Conductor has been deleted.

A grounding conductor was defined in the 2008 National Electrical Code as: ***A conductor used to connect equipment or the grounded circuit of a wiring system to a grounding electrode or electrodes.***

The definition was deleted in the 2011 edition because a grounding conductor as used in the 2008 NEC was the same thing as a grounding electrode conductor, or a bonding conductor.

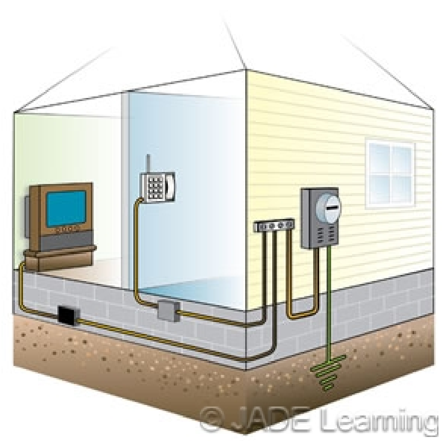
For example, in the 2008 NEC the wording in Section 800.100 (A)(2) said: ***The grounding conductor shall be copper or other corrosion-resistant conductive material, stranded or solid.*** The wording in the 2011 NEC says: ***The bonding conductor or grounding electrode conductor shall be copper or other corrosion-resistant conductive material, stranded or solid.***

Question 8: Which of the following terms is now used instead of Grounding Conductor?

A: Intersystem Bonding Termination.
B: Grounding Electrode Conductor, or Bonding Conductor.
C: Grounding Conductor.
D: Grounding Conductor, Equipment.

Question 9: Article 100 Definitions. Intersystem Bonding Termination.

Question ID#: 9



The Intersystem Bonding Termination connects communications system wiring to the grounding electrode system.

The revised definition in the 2011 NEC defines Intersystem Bonding Termination as: ***A device that provides a means for connecting bonding conductors for communications systems to the grounding electrode system.***

2008 NEC definition: ***A device that provides a means for connecting communications system(s) grounding conductors(s) and bonding conductor(s) at the service equipment or at the disconnecting means for buildings or structures supplied by a feeder or branch circuit.***

The Intersystem Bonding Termination is used to connect limited energy systems such as telephone, radio and television satellites, CATV, and Network-Powered Broadband systems to the grounding electrode system.

The new definition makes two things clearer: (1) the communications networks are connected to the grounding electrode system and (2) the connection is permitted to be made at any point on the grounding electrode system.

Question 9: What is the purpose of the Intersystem Bonding Termination?

A: To isolate the telephone and CATV system from each other.
B: To isolate the communications systems in the building from the electrical power system in the building.
C: To isolate sensitive electronic hardware from lightning damage.
D: To establish a common reference to ground for communications and electrical power systems.

Question 10: Article 100 Definitions. Separately Derived System.

Question ID#: 10

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.***

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

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.

Question 10: Which of the following is the best description of the connections between a separately derived system and a service?

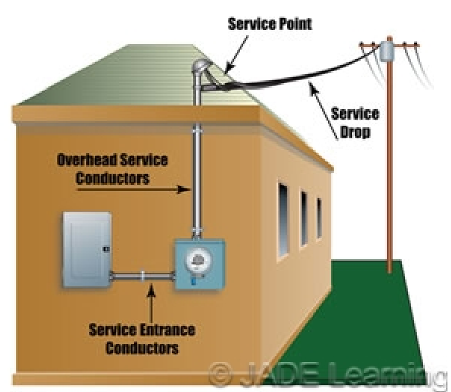
A: The grounded circuit conductor of a separately derived system has a direct connection to the grounded circuit conductor of the service.
B: The metal raceways and metal enclosure of a separately derived system are connected together, and they are connected to a grounding electrode system.
C: Separately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

Question 11: Article 100 Definitions. Service Conductors, Overhead. Service Drop.

Question ID#: 11

The term ***Service Conductors, Overhead*** has been added to Article 100 in the 2011 NEC and the definition of ***Service Drop*** has been changed. The changes were made to clear up which conductors in an overhead service system are utility conductors and which conductors are part of the premises wiring.

Service-Entrance Conductors, Overhead System: ***The service conductors between the terminals of the service equipment and a point usually outside the building, clear of building walls, where joined by tap or splice to the service drop or overhead service conductors.*** These conductors are part of the premise's wiring system and are covered by the NEC.



Overhead service conductors are customer wires. Service drop conductors are utility wires.

Service Drop: The overhead conductors between the utility electric supply system and the service point. These utility conductors are not covered by the NEC. Service Drop conductors are covered by the NESC.

Service Point: The point of connection between the facilities of the serving utility and the premises wiring. On the customer side of the service point the NEC applies. On the utility side of the service point the rules change and the NESC applies.

Service Conductors, Overhead: ***The overhead conductors between the service point and the first point of connection to the service-entrance conductors at the building or other structure.*** These conductors are part of the premise's wiring system and are covered by the NEC.

The service drop conductors are utility wires and connect to the premises wiring system at the service point. They are normally installed by the utility according to the National Electrical Safety Code (NESC). The overhead service conductors are part of the premises wiring system and are installed by an electrical contractor according to the National Electrical Code (NEC).

Question 11: Which of the following statements about overhead service conductors is true?

A: They are installed according to the NESC (National Electrical Safety Code).
B: They connect to a service lateral.
C: They connect utility conductors to service-entrance conductors of an overhead system.
D: They extend from the utility transformer to the service disconnecting means.

Question 12: Article 100 Definitions. Service Conductors, Underground.

Question ID#: 12

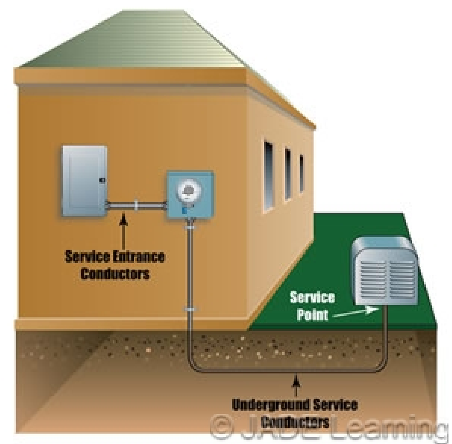
The term Service Conductors, Underground has been added to Article 100 and is defined as follows:

The underground conductors between the service point and the first point of connection to the service-entrance conductors in a terminal box, meter, or other enclosure inside or outside the building wall.

Utility wiring connects to the service point, from there, the underground service conductors extend to the service-entrance wires, which are part of the premises wiring system. The connection to the service-entrance wires is made in a wireway, meter, disconnecting means or other enclosure. This connection can be either outside or inside the building.

An Informational Note says: ***Where there is no terminal box, meter, or other enclosure, the point of connection is considered to be the point of entrance of the service conductors into the building.***

Because underground service conductors begin at the service point, where utility wiring ends, underground service conductors are not utility wiring and must be installed according to the National Electrical Code.



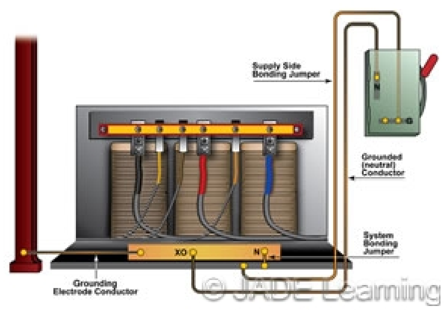
Underground service conductors are installed between the service point and the connection to the service-entrance conductors.

Question 12: What is the best description of underground service conductors?

A: Underground service conductors are the same as service-entrance conductors.
B: Underground service conductors connect from the service point to the service entrance conductors serving the premises wiring, in an underground system.
C: Underground service conductors are installed and maintained by the serving utility.
D: Underground service conductors extend beyond the first building disconnecting means.

Question 13: Article 100 Definitions. Bonding Jumper, System.

Question ID#: 13



The system bonding jumper is installed at a separately derived system.

The term Bonding Jumper, System has been added to Article 100 in the 2011 NEC and is defined as follows:

The connection between the grounded circuit conductor and the supply-side bonding jumper, or the equipment grounding conductor, or both, at a separately derived system.

The definition was relocated from Section 250.2 to Article 100 and changed to include the fact that a system bonding jumper connects the grounded conductor to a supply side bonding jumper, an equipment grounding conductor, or both.

The ***supply-side bonding jumper*** is a new term. The supply-side bonding jumper is located on the secondary of a transformer.

The system bonding jumper connection to the grounded conductor can be located either at the transformer or at the first disconnecting means, per 250.30(A)(1). In either case, the supply-side bonding jumper is installed between the transformer enclosure and the enclosure for the first disconnecting means.

Question 13: What is the best description for a system bonding jumper?

A: The system bonding jumper connects the grounded conductor to the supply-side bonding jumper and/or the equipment grounding conductor at a separately derived system.
B: The system bonding jumper and the supply-side bonding jumper are identical.
C: The system bonding jumper connects the grounded conductor of the primary of a transformer to the secondary of the transformer.
D: The system bonding jumper isolates the enclosure of the transformer from the enclosure of the first disconnecting means.

Question 14: Article 100 Definitions. Uninterruptible Power Supply.

Question ID#: 14

An uninterruptible power supply provides power to the load in the event of a power failure.

The term Uninterruptible Power Supply and an Informational Note have been added to Article 100 in the 2011 NEC; it is defined as follows: ***A power supply used to provide alternating current power to a load for some period of time in the event of a power failure.***

Informational Note: ***In addition, it may provide a more constant voltage and frequency supply to the load, reducing the effects of voltage and frequency variations.***

The definition describes the main function of an uninterruptible power supply (UPS): keeping equipment running when the main source of power fails. The loss of power for even a fraction of the AC cycle can cause sensitive electronic equipment like computers and other microprocessor driven devices to shut down. When this happens, the active memory is lost.

The Informational Note highlights the other important function of an uninterruptible power supply: smoothing out the AC sine wave so computers and electronic equipment can function reliably.

Question 14: Which statement best describes the purpose of an uninterruptible power supply?

A: It is a backup memory for computers.
B: It is an electronic filter for sensitive electronic equipment.
C: It is a backup source for AC power.
D: It is a backup source of power for DC driven equipment.

Question 15: 110.3(A)(1) Examination, Identification, Installation, and Use of Equipment. Informational Note.

Question ID#: 15

Equipment must be installed and used according to the listing and labeling.

This section covers the suitability of equipment for installation and use. It is important that equipment is used for its intended purpose, that equipment is used in the proper environment, for example outdoors or indoors, and that equipment is used for the type of application for which it was designed.

Other conditions exist that may affect the safe operation of the equipment. The equipment may not be suitable for use in especially hot or cold areas. It may require power conditioning to prevent damage to sensitive electronic equipment. It may require special types of overcurrent protection, such as fast acting fuses, in the branch circuit supplying the equipment.

These special conditions may now be marked on the equipment or included in the installation instructions. They become part of the listing and labeling of the equipment and are mandatory requirements for the installer.

The Informational Note has added the sentence: ***Special conditions of use or other limitations and other pertinent information may be marked on the equipment, included in the product instructions, or included in the appropriate listing and labeling information.***

Question 15: The nameplate on a 240 Volt, single-phase heat pump states that the maximum overcurrent protection is a 30 ampere time delay fuse. Which of the following is the installer permitted to use to protect the unit?

A: Any 30 ampere fuse.
B: A 30 ampere time delay fuse.
C: Either a 30 ampere time delay fuse or a 30 ampere inverse time circuit breaker.
D: A 30 ampere inverse time circuit breaker.

Question 16: 110.14 Electrical Connections.

Question ID#: 16

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

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

Question 17: 110.16 Arc-Flash Hazard Warning.

Question ID#: 17

The title to this section has changed from Flash Protection to Arc-Flash Hazard Warning. The new title better describes the warning label that is required to be field applied to equipment such as switchboards, panelboards, industrial control panels, meter socket enclosures and motor control centers. The hazard warning is required to be applied to equipment that is likely to require examination, adjustment, servicing or maintenance while energized.

Arc Flash is a danger when working on energized equipment.

An arc-flash hazard warning is not required on dwelling units in 2011. In 2008, warning labels were not required on dwelling ***occupancies***. A dwelling unit is a single dwelling. A dwelling occupancy could include a large multi-family apartment complex. The electrical load on a multi-family dwelling occupancy can be as large as or larger than the load on a commercial building. On a larger load, there is more energy delivered to the terminals of equipment. More potential electrical energy means there is an increased danger of an arc flash.

An arc-flash hazard warning label will serve to caution a qualified person of the dangers of arc-flash and arc-blast. Informational Note No. 1 refers to NFPA 70E-2009, Standard for Electrical Safety in the Workplace, as the document from which to get additional information on safe work practices and selecting personal protective equipment when working on energized equipment.

Question 17: Which of the following pieces of equipment requires an arc-flash hazard warning label?

A: A service panelboard in a single family dwelling.
B: A feeder junction box in an office building.
C: A power distribution panel in a mall.
D: A cable tray containing service conductors.

Question 18: 110.24 Available Fault Current.

Question ID#: 18

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 18:   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 19:   110.26(A)(3) Height of Working Space.

Question ID#: 19

The height of the working space is 6.5 ft. tall or the height of the equipment, whichever is greater.

The height of the required working space at electrical equipment has not changed. It is still 6 1/2 ft., or the height of the equipment, whichever is greater.

Also, other equipment which is above or below the electrical equipment cannot extend more than 6 inches beyond the front of the equipment. A new exception has been added, however, which permits meters to extend further than 6 inches into the space reserved for the electrical equipment.

Another exception has been relocated to this section which permits panelboards not greater than 200 amps to be installed in existing dwelling units where the height of the working space is less than 6 1/2 ft.

The section on headroom required at electrical equipment has been deleted, since headroom was the same as the height of the working space.

Question 19:   What is the required height of work space at equipment which is 7 ft. tall?

A: 6 ft.
B: 6.5 ft.
C: 7 ft.
D: 8 ft.

Question 20:   110.26(D) Illumination.

Question ID#: 20

Illumination in electrical rooms cannot be controlled by automatic means.

A new school built in Washington state had the electrical room where the electrical service was located noted as "storage" on the building plans. Because it was listed as storage space, occupancy sensors were installed in the area, as many building energy codes require.

Electrical personnel could have been in serious danger if they were working on the equipment and the lights were turned off because the occupancy sensors did not detect movement.

Section 110.26(D) of the 2008 NEC required that illumination in electrical rooms cannot be controlled by automatic means. The 2011 NEC deleted the phrase, ***in electrical rooms,*** so now no matter how the space is classified, illumination that is not controlled only by automatic means must be provided for the work space around indoor service equipment, switchboards, panelboards, and motor control centers.

Question 20:   A panelboard is located in a utility room. Which of the following statements is true?

A: The lights in the room can be controlled by automatic means only.
B: The lights in the room cannot be controlled by automatic means only.
C: An occupancy sensor is permitted as the only lighting control in the utility room.
D: A skylight is permitted as the only source of illumination in the utility room.

Question 21:   110.28 Enclosure Types.

Question ID#: 21

Enclosure types are classified by Number and Letter, such as 3R, to show the degree of protection the enclosure provides from different environmental conditions like rain, snow, and sleet. The enclosure types are listed in Table 110.28, and nothing in the Table has changed.

An enclosure must be suitable for the environment where it is installed.

Section 110.28 has added a number of different enclosure types to the list of enclosures that must be marked with the letter and number classifications of Table 110.28.

In addition to switchboards, panelboards, industrial control panels, motor control centers, and meter sockets, now enclosed switches, transfer switches, power outlets, circuit breakers, adjustable-speed drive systems, pullout switches, portable power distribution equipment, termination boxes, general-purpose transformers, fire pump controllers, and fire pump motors must all be marked with an enclosure-type number from Table 110.28.

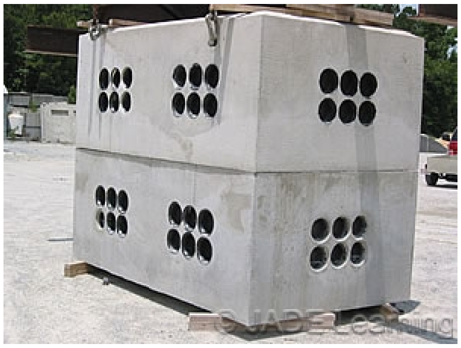
The enclosure-type numbers apply only to enclosures used on systems 600 volts and below.

Question 21:   Which one of the following types of enclosures is not required to be marked with an enclosure-type number when used on 480 volt systems?

A: A motor-control center enclosure.
B: A transfer switch enclosure.
C: An enclosure for circuit breakers.
D: A pull box used with rigid metal conduit.

Question 22:   110.31(A) Electrical Vaults.

Question ID#: 22



Electrical vaults must have a 3 hour fire rating.

The section on electrical vaults used on systems over 600 volts has been reformatted to include requirements for vault doors, locks, floors, walls and roofs.

The general requirement for the fire resistance rating of an electrical vault is 3 hours. According to Informational Note No. 2, six inches of reinforced concrete provides a 3 hour fire resistance rating. However, a new exception has been added that permits use of 1 hour vault construction methods provided that the vault is also protected with an automatic sprinkler, water spray, carbon dioxide, or halon fire suppression system. However, section 110.31(A) does not permit the use of wallboard and stud construction to comply with the requirements of this section.

When a transformer is installed in a vault, the construction of the vault must meet the requirements for transformer vaults in Part III of Article 450.

Question 22:   Which of the following are not permitted for the protection of equipment in electrical vaults?

A: Reinforced concrete roof with a 3 hour rating.
B: Reinforced concrete wall with a 3 hour rating.
C: An automatic halon or carbon dioxide fire suppression system.
D: Stud walls covered with wallboard having a 3 hour rating.

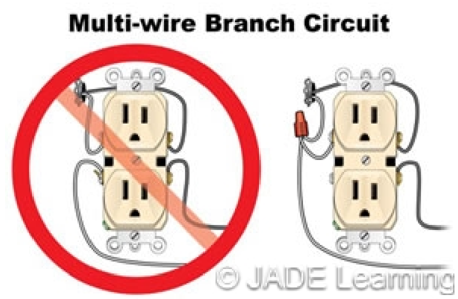
Question 23:   200.2(B) Continuity.

Question ID#: 23

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

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.



In multiwire branch circuits the grounded conductor must be continuous.

Question 23:   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 24:   200.4 Neutral Conductors.

Question ID#: 24

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 24:   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.

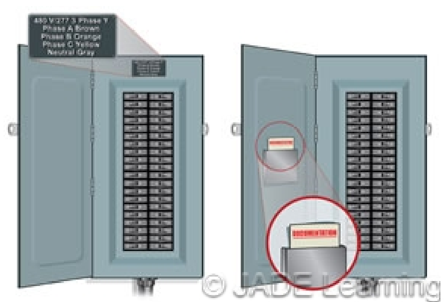
Question 25:   200.6(D) Grounded Conductors of Different Systems.

Question ID#: 25

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.

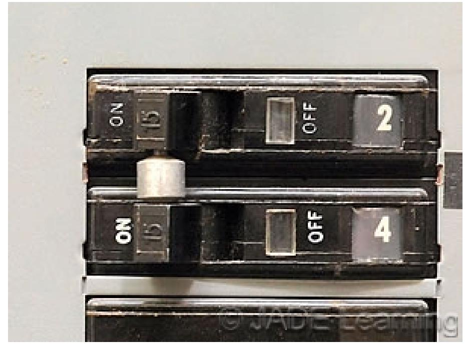
Question 25:   If grounded conductors of different systems are installed in the same raceway:

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 26: 210.4(B) Multiwire Branch Circuits. Disconnecting Means.

Question ID#: 26

The 2008 NEC required all of the ungrounded conductors in a multiwire branch circuit to be disconnected simultaneously. A new Informational Note has been added in the 2011 NEC with a reference to 240.15(B) for the use of single-pole circuit breakers as the disconnecting means for multiwire branch circuits.



Handle ties on single pole circuit breakers can be used as the simultaneous disconnecting means.

Section 240.15(B) now requires all individual single pole circuit breakers used in multiwire branch circuits to use identified handle ties. This section also permits a 2-pole or 3-pole circuit breaker to be used on a multiwire branch circuit because when it trips, this type of breaker automatically disconnects all ungrounded conductors in the circuit. It also opens all ungrounded conductors when the breakers are turned off manually.

Section 240.15(B) also limits the voltage rating on individual single-pole circuit breakers used to simultaneously disconnect multiwire branch circuits. The rating on circuit breakers used with identified handle ties on multiwire branch circuits cannot be greater than 120/240 volts for line-to-line AC circuits and 125/250 volts on DC circuits.

Single-pole circuit breakers with identified handle ties cannot be used as the disconnecting means on line-to-line circuits operating at 277/480 volts.

Question 26: Which of the following can be used as the disconnecting means for a single phase, 120/240 volt multiwire branch circuit?

A: Individual single-pole circuit breakers.
B: Individual single-pole circuit breakers rated 120/240 volts with identified handle ties.
C: Individual single-pole circuit breakers with identified handle ties, rated 277/480 volts.
D: Individual single-pole circuit breakers with No. 12 AWG used to connect the circuit breaker handles together.

Question 27: 210.5(C) Identification for Branch Circuits. Ungrounded Conductors.

Question ID#: 27

This is an example of a Code change that makes the Code more user-friendly but does not change technical requirements.

Numbered lists are used to make requirements easier to understand.

Numbered lists are easier to understand than a single paragraph with several requirements. A numbered list separates each requirement and gives it emphasis by using a title with a unique number.

Section 210.5(C) now reads:

(C) Identification of Ungrounded Conductors.

(1) Application.

(2) Means of Identification.

(3) Posting of Identification Means.

If the Code user has a question about how ungrounded conductors in branch circuits must be identified, it will be easier to locate the requirements in the NEC because they are now written in a numbered list format. The means of identification for ungrounded branch circuit conductors is found in 210.5(C)(2).

Question 27: In the 2011 NEC, which of the following is not one of the means specified for identifying ungrounded conductors?

A: Painting the conductors.
B: Tagging.
C: Separate color coding.
D: Marking tape.

Question 28: 210.8 Ground-Fault Circuit-Interrupter Protection for Personnel.

Question ID#: 28

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 28: 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 29: 210.8(A)(7) Ground-Fault Circuit-Interrupter Protection for Personnel. Dwelling Units. Sinks.

Question ID#: 29

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 29:   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 30:   210.8(B)(5) Exception 2 to 5. Ground-Fault Circuit-Interrupter Protection for Personnel. Other Than Dwelling Units. Sinks.

Question ID#: 30

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 30:   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 31:   210.8(B)(6) Ground-Fault Circuit-Interrupter Protection for Personnel. Other Than Dwelling Units. Indoor Wet Locations.

Question ID#: 31

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 31: 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 32: 210.8(B)(7) Ground-Fault Circuit-Interrupter Protection for Personnel. Other Than Dwelling Units. Locker Rooms.

Question ID#: 32

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 32: 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 33: 210.8(B)(8) Ground-Fault Circuit-Interrupter Protection for Personnel. Other Than Dwelling Units.

Question ID#: 33

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.

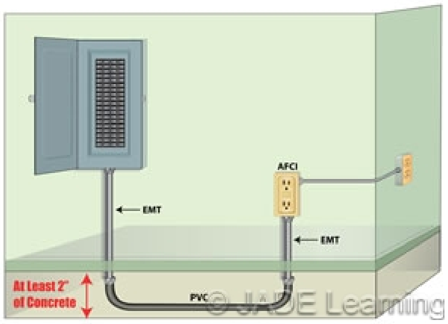
Vehicle storage areas and parking garages where power tools, portable lighting, and diagnostic equipment are NOT used do not require GFCI protected receptacle outlets.

Question 33: 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 34: 210.12(A) Ex. No. 1&2. Arc-Fault Circuit-Interrupter Protection. Dwelling Units.

Question ID#: 34



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 34: 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 35: 210.12(B) Arc-Fault Circuit-Interrupter Protection. Branch Circuit Extensions or Modifications- Dwelling Units.

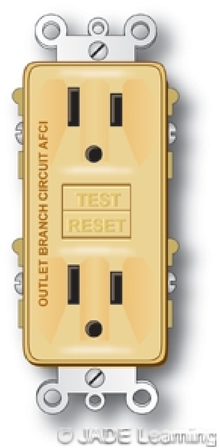
Question ID#: 35

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 35:   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 36:   210.19(A)(1) Exception No.2 Deleted.

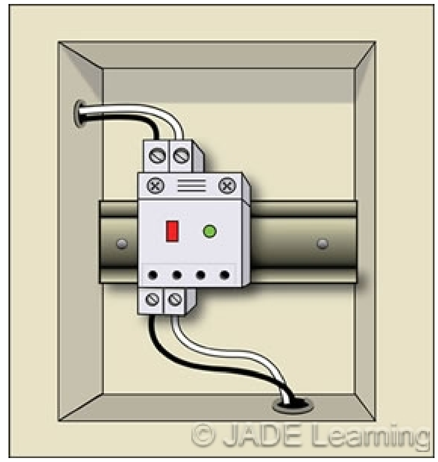
Question ID#: 36

The 2008 NEC added Exception No. 2 to section 210.19(A)(1) which permitted a branch circuit grounded conductor that was not connected to an overcurrent device to be sized at 100% of the continuous load.

The 2011 NEC has deleted Exception No.2. The exception was deleted because branch circuit installations include grounded conductors that run from a panelboard grounded busbar to the grounded terminals of devices. While the terminations on the busbar may be able to dissipate heat in the grounded conductor, device and equipment terminations at the load end of the grounded conductor were not always able to dissipate heat at the load side termination.

By requiring the grounded conductors to be sized to handle 100% of the non-continuous load and 125% of the continuous load, load side terminations of grounded conductors should be able to prevent heat build-up at grounded conductor terminations.

Exception No. 1 from the 2008 NEC, is included with minor editorial changes in the 2011 NEC as follows: ***"If the assembly, including the overcurrent devices protecting the branch circuit(s) is listed for operation at 100 percent of its rating, the allowable ampacity of the branch circuit conductors shall be permitted to be not less than the sum of the continuous load plus the non-continuous load."***



Grounded conductors must be sized at 125% of the continuous load.

Question 36:   Which of the following statements is true about branch circuit grounded conductors?

A: A branch circuit grounded conductor is not required to be sized for 125% of the continuous load.
B: A branch circuit grounded conductor is not required to be sized for 125% of a continuous load when terminated to a recessed lug.
C: Without applying any exception, a branch circuit grounded conductor is required to be sized for 100% of any non-continuous load in addition to 125% of any continuous load.
D: A commercial office building lighting branch circuit grounded conductor is not required to be sized for 125% of the load.

Question 37:   210.52(A)(4) Dwelling Unit Receptacle Outlets. General Provisions. Countertop Receptacles.

Question ID#: 37

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 37: 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 38: 210.52(C)(5) Dwelling Unit Receptacle Outlets. Countertops. Receptacle Outlet Location.

Question ID#: 38

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

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

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.

Question 38: 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 39: 210.52(E)(3) Dwelling Unit Receptacle Outlets. Outdoor Outlets. Balconies, Decks, and Porches.

Question ID#: 39

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 39: 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 40: 210.52(G) Dwelling Unit Receptacle Outlets. Basements, Garages, and Accessory Buildings.

Question ID#: 40

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 40: 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 41: 210.52(I) Dwelling Unit Receptacle Outlets. Foyers.

Question ID#: 41

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 41: 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 42: 220.43(B) Track Lighting.

Question ID#: 42

The load on track lighting can be calculated based on the rating of a current limiting device.

A new exception has been added which permits the calculation for a section of lighting track to be based on the rating of a device which limits the current to the lighting track. Without the exception, the load calculation for lighting track is based on 150 volt-amperes for every 2 ft. of lighting track (75 watts per linear ft.).

Modern energy codes limit the load on lighting track. Not all states choose to limit loads on track lighting, but where legally adopted energy codes require it, a linear foot of lighting track is limited to between 30-50 watts, depending on the energy code which is adopted. Calculating lighting track load per the NEC at 150 watts per 2 ft. results in conductors and equipment that are sized for loads they will never legally see. If a device is installed which limits the load on the lighting track, the load calculation for the track lighting can be based on the rating of the device, not 150 watts per 2 ft.

Question 42: A state energy codes limits lighting track to 50 watts per linear foot. If a device is installed to limit the load on a 10 ft. section of track lighting to the state adopted code, what is the calculated load on the lighting track?

A: 1500 watts.
B: 1000 watts.
C: 750 watts.
D: 500 watts.

Question 43: 225.7(C) Lighting Equipment Installed Outdoors. 277 Volts to Ground.

Question ID#: 43

Luminaires rated 277 volts are permitted to be installed within reach by the general public.

The 2008 NEC required luminaries supplied by circuits exceeding 120 volts between conductors but not exceeding 277 volts to ground to be installed at least 3 ft. away from windows, platforms, and fire escapes at commercial and industrial buildings. The purpose of the requirement was to prevent human contact with the luminaire.

The 3 ft. installation limitation has been deleted. Luminaires with a voltage to ground of 277 volts can be installed at any distance from windows, doors, working platforms or fire escapes.

All luminaires are required to be listed, and a listed luminaire is made so that no one can accidently come in contact with the supply voltage or any energized part of the luminaire. Many 277 volt luminaires are installed in commercial settings where crowds pass by or touch the luminaire without incident. There was no reason to require luminaires to maintain a 3 ft. clearance on the side of a building.

Question 43: A listed luminaire, rated for 277 volts to ground, is installed on an outside stairway at a warehouse. What is required?

A: The luminaire must be installed more than 3 ft. away from the railing.
B: The luminaire must be installed at least 8 ft. above the stairway.
C: The luminaire must be installed so no one standing on the stairway could touch the luminaire.
D: The luminaire can be installed at any location near the stairway.

Question 44: 225.18(5) Clearance for Overhead Conductors and Cables. Over Track Rails of Railroads.

Question ID#: 44

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 44: 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 45:   225.27 Raceway Seal.

Question ID#: 45

<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.

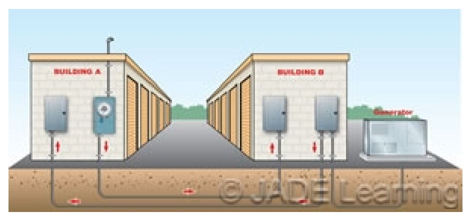
Question 45:   Which of the following are examples of raceways that are required to be sealed?

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 46:   225.30 Number of Supplies.

Question ID#: 46

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.

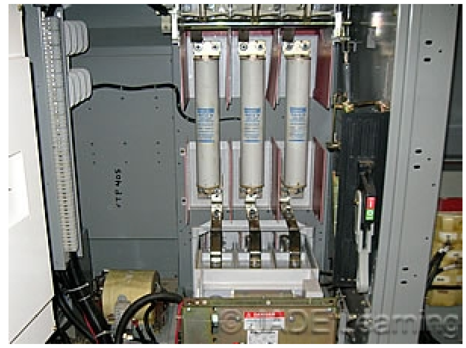
Question 46:   A legally required standby generator in Building B supplies a distribution panel in Building A. If the circuits are not permitted by 225.30(A - E), which of the following statements is true about circuits from the distribution panel in Building A?

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 47: 225.52 Over 600 Volts. Disconnecting Means.

Question ID#: 47

A new section on disconnecting means for systems over 600 volts has the following parts:



Disconnecting means from circuits over 600 volts must meet the requirements of this section.

Location — Inside or outside. Must be readily accessible if inside.

Type — Simultaneously disconnects all conductors. An exception permits fused cutouts to disconnect individual conductors.

Locking — Disconnects must be capable of being locked.

Indicating — Disconnects must clearly indicate an on and off position.

Uniform Position — If the disconnect handle moves vertically, the switch is on when the handle is UP.

Identification — A permanent plaque or directory shall identify all other feeders or branch circuits supplying the building or passing through the building.

Question 47: A building is supplied by a single feeder and a 2nd feeder passes through the building. What types of identification are required at the disconnecting means?

A: A plaque or directory that describes the location of other services, feeders or branch circuits that supply the building or pass through the building.
B: A plaque or directory that describes the disconnect location in the building.
C: A plaque or directory that describes the voltage, amperage and color code used for the feeder that supplies the building.
D: A plaque or directory that shows the on and off position of the disconnecting means.

Question 48: 225.56 Inspections and Tests.

Question ID#: 48

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 48: 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 49: 225.70 Substations.

Question ID#: 49

Substations on customer owned property must have warning signs.

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.

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 49: 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 50: 230.6 Conductors Considered Outside the Building.

Question ID#: 50

Service conductors in a service mast that passes through the eave of a house are considered outside the building.

A new section No. (5) has been added that says when service conductors are installed in a service mast that passes through the eave of a building, the overhead service conductors are still considered to be outside the building.

An overhead service mast that penetrates the roof, goes through the eave, and remains on the outside of the building is still outside the building. This has been a common practice and is now recognized by the Code.

Overhead service masts extend above the roof to maintain the required vertical clearances from ground, as listed in 230.24(B). A service mast, containing overhead service conductors, can extend above the roof, penetrate the roof and go through the eave and still be considered outside the building.

Question 50: If 2 inch RMC is used for a service mast that penetrates the roof:

A: The overhead service conductors inside the mast are considered inside the building.
B: The overhead service conductors inside the mast must terminate nearest the point of entrance.
C: The overhead service conductors inside the mast are considered outside the building, provided the mast only passes through the building's eave.
D: The overhead service conductors inside the mast cannot pass through the eave.

Question 51: 230.24(A) Ex. No. 5. Clearances. Above Roofs.

Question ID#: 51

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.

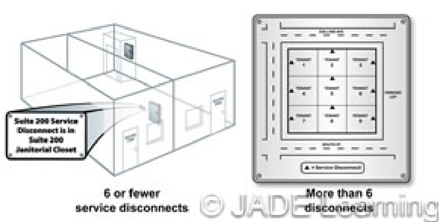
New exception No. 5 reduces the required clearance of overhead service conductors to 3 ft. if the voltage between conductors is not more than 300 volts and the roof area is guarded or isolated. If there are no ladders, steps or stairs leading to the roof, or if the area where the overhead service conductors 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 51: 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 52: 230.40 Ex. No. 1. Number of Service-Entrance Conductor Sets.

Question ID#: 52



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.

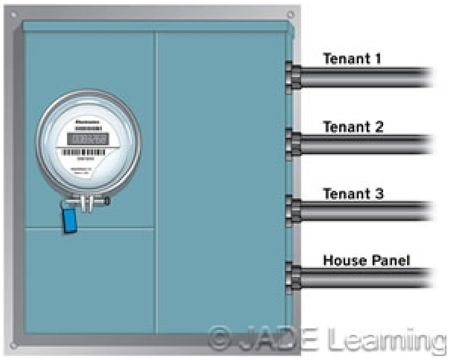
Question 52: A multi-occupancy building has a single service lateral that supplies 8 tenant spaces. Service-entrance conductors are run to each tenant space and the service disconnect for each tenant space is located in the tenant space. What is required on the plaque at the service point?

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 53: 230.40 Ex. 4 Number of Service-Entrance Conductor Sets.

Question ID#: 53



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 53: 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 54: 230.42(A)(1) Ex. Minimum Size and Rating.

Question ID#: 54

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 54: 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.

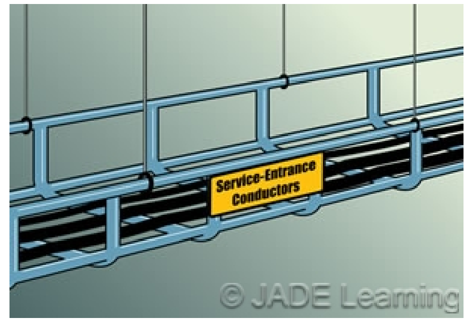
C: No. 1 AWG.
D: 1/0 AWG.

Question 55: 230.44 Cable Trays.

Question ID#: 55

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 55: 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 56: 230.66 Marking.

Question ID#: 56

All service equipment must now be listed. Service equipment rated at 600 volts or less shall also be marked to identify it as being suitable for use as service equipment. Individual meter sockets are not considered by the NEC to be service equipment.

Service equipment is now required to be listed and marked as suitable for service equipment.

There was no requirement in the 2008 NEC for service equipment to be listed. As long as it was marked suitable for use as service equipment it was permitted.

Suitable for use as service equipment means the manufacturer has provided means to bond the grounded conductor to the enclosure or has supplied a main bonding jumper.

Listing means the equipment has been tested by a third party testing agency and has passed tests for mechanical strength and durability, wire bending and connection space, electrical insulation, and other characteristics of the equipment that make for a safe installation.

Question 56: Which of the following statements about service equipment is true?

A: Individual meter socket enclosures shall be considered as service equipment.
B: Service equipment is not required to be listed.
C: Service equipment which is marked as being suitable for use as service equipment is not required to be listed.
D: Service equipment rated at 600 volts or below is required to be marked as suitable for use as service equipment and listed.

Question 57: 230.72(A) Exception. Grouping of Disconnects. General.

Question ID#: 57

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.

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.

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

Question 57: 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 58: 230.82(9) Equipment Connected to the Supply Side of Service Disconnect.

Question ID#: 58

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.

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.

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.

Question 58: 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 59: 230.205(A) Services Exceeding 600 Volts. Disconnecting Means. Location.

Question ID#: 59

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.

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.

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

Question 59: 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 60: 240.15(B) Ungrounded Conductors. Circuit Breaker as Overcurrent Device.

Question ID#: 60

Single-pole circuit breakers with identified handle ties can be used to open circuits manually or automatically.

Circuit breakers used as overcurrent devices are required to open all ungrounded conductors of the circuit both manually and automatically except for specific circuits mentioned in 240.15(B) such as a multiwire branch circuit.

In a multiwire branch circuit, when two or three, single pole breakers are connected together by identified handle ties, if one of the breakers trips it is required to open only the tripped circuit. It is NOT required to open the circuits that are not affected by the overcurrent condition. When a breaker trips, the handle only moves to an intermediate tripped position; it opens the circuit; but does not move to the full off position. When a tripped breaker automatically moves to this intermediate position, even though it is connected to other breakers by an identified handle-tie, it does not exert enough force to move breakers that are not tripped to the off position. However, when turned off manually, enough force is exerted to open all breakers that are connected together by identified handle ties.

Circuit breakers with identified handle ties can be used on multiwire branch circuits that serve single-phase line-to-neutral loads. They can also be used for line-to-line connected loads for single phase circuits if the circuit breakers are rated 120/240 volts. Circuit breakers with identified handle ties can be used on 3-phase systems with circuit breakers rated 120/240 volts if there is a grounded neutral point and the voltage to ground does not exceed 120 volts.

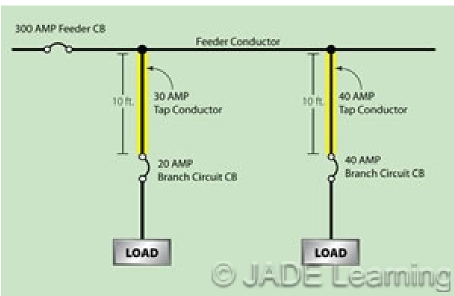
Two-pole or 3-pole circuit breakers on 277/480 volt systems are required for line-to-line loads.

Question 60: Circuit breakers are used to disconnect the ungrounded conductors for a multiwire branch circuit on a 120/208 volt, 3-phase system. Which statement is true?

A: Individual single-pole circuit breakers with identified handle ties are permitted.
B: Only two-pole or 3-pole circuit breakers are permitted to be used.
C: Single-pole circuit breakers without handle ties are permitted.
D: The circuit breaker(s) must automatically disconnect ALL ungrounded conductors if there is a fault on any of the ungrounded circuit conductors in the multiwire branch circuit.

Question 61: 240.21(B)(1) Location in Circuit. Feeder Taps. Taps Not Over 10 ft. Long.

Question ID#: 61



The minimum ampacity of 10-foot tap conductors is 1/10th the ampacity of the overcurrent device protecting the feeder conductors.

The rules for installing tap conductors are complicated. Any change that makes the requirements easier to understand is welcome. Section 240.21(B)(1)(4) has been rewritten to make calculating the ampacity of a feeder tap up to 10 ft. long more understandable.

The 2008 NEC said, ***For field installations where the tap conductors leave the enclosure or vault in which the tap is made, the rating of the overcurrent device on the line side of the tap conductors shall not exceed 10 times the ampacity of the tap conductor.***

The 2011 NEC says, ***For field installations, if the tap conductors leave the enclosure or vault in which the tap is made, the ampacity of the tap conductors is not less than one tenth of the rating of the overcurrent device protecting the feeder conductors.***

This revision is not a technical change; however, the 2011 version is easier to understand. To find the minimum ampacity required for a tap conductor, just divide the rating of the feeder overcurrent protective device by 10.

So, for a 200 amp feeder, a 10 ft. feeder tap must be rated at least 20 amps, for a 300 amp feeder, a 10 ft. feeder tap must be rated at least 30 amps, and for a 400 amp feeder, a 10 ft. feeder tap must be rated at least 40 amps.

Question 61: What is the minimum rating of a 10 ft. feeder tap if the tap conductors leave the enclosure where the tap is made, and the ampacity of the rating of the overcurrent device protecting the feeder is 350 amps?

A: 35 amps.
B: 75 amps.
C: 150 amps.
D: 350 amps.

Question 62: 240.24(E) Location in or on Premises. Not Located in Bathrooms.

Question ID#: 62

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 62: 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 63: 240.87 Noninstantaneous Trip.

Question ID#: 63

There are 3 options for limiting the incident energy in coordinated systems that do not incorporate instantaneous trip circuit breakers.

The goal of this new section is to add another layer of protection for electricians working on energized equipment.

Large power circuit breakers often have built in delays to provide a coordinated system. The upstream circuit breaker waits for the downstream circuit breaker to trip, thus avoiding an outage on a feeder that could have been cleared by a branch circuit breaker. The extra delay is dangerous to anyone working on the system when it is energized because the delay on the upstream circuit breaker will let through more fault current. More let-through current means more incident energy is available, and larger arc flash and arc blasts are possible.

This section specifies 3 possible options for limiting the incident energy on a coordinated system while still maintaining the benefits of using circuit breakers without an instantaneous trip. The three options listed are: (1) Zone selective interlocking which allows the upstream and downstream circuit breaker to communicate with each other. (2) Differential relaying which compares the fault current entering the upstream circuit breaker to the fault current leaving the downstream circuit breaker. (3) Energy-reducing maintenance switch, with status indicator, which allows the electrician to set the circuit breaker to instantaneous trip.

Section 240.87 was added to the NEC to provide several different options that can be used to reduce the level of incident energy and the arc-flash hazard workers are exposed to when working on energized systems.

Question 63: When using a circuit breaker which does not have an instantaneous trip, which of the following is not one of the options specified in the NEC?

A: Energy-reducing maintenance switching with a local status indicator.
B: Current limiting fused switch.
C: Differential relaying.
D: Zone-selective interlocking.

Question 64: 240.91(B) Protection of Conductors. Devices Rated Over 800 Amperes.

Question ID#: 64

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 64: 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 65: 250.2 Definitions. Bonding Jumper, Supply-Side.

Question ID#: 65

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.

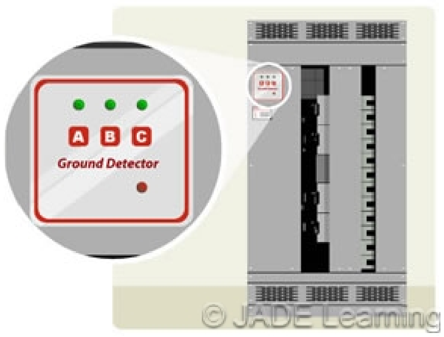
Since the supply-side bonding jumper has no overcurrent protection at the transformer, it must be sized from Table 250.66. Table 250.66 is used to select the ampacity of conductors on the supply side of the service or separately derived system, based on the size of the ungrounded conductors.

Question 65: 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 66: 250.21(B) & (C) Alternating-Current Systems of 50 Volts to Less Than 1000 Volts Not Required to Be Grounded. Ground Detectors. Marking.

Question ID#: 66



Ungrounded systems are required to have ground detection sensing equipment connected as close as practicable to where the system receives its supply.

Systems that are permitted to be ungrounded must have the ground detection sensing equipment connected as close as practicable to where the system receives its supply. This enables the ground detection sensors to monitor the entire system and not to be de-energized by the opening of a switch or overcurrent device. The indicating device for the sensors can be located at any convenient location.

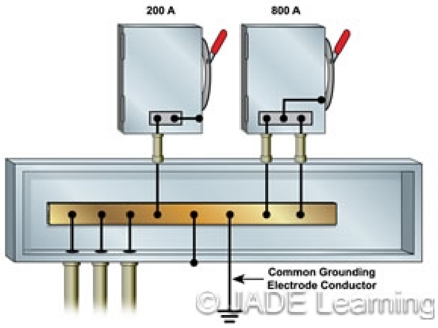
Ungrounded systems must be marked as an ***Ungrounded System*** at the source or first disconnecting means of the system. The marking must be legible and able to withstand the environment where it is located.

Question 66: What is the best location for ground detection sensors on an ungrounded system?

A: Before the last outlet on a branch circuit.
B: On the load side of a main distribution panelboard.
C: As close as possible to where the system receives its supply.
D: Downstream of a feeder disconnecting means.

Question 67: 250.24(C) Grounding Service-Supplied Alternating-Current Systems. Grounded Conductor Brought to Service Equipment.

Question ID#: 67



Use Table 250.66 to determine the size of grounded service entrance conductors.

No technical changes were made in this section. A grounded conductor is still required to be brought to the service disconnecting means for a service that is grounded and operating at less than 1000 volts.

Editorial changes make it clearer how to size the grounded conductor when the service is installed in a single raceway and when it is installed as parallel conductors in two or more raceways.

In a single raceway the grounded conductor cannot be smaller than the required grounding electrode conductor selected from Table 250.66. The grounded conductor is not required to be larger than the ungrounded conductors.

If sets of service-entrance conductors are larger than 1100 kcmil copper or 1750 kcmil aluminum, the minimum size of the grounded conductor is 12.5% of the largest ungrounded conductor. 12.5% = .125

For example, if the largest ungrounded service-entrance conductor was 1250 kcmil copper, the size of the grounded conductor is required to be at least 12.5% of 1250 kcmil: 1250 X .125 = 156.25 kcmil. A 3/0 AWG conductor is the smallest conductor that has a circular mill area that equals or exceeds 156.25 kcmils.

If the ungrounded service-entrance conductors are installed in parallel in two or more raceways, the grounded conductor must be installed in parallel. The size of the grounded conductor in each raceway is selected from Table 250.66 based on the size of the largest service-entrance conductor in the raceway, but not smaller than 1/0.

Question 67: Two raceways bring power to a service. Each raceway contains 3 ungrounded 500 kcmil copper conductors for the 3-phases and one grounded conductor.
The conductors in the two raceways are connected in parallel.
What is the minimum size cu. grounded conductor in each raceway?

A: 1/0 AWG cu.
B: 2/0 AWG cu.
C: 3/0 AWG cu.
D: 4/0 AWG cu.

Question 68: 250.30 Grounding Separately Derived Alternating-Current Systems.

Question ID#: 68


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:

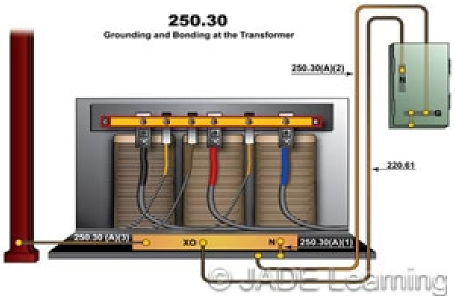
(1) System Bonding Jumper
(2) Supply-Side Bonding Jumper
(3) Grounded Conductor
(4) Grounding Electrode
(5) Grounding Electrode Conductor, Single Separately Derived System
(6) Grounding Electrode Conductor, Multiple Separately Derived Systems
(7) Installation
(8) Bonding

Question 68: 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 69: 250.30(A)(1)&(2). Grounding Separately Derived Alternating-Current Systems. Grounded Systems. System Bonding Jumper. Supply-Side Bonding Jumper.

Question ID#: 69



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.

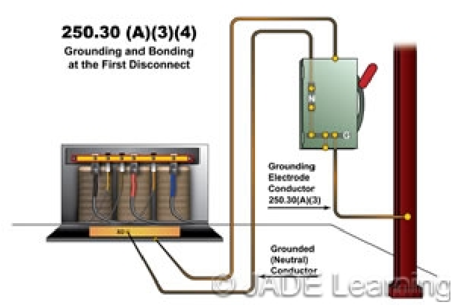
Question 69: What is the purpose of the system bonding jumper?

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 70: 250.30(A)(3)&(4). Grounding Separately Derived Alternating-Current Systems. Grounded Systems. Grounded Conductor. Grounding Electrode.

Question ID#: 70

250.30(A)(3) Grounded Conductor. In most applications the grounded conductor is connected to the system bonding jumper and the enclosure at the source of the separately derived system. However, the grounded conductor is permitted to be connected at the first disconnecting means instead of at the transformer. If the grounded conductor is connected to ground at the first disconnecting means rather than at the transformer, fault current returning to the transformer will travel on the grounded conductor, not on the supply-side bonding jumper. In order to guarantee that the grounded conductor is sized large enough to carry the fault current, it must be sized from Table 250.66. If the derived phase 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.



The grounded conductor is connected to the grounding electrode at the transformer or at the first disconnecting means of a separately derived system.

250.30(A)(4) Grounding Electrode. The grounding electrode should be as close to where the grounding electrode conductor is connected to the transformer as practicable. The grounding electrode used for the separately derived system should be a metal water pipe which is in direct contact with the earth for 10 ft. or more, or to grounded structural metal. The grounding electrode which is closest to the point of connection of the grounding electrode conductor should be used. Exception No. 1 allows other grounding electrodes to be used if a metal water pipe or grounded structural steel is not available.

Question 70: If the grounded conductor is connected to the system bonding jumper at the first disconnecting means of a separately derived system, what is the minimum required size of a copper grounded conductor installed between the separately derived system and the first disconnecting means if the derived phase conductors are 3/0 AWG cu?

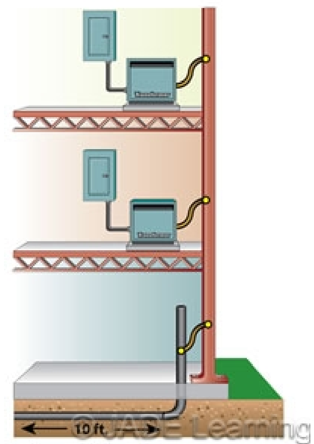
A: 1/0 AWG cu.
B: No. 2 AWG cu.
C: No. 4 AWG cu.
D: No. 6 AWG cu.

Question 71: 250.30(A)(6)(a)(2) Grounding Electrode Conductor, Multiple Separately Derived Systems. Common Grounding Electrode Conductor.

Question ID#: 71

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.

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.



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

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 71: 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 72: 250.30(C) Grounding Separately Derived Alternating-Current Systems. Outdoor Source.

Question ID#: 72

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.

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

Question 72: 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.

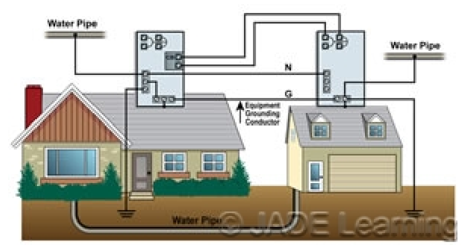
Question 73: 250.32(B)(1) Exception. Buildings or Structures Supplied by a Feeder(s) or Branch Circuit(s). Grounded Systems. Supplied by a Feeder or Branch Circuit.

Question ID#: 73

The general rule in this section requires a feeder or branch circuit that supplies a building to include an equipment grounding conductor. The equipment grounding conductor is connected to the grounding electrode and the building disconnect. The grounded conductor is not permitted to be used to ground the building. The grounded conductor must be isolated from the building disconnecting means and not connected to the grounding electrode.

In the 2011 NEC, the exception has been changed to say that although using the grounded conductor as the path for fault current from the building was permitted in the past, it is no longer permitted for new installations. For existing installations only, the exception lists 3 requirements which must continue to be met if the grounded conductor is used to carry fault current: (1) ***<u>An equipment grounding conductor is not run with the supply to the building or structure. (2) There are no continuous metallic paths bonded to the grounding system in each building or structure served. (3) Ground-fault protection of equipment has not been installed on the supply side of the feeder(s).</u>***

If an existing feeder to a building that was wired under a previous code did not include an equipment grounding conductor, and for the first time a metal water pipe was installed between the two buildings and the pipe was bonded to grounding system in each building, the system would not meet the criteria required to permit the grounded conductor to serve as an equipment grounding conductor supplying the second building because the pipe would be a metallic path connecting the grounding systems of two buildings. The Authority Having Jurisdiction could require an equipment grounding conductor to be installed between the two buildings so there was not a parallel path for fault current between the two buildings.



<u>In new construction, a feeder or branch circuit that supplies a building is required to include an equipment grounding conductor.</u>

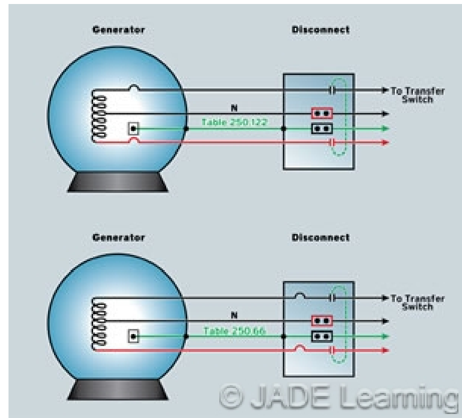
Question 73: In a new installation, which of the following statements is true when a 4-wire single-phase, 120/240-volt feeder from one building supplies a second building?

A: The grounded neutral conductor at the second building is bonded to the building disconnect.
B: The grounded neutral conductor of the feeder is connected to the metal non-current-carrying parts of equipment in both buildings.
C: The equipment grounding conductor is connected to the grounding electrode at the second building.
D: The equipment grounding conductor and the grounded neutral conductor are bonded together at the second building.

Question 74: 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

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.



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.

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.

Question 74: 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 75: 250.52(A)(1) Grounding Electrodes. Electrodes Permitted for Grounding. Metal Underground Water Pipe.

Question ID#: 75

Metal water pipe above ground is considered to be a grounding electrode conductor.

A metal water pipe is still permitted to be used as a grounding electrode if it is in contact with the earth for 10 ft. or more. The connection of the grounding electrode conductor to the metal underground water pipe is still required to be made within the first 5 ft. of where the pipe enters the building unless the building is covered by the exception for facilities where conditions or maintenance and supervision ensure that only qualified personnel service the installation. The language about connecting the grounding electrode conductor within the first 5 ft. of where the pipe enters the building, and the exception which allows the connection to be made in any exposed location in a supervised industrial facility, have been moved to 250.68(C).

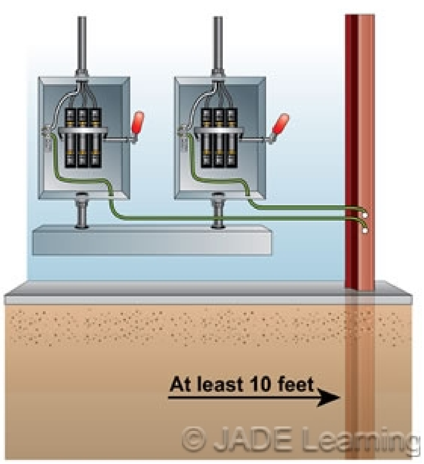
The reason for the change was a Code proposal that pointed out the above ground portion of the water pipe was not a grounding electrode because it was not in contact with the earth. The above ground part of the pipe could be considered a grounding electrode conductor, but not a grounding electrode. Only that part of the water pipe that is actually buried in the earth is a grounding electrode.

Question 75: Which of the following statements about using metal water pipe as a grounding electrode is true?

A: Metal water pipe inside a building is a grounding electrode.
B: Metal water pipe buried in the ground for 10 ft. is a grounding electrode.
C: A grounding electrode connection to the metal water pipe must be made within 10 ft. of where the pipe enters the building.
D: Metal water pipe buried in the ground for 10 ft. or more is not a grounding electrode.

Question 76: 250.52(A)(2) Metal Frame of the Building or Structure.

Question ID#: 76



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.

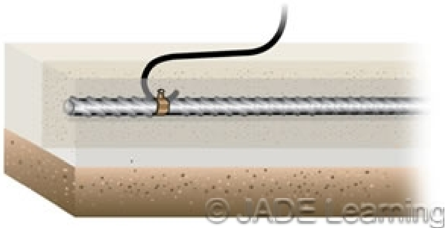
In order for the building steel to be considered a grounding electrode, a steel structural member must be in contact with the earth for at least 10 ft., or the hold-down bolts of a column must be connected to a concrete-encased electrode. The connection from the hold-down bolts to the concrete-encased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

Question 76: 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 77: 250.52(A)(3) Concrete-Encased Electrode.

Question ID#: 77



When an electrode is encased in concrete, the concrete must be in direct contact with the earth.

A bare or galvanized steel reinforcing bar is a concrete-encased grounding electrode if it is 1/2 in. diameter, 20 ft. long, or has separate pieces of rebar tied together to equal 20 ft. A bare copper conductor not smaller than 4 AWG and at least 20 ft. long can also serve as a grounding electrode provided it is encased in at least 2 in. of concrete, laying horizontally in a footing or vertically in a column. The footing or column must be in direct contact with earth.

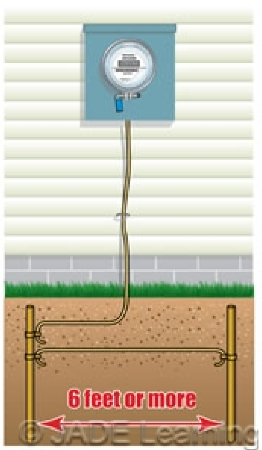
A new Informational Note says that if the concrete is installed with insulation, vapor barriers, films or similar items separating the concrete from the earth, the concrete is not considered to be in direct contact with earth.

Question 77:   When encased by at least 2 in. of concrete, which of the following can be used as a grounding electrode?

A: Two pieces of reinforcing bar, 5 ft. 6 in. long, tied together with steel tie wires lying horizontally in a footing.
B: Three pieces of reinforcing bar, 5 ft. 6 in. long, tied together with steel tie wires and positioned vertically in column that was in direct contact with earth.
C: Four pieces of reinforcing bar, 5 ft. 6 in. long, tied together with steel tie wires and positioned vertically in a column that is in direct contact with earth.
D: A single 20 ft. piece of reinforcing bar that was lying horizontally in a concrete footing that had a vapor barrier installed.

Question 78: 250.53(A)(2) Grounding Electrode Installation. Rod, Pipe and Plate Electrodes. Supplemental Electrode Required.

Question ID#: 78



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 78:   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 79: 250.64(B) Grounding Electrode Conductor Installation. Securing and Protection Against Physical Damage.

Question ID#: 79

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 79: 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 80: 250.64(D) Grounding Electrode Conductor Installation. Service with Multiple Disconnecting Means Enclosures. Common Grounding Electrode Conductor and Taps.

Question ID#: 80

When a service consists of multiple disconnecting means enclosures, a common grounding electrode conductor and grounding electrode taps must be installed. The common grounding electrode conductor is run to the grounding electrode and the grounding electrode conductor taps that are connected to it are extended to the inside of each service disconnecting means enclosure.

Where multiple service disconnects are installed in separate enclosures, taps are permitted to be connected to a common grounding electrode conductor by a copper or aluminum busbar.

The common grounding electrode conductor is selected from Table 250.66 based on the size of the largest ungrounded service-entrance conductor. The grounding electrode conductor taps are sized based on the size of the service-entrance conductors serving each of the separate service disconnecting means.

A busbar that is at least 1/2 in. x 2 in., copper or aluminum, can now be used to connect the common grounding electrode conductor and the grounding electrode conductor taps. The busbar must be securely fastened and installed in an accessible location. Connections must be made by a listed connector or by exothermic welding. If an aluminum busbar is used in an outside location, the installation is required to comply with 250.64(A) which prohibits aluminum grounding electrode conductors from being terminated within 18 in. of earth.

Question 80: Which of the following installations is a Code violation?

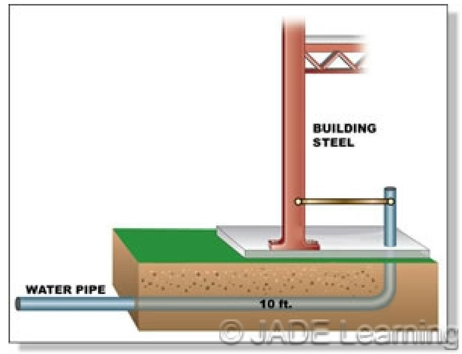
A: Grounding electrode conductor taps sized according to the ungrounded service-entrance conductor serving the individual enclosure.
B: Grounding electrode conductor taps connected to the common grounding electrode conductor at a busbar.
C: A common grounding electrode conductor connected to a busbar with listed connectors.
D: Grounding electrode conductor taps that are connected together but not connected to the common grounding electrode

conductor.

Question 81: 250.68(C) Grounding Electrode Conductor and Bonding Jumper Connection to Grounding Electrodes. Metallic Water Pipe and Structural Metal.

Question ID#: 81

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 81: 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.

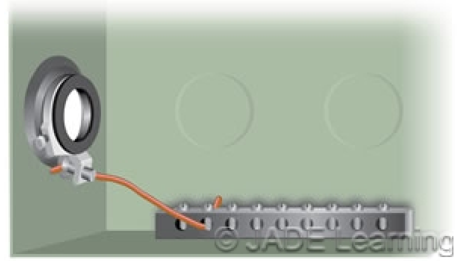
Question 82: 250.92(B) Services. Method of Bonding at the Service.

Question ID#: 82

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 82: 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.

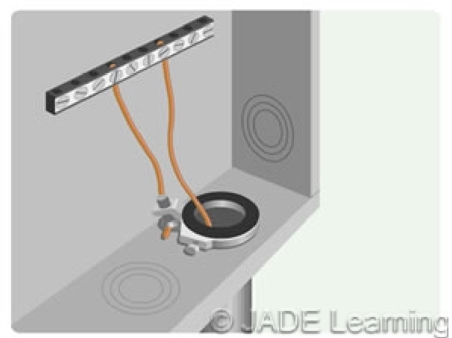
Question 83: 250.102(C) Bonding Conductors and Jumpers. Size. Supply-Side Bonding Jumper.

Question ID#: 83

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 83: 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 84: 250.104(C) Bonding of Piping Systems and Exposed Structural Steel. Structural Steel.

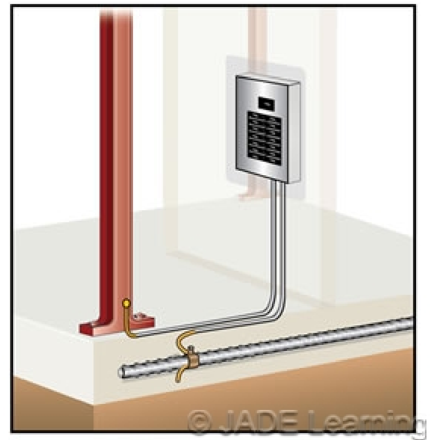
Question ID#: 84

Exposed structural metal that is likely to become energized must be bonded.

When the building power is supplied by a service, the structural metal is bonded to the service equipment enclosure, to the grounded conductor at the service, and to the grounding electrode.

When the building power is supplied by a feeder or branch circuit, the structural metal is bonded to the disconnecting means for the building, and to the grounding electrode. The bonding jumper is selected from Table 250.66 based on the size of the largest ungrounded conductor in the feeder or branch circuit.

The points of attachment of the bonding jumper must be accessible unless they are covered with fireproofing material, as permitted in 250.68(A) Exception No. 2.



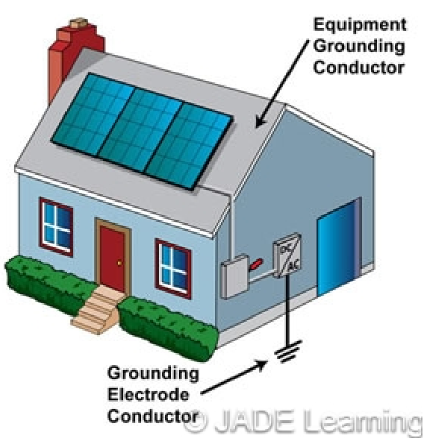
Exposed structural metal that is likely to become energized must be bonded.

Question 84: A No. 1 AWG copper feeder supplies a building with exposed structural steel. What is the minimum size copper bonding jumper required to bond the exposed structural metal?

A: No. 2 AWG copper.
B: No. 4 AWG copper.
C: No. 6 AWG copper.
D: No. 8 AWG copper.

Question 85: 250.121 Use of Equipment Grounding Conductors.

Question ID#: 85



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.

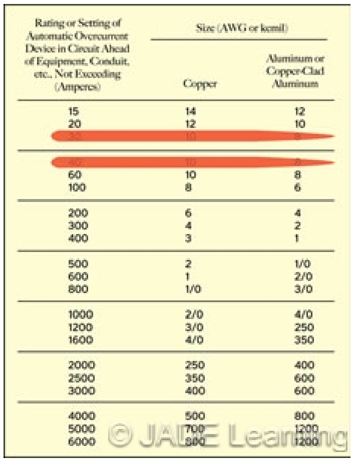
For example, an equipment grounding conductor is required to be installed with a feeder to a second building. A separate grounding electrode conductor is required to be installed at the second building and be connected to a grounding electrode. The equipment grounding conductor could not serve as both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

Question 85: 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 86: Table 250.122 Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment.

Question ID#: 86



Rating or Setting of Automatic Overcurrent Device in Circuit Ahead of Equipment, Conduit, etc., Not Exceeding (Amperes)	Size (AWG or kcmil)	
	Copper	Aluminum or Copper-Clad Aluminum
15	14	12
20	12	10
~~30~~	~~10~~	~~8~~
~~40~~	~~10~~	~~8~~
60	10	8
100	8	6
200	6	4
300	4	2
400	3	1
500	2	1/0
600	1	2/0
800	1/0	3/0
1000	2/0	4/0
1200	3/0	250
1600	4/0	350
2000	250	400
2500	350	600
3000	400	600
4000	500	800
5000	700	1200
6000	800	1200

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Table 250.122 has been reformatted to make it easier to read.

Table 250.122 has been changed to make the table more readable. A No. 10 AWG CU. conductor is now listed as the proper size equipment grounding conductor for overcurrent devices not exceeding 60 amps. Likewise, a No. 8 AL. conductor is used for circuits not larger than 60 amps. In the 2008 NEC a No. 10 CU and a No. 8 AL were listed for 30, 40, and 60 amp circuits. No technical changes were made to Table 250.122, but the Table is easier to read in the 2011 NEC.

The left-hand column in the Table is titled, ***Rating or Setting of Automatic Overcurrent Device in Circuit Ahead of Equipment, Conduit, etc., Not Exceeding (Amperes).*** ***Not Exceeding*** means a No. 10 AWG CU equipment grounding conductor is required for a circuit protected at 30, 40, 50 or 60 amps.

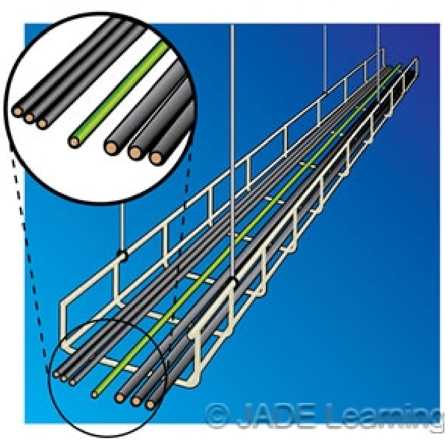
The equipment grounding conductors in Table 250.122 increase in size as the overcurrent device protecting the circuit increases. The purpose of the equipment grounding conductor is to carry fault current back to the overcurrent device so that it will trip and de-energize the faulted circuit. The size of the equipment grounding conductor is small relative to the amount of current carried by the ungrounded conductors during normal operation. This is because the equipment grounding conductors will only carry fault current for a brief period of time.

Question 86: What size CU equipment grounding conductor is required for a circuit protected at 800 amps?

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

Question 87: 250.122(F) Size of Equipment Grounding Conductors. Conductors in Parallel.

Question ID#: 87



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 87: 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 88: 250.190 Grounding of Systems and Circuits of over 1 kV. Grounding of Equipment. Equipment Grounding Conductor.

Question ID#: 88

Equipment grounding conductors are required for medium voltage circuits.

Section 250.190 is in Part X, Grounding of Systems and Circuits of over 1 kV. New material has been added about the requirements for the grounding electrode conductor and the equipment grounding conductor on these high and medium voltage systems.

This revision now requires an equipment grounding conductor to ground equipment operating at over 1 kV. The equipment grounding conductor is selected from Table 250.122 based on the rating of the fuse or the overcurrent setting of the protective relay protecting the conductors supplying the equipment.

The ribbon shield on Medium Voltage (MV) cable is acceptable as an equipment grounding conductor, but only if the fault current carrying capacity of the ribbon shield is the equivalent of the conductor that would be selected from Table 250.122. The copper ribbon in MV Cable has the same cross sectional area as a No. 8 AWG conductor. According to Table 250.122, a No. 8 cu. conductor cannot be used as an equipment grounding conductor for circuits protected by overcurrent protective devices rated over 100 amps.

Question 88: A 150 amp fuse protects a Medium Voltage cable. What is the minimum size equipment grounding conductor?

A: No. 6 AWG cu.
B: No. 4 AWG cu.
C: No. 3 AWG cu.
D: No. 2 AWG cu.

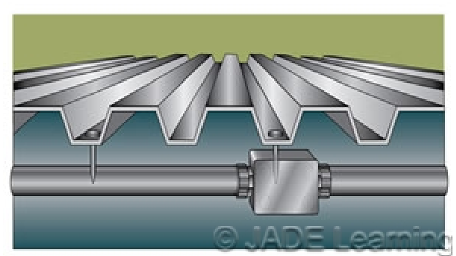
Question 89: 300.4(E) Protection Against Physical Damage. Cables, Raceways, or Boxes Installed in or Under Roof Decking.

Question ID#: 89

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.



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

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

Question 89: 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 90: 300.4(H) Protection Against Physical Damage. Structural Joints.

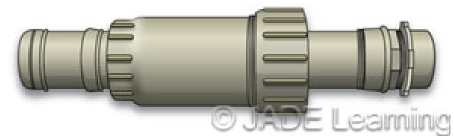
Question ID#: 90

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.



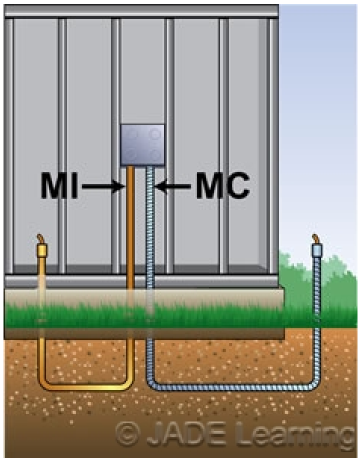
Listed expansion fittings are required where raceways cross structural joints intended for expansion, contraction or deflection in structures.

Question 90: 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 91: 300.5(C) Exception 1&2 Underground Installations. Underground Cables Under Buildings.

Question ID#: 91



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 91: 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 92: 300.5(I) Exception No. 1 Underground Installations. Conductors of the Same Circuit.

Question ID#: 92

When conductors are installed in parallel, all conductors of the same circuit must be installed in the same raceway or cable or trench. This includes the ungrounded, grounded and equipment grounding conductors. When conductors of the same circuit are installed close to each other, the magnetic fields surrounding each conductor are canceled and there is no inductive heating and circuit impedance is reduced.

Exception No. 1 has been rewritten to require single conductors in a trench to be installed close together. ***Each direct-buried single conductor cable shall be located in close proximity in the trench to the other single conductor cables in the same parallel set of conductors in the circuit, including equipment grounding conductors.***

For the same reasons that all conductors of the same circuit must be installed in the same raceway or cable, when single conductor cables of the same circuit are installed underground in a trench, they must be installed close together.

Paralleled circuit conductors including equipment grounding conductors are required to be located closely together when buried in a trench.

Question 92: When installed underground in a trench:

A: All conductors must be installed in a raceway.
B: All conductors of a parallel set shall not be grouped together.
C: Single conductor cables of the same circuit must be grouped together.
D: Ungrounded single conductor cables must be separated from grounded conductors.

Question 93: 300.11(A)(2) Securing and Supporting. Secured in Place. Non-Fire-Rated Assemblies.

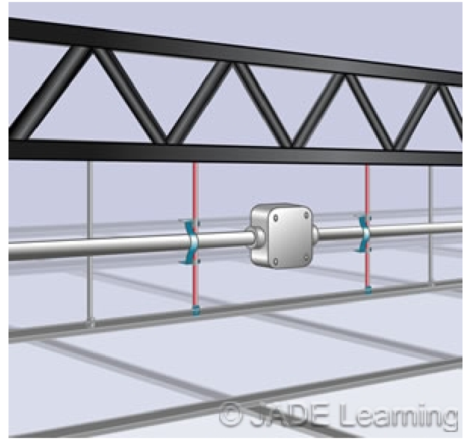
Question ID#: 93

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.



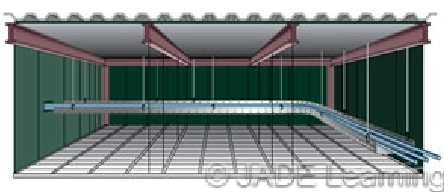
Except when permitted by manufacturer's instructions, ceiling support wires cannot be used to secure wiring or equipment in the space above the ceiling.

Question 93: 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 94: 300.22 Wiring in Ducts Not Used for Air Handling, Fabricated Ducts for Environmental Air, and Other Spaces for Environmental Air (Plenums).

Question ID#: 94



When they are accessible, some cable tray systems are permitted in plenums.

The new title for this expanded section better describes the types of areas that are covered. Ducts that are not used for air handling are commonly used for dust, loose stock, or vapor removal. Sections 300.22 (B) applies to ducts fabricated specifically for environmental air. Section 300.22(C) applies to other spaces used for environmental air which are sometimes referred to as plenums in the NEC and in other NFPA standards; these ***other spaces or plenums*** are spaces other than ducts which are specifically fabricated for environmental air.

Cable tray systems are now permitted to be used in plenums; only metal cable trays are permitted and they must be accessible. Metal cable trays can support metal raceways such as electrical metallic tubing, rigid metal conduit, intermediate metal conduit and Type MC cable without an overall nonmetallic covering. Non-metallic coverings on raceways are not permitted in metallic cable trays that do not have solid bottoms, sides, and covers that completely enclose wiring in the cable tray in plenums because of the smoke they would produce if a fire started in the plenum.

However, as permitted in 300.22(C)(2)(a & b), if the cable tray has a solid metal bottom, side and cover, then nonmetallic wiring methods is one of 32 different wiring methods listed in 392.10(A) that are permitted to be installed in a cable tray in a plenum, if permitted by the article covering that type of wiring method.

Question 94: Which of the following statements about cable tray systems is true?

A: All types of cable tray can be installed in ducts fabricated for environmental air provided the cable tray is accessible.
B: Non-metallic cable trays are always permitted in plenums provided the cable tray is accessible.
C: Non-metallic wiring methods can be installed in metal cable tray systems that have solid sides, bottoms, and solid metal covers in plenums, provided the cable tray is accessible.
D: Non-metallic wiring methods can be used in ducts fabricated for environmental air but not in plenums.

Question 95: 300.50(B) Requirements for over 600 Volts. Underground Installations. Wet Locations.

Question ID#: 95

Regardless of voltage, conductors in underground raceways and/or enclosures are required to be listed for wet locations.

Underground installations for conductors and cables rated 600 volts and below, and now for installations over 600 volts, are considered wet locations. In 2008 the statement that underground installations are considered wet locations was added to 300.5(B) for installations 600 volts and below. In 2011 the same statement was added for over 600 volt installations and a reference to the types of conductors and cables used in wet locations was added to both sections.

Conductors and cables used in wet locations, according to 310.10(C), must have a moisture-impervious metal-sheath, be of a type listed for wet locations, or be type MTW, RHW, RHW-2, TW, THW, THW-2, THHW, THWN, THWN-2, XHHW, XHHW-2, ZW.

The inside of all raceways and enclosures installed underground is a wet location regardless of voltage.

Question 95: Which type of conductor or cable rated over 600 volts is prohibited for an underground installation?

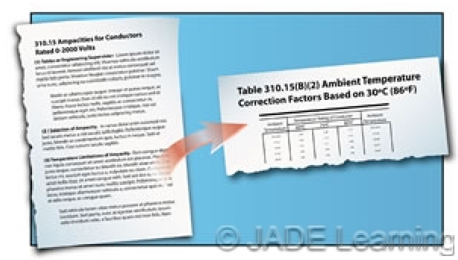
A: TW.
B: ZW.
C: THW.
D: THHN.

Question 96: Article 310 Conductors for General Wiring.

Question ID#: 96

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.

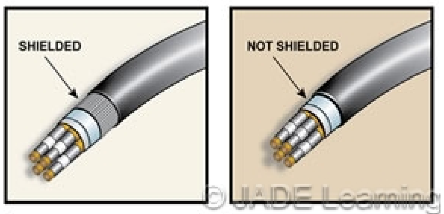
Most of the technical requirements in Article 310 have not changed.

Question 96: 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 97: 310.10(E) Uses Permitted. Shielding.

Question ID#: 97



Non-shielded, ozone resistant conductors in Type MC Cable are permitted to operate with a maximum phase-to-phase voltage of 5000 volts in selected locations.

Shielding of high voltage conductors is important because a metallic shield helps prevent short circuits and ground faults. The shield prevents the high voltage, high power leakage current from causing problems. It confines the voltage stresses to the insulation, drains off the capacitive charging current and carries fault current during ground-fault conditions.

The main rule requires conductors operating at over 2000 volts to be shielded. An existing exception permits conductors operating at up to 2400 volts to be non-shielded under certain conditions.

A Code change allows non-shielded, ozone resistant conductors in Type MC cable in industrial establishments to operate with a maximum phase-to-phase voltage of 5000 volts. A new Exception permits non-shielded conductors for use up to 5000 volts to replace existing non-shielded conductors on existing equipment in industrial establishments if qualified personnel service the installation.

Non-shielded cable is more flexible, has a smaller outside diameter and is easier to install than shielded cable. In existing installations the new exception will permit non-shielded cable up to 5000 volts to replace existing non-shielded cable without installing new and larger raceways.

Question 97: Which of the following installations is acceptable under the 2011 National Electrical Code?

A: Non-shielded, ozone resistant cables operating at 4160 volts supplying a college campus.
B: Non-shielded, ozone resistant cables operating at 4160 volts supplying a hospital complex.
C: Non-shielded, ozone resistant cables operating at 4160 volts supplying an industrial complex.
D: Non-shielded, ozone resistant cables operating at 4160 volts supplying a large apartment complex.

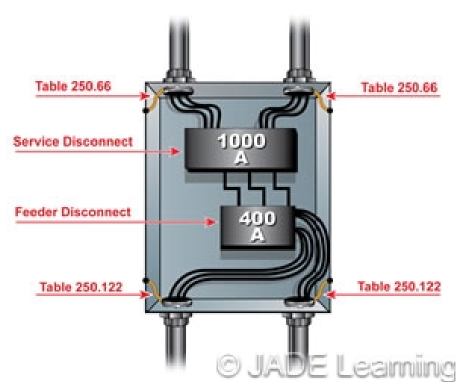
Question 98: 310.10(H)(6) Uses Permitted. Conductors in Parallel. Equipment Bonding Jumpers.

Question ID#: 98

A new section on equipment bonding jumpers has been added to the requirements for installing conductors in parallel. Equipment bonding jumpers are different than equipment grounding conductors.

Equipment grounding conductors are always selected from Table 250.122, based on the overcurrent device protecting the conductors. Equipment bonding jumpers are selected from Table 250.66 or Table 250.122, depending on whether they are on the line side or load side of an overcurrent device. At the service, equipment bonding jumpers (supply-side bonding jumpers) are selected from Table 250.66, based on the size of the largest ungrounded conductor in the raceway. Equipment bonding jumpers downstream from an overcurrent device are selected from Table 250.122 based on the size of the overcurrent device protecting all the conductors in parallel.

Where parallel equipment bonding jumpers are installed in raceways, they shall be sized and installed in accordance with 250.102.



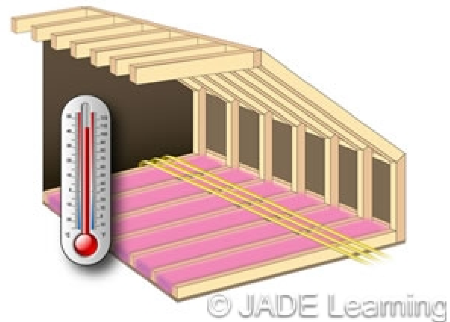
Parallel equipment bonding jumpers installed in raceways are required to be sized and installed in accordance with Section 250.102.

Question 98: If a feeder circuit is copper and installed in two parallel conduits, what is the minimum size of the copper equipment bonding jumpers required for a circuit protected by 800 amp fuses?

A: 1/0 AWG.
B: 2/0 AWG.
C: 3/0 AWG.
D: 4/0 AWG.

Question 99: 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



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

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.

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.

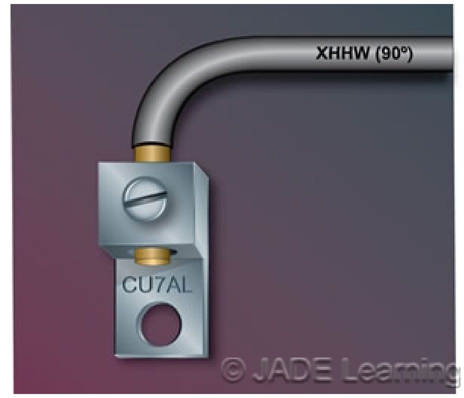
Question 99: For ambient temperature correction factors based on 86Â°F, what is the ampacity correction multiplier for a 90Â°C conductor operating in an ambient temperature of 115Â°F?

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

Question 100: 310.15(B) Ampacities for Conductors Rated 0-2000 volts. Tables.

Question ID#: 100

The following statement was added to 310.15(B) in the 2011 NEC. It clarifies but does not change the requirement for determining the ampacity of conductors. It simply makes it absolutely clear that in addition to considering conductor material (CU or AL), conductor insulation type, ambient temperature, and the number of current-carrying conductors in a raceway or cable, the ampacity of a conductor is also limited by the temperature rating of the conductor's termination.



The temperature rating of terminals affects the ampacity of conductors.

The temperature correction and adjustment factors shall be permitted to be applied to the ampacity for the temperature rating of the conductor, if the corrected and adjusted ampacity does not exceed the ampacity for the temperature rating of the termination in accordance with the provisions of 110.14(C).

This change describes the proper way to apply the ambient temperature correction and the adjustments for more than 3 current-carrying conductors in a raceway or cable to the ampacities of conductors in Table 310.15(B)(16). It emphasizes that when adjusting and/or correcting the ampacity of a conductor for ambient temperature and/or number of current-carrying conductors, the corrected ampacity of the conductor cannot ***exceed the ampacity for the temperature rating of the termination in accordance with the provision of 110.14(C).***

Many 90Â°C conductors, such as THHN or THWN, are connected to 75Â°C terminals. The ampacity correction multipliers should be used based on the 90Â°C rating of the wire, not the 75Â°C rating of the terminal. After the ampacity correction multipliers are calculated, the ending value of the conductor cannot be greater than the value from the 75Â°C column of Table 310.15(B)(16).

For example, in Table 310.15(B)(16), a 90Â°C, No 6 AWG cu. conductor can carry 75 amps. If the ambient temperature is 120Â°F the temperature multiplier is .82. 75 amps x .82 = 61.5 amps. This is less than the value of a No. 6 AWG cu. from the 75Â°C column of Table 310.15(B)(16), which is 65 amps; therefore, the maximum ampacity of the conductor is 61.5 amps.

Question 100: The ampacity of a No. 1 AWG, copper conductor with THHN insulation is 145 amps, taken from the 90 degree column of Table 310.15(B)(16). If the ambient temperature is 105 degrees F, the ampacity adjustment is .87. If the conductor is connected to 75 degree C terminals, the adjusted ampacity cannot be greater than 130 amps, taken from the 75 degree column of Table 310.15(B)(16). What is the ampacity of the No. 1 AWG, THHN conductor that is connected to 75 degree C terminals and is operating in an ambient temperature of 105 degrees F?

A: 87 amps.
B: 126 amps.
C: 130 amps.
D: 145 amps.

Question 101: Table 310.15(B)(3)(a) Adjustment Factors for More Than Three Current-Carrying Conductors in a Raceway or Cable.

Question ID#: 101

The title to the table is the same, but the heading for the left hand column changed from ***Number of Current-Carrying Conductors*** to ***Number of Conductors***. This means that spare conductors which are pulled into the raceway for future use need to be counted, even though they are not current-carrying conductors at the time of installation. The grounded neutral conductors of balanced resistive loads that do not carry current and the equipment grounding conductors are not included when counting the number of conductors in conduit.

The number of conductors in a raceway affects the ampacity of conductors.

Even though the spare conductors do not carry current until they are energized, there is a good possibility they will be used in the future. Also, more conductors in a conduit will prevent the conductors that do carry current and are generating heat from cooling as quickly.

The ampacity adjustment multipliers in the table have not changed:

Number of Conductors	Percent of Values in the Table
4-6	80%
7-9	70%
10-20	50%
21-30	45%
31-40	40%
41 and more	35%

Question 101: Six current-carrying conductors and 3 spares are installed in conduit. Each conductor is rated 100 amps. What is the value of each wire after the ampacity adjustment is made?

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

Question 102: 312.8 Switch and Overcurrent Device Enclosures with Splices, Taps, and Feed-Through Conductors.

Question ID#: 102

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.

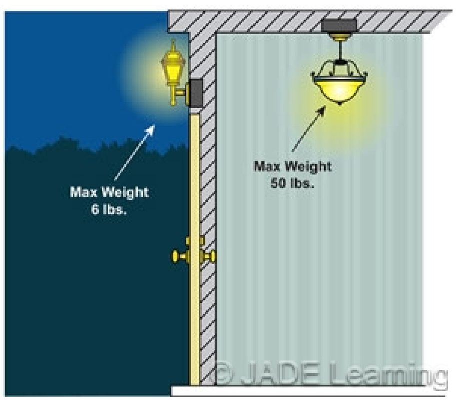
Warning signs must be posted on enclosures with pass through conductors.

Question 102: 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 103: 314.27(A) Outlet Boxes. Boxes at Luminaire or Lampholder Outlets.

Question ID#: 103



Separate requirements apply to outlet boxes installed for wall and ceiling mounted luminaries.

The title of the section was changed to include lampholder outlets as well as luminaire outlets. Lampholder is not defined in Article 100, but the definition of luminaire says, ***a lampholder itself is not a luminaire.*** A keyless or pull chain porcelain fixture is a lampholder because it lacks a ballast, reflector, or means to protect the light source.

There are two types of luminaire or lampholder outlets: (1) Wall Outlets and (2) Ceiling Outlets. The requirements for each type of outlet is listed in 314.27(A)(1) for wall outlets and 314.27(A)(2) for ceiling outlets. This new format for 314.27(A) makes it easier to locate the rules for installing outlets based on the location of the luminaire or lampholder. The 2008 NEC had the requirements for both locations in a single section, ***Boxes at Luminaire Outlets.***

Presenting information so it is straightforward and easier to find is a big accomplishment of the 2011 NEC. Breaking up long paragraphs that had several requirements into a numbered list is a more user friendly way to present material.

The technical requirements of 314.27(A) have not changed. However, at a wall outlet, if a box is rated to support a weight other than 50 lbs., the maximum weight the box can support must be marked on the inside of the box, rather than on the outside of the box.

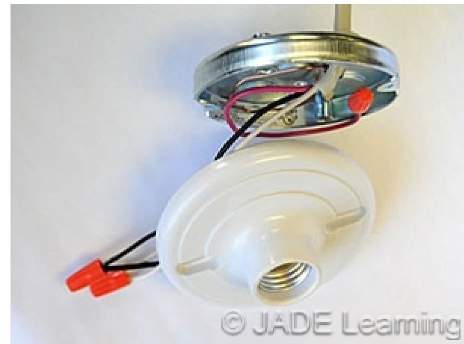
Question 103: Which of the following statements about boxes at luminaire or lampholder outlets is true?

A: Luminaires and lampholders must be supported independently of the box.
B: Two No. 6 or larger screws can support a luminaire of any weight to a ceiling box.
C: In general a lampholder weighs more than a luminaire.
D: A box installed at a ceiling outlet must be designed or installed so that a luminaire or lampholder may be attached.

Question 104:   314.27(C) Outlet Boxes. Boxes at Ceiling-Suspended (Paddle) Fan Outlets.

Question ID#: 104

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.

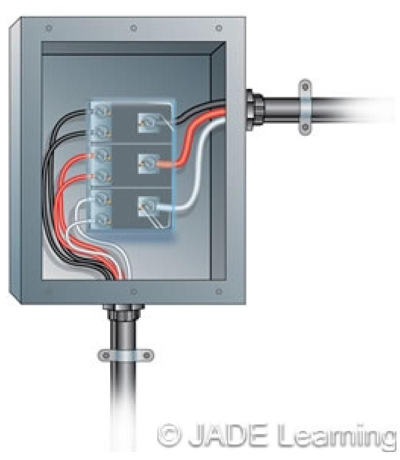
The new requirement will prevent this situation from happening by making the installation of a ceiling fan rated box mandatory when two switches and spare ungrounded conductor(s) are installed for a ceiling luminaire outlet box.

Question 104:   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 105:   314.28(E) Pull and Junction Boxes and Conduit Bodies. Power Distribution Blocks.

Question ID#: 105



Power distribution blocks cannot have live parts exposed and conductors traveling through the junction box cannot obstruct the distribution blocks.

Power distribution blocks are now permitted in pull and junction boxes that are over 100 cubic inches. Power distribution blocks in boxes 100 cubic inches and smaller are not permitted.

The requirements for power distribution blocks in pull and junction boxes are basically the same as the requirements in Article 376, Metal Wireways, including the need to maintain the minimum wire-bending space at terminals, from Table 312.6.

One new requirement for power distribution blocks in pull and junction boxes has been added. Through conductors, or those conductors that do not terminate on the power distribution blocks, must be arranged so the power distribution block terminals are not obstructed by the through conductors after installation. There must be enough space within the pull or junction box so there is access to the set screws on the terminal blocks, and they can be tightened without damaging the through conductors or other conductors in the box.

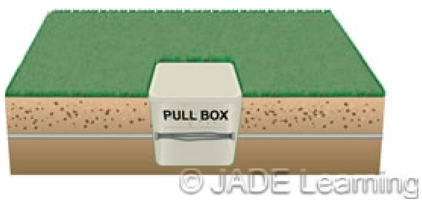
Other requirements for power distribution blocks are (1) equipment grounding terminals are permitted in pull and junction boxes 100 cubic inches and larger, (2) power distribution blocks must be listed, and (3) power distribution blocks cannot have any live parts exposed, whether or not the cover is installed.

Question 105: Which of the following statements about power distribution blocks in pull and junction boxes is true?

A: Power distribution blocks can only be installed in boxes used for straight pulls.
B: Power distribution blocks can only be installed in boxes used for angle pulls.
C: Power distribution blocks can be installed in any size box.
D: Power distribution blocks can be installed in boxes over 100 cubic inches.

Question 106: 314.70 Part IV. Pull and Junction Boxes, Conduit Bodies, and Handhole Enclosures for Use on Systems over 600 Volts. Nominal. General.

Question ID#: 106



Metal conduit bodies and handhole enclosures used on systems over 600 volts must prevent moisture from entering, must be corrosion resistant, and must be grounded and bonded according to Article 250.

Article 314 covers outlet, device, pull and junction boxes, conduit bodies, fittings and handholes. The requirements for boxes, conduit bodies and handholes used on systems over 600 volts can be different than the requirements for under 600 volts. SOME (but not all) of the requirements for installations of 600 volts or less in Part I, Part II, and Part III of Article 314, will also apply to installations over 600 volts mentioned in Part IV of Article 314.

References to Part I, Part II and Part III of Article 314 for pull and junction boxes already existed in the 2008 NEC. They have been added for conduit bodies and handhole enclosures in the 2011 NEC.

For example, metal conduit bodies and handhole enclosures used on systems over 600 volts must be grounded and bonded according to Article 250; in damp or wet locations conduit bodies and handhole enclosures must prevent moisture from entering and accumulating, conductors entering conduit bodies or handhole enclosures must be protected from abrasion, and all openings must be closed. Metal conduit bodies and handhole enclosures used on systems over 600 volts must be corrosion resistant and have covers that are the same thickness as the walls of the conduit body or handhole enclosure.

Question 106: Which of the following statements about pull and junction boxes, is true?

A: Pull and junction boxes, used on systems above 600 volts are not required to meet any of the requirements in Parts I, II or III of Article 314.
B: Pull and junction boxes, used on systems above 600 volts have all of the same requirements as conduit bodies used on systems 600 volts or below.
C: Pull and junction boxes, used on systems above 600 volts must meet all of the same requirements for the same types of equipment used on systems 600 volts or below.
D: Pull and junction boxes, used on systems above 600 volts must also meet certain requirements in Part I, II and III of Article 314.

Question 107: 328.14 Medium Voltage Cable: Type MV. Installation.

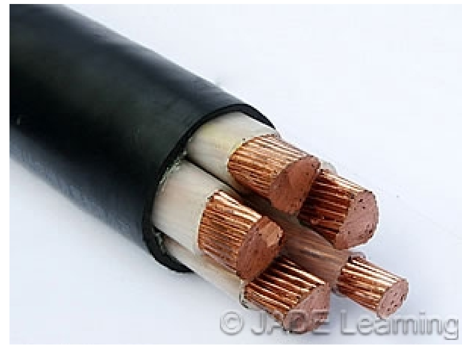
Question ID#: 107

Type MV cable shall 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.



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

Question 107: 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 108: 334.10(1) & 334.12 Nonmetallic-Sheathed Cable: Types NM, NMC, and NMS. Uses Permitted. Uses Not Permitted.

Question ID#: 108

NM cable is permitted in one- and two-family dwellings, and their attached or detached garages, and their storage buildings.

One- and two-family dwellings often have attached or detached garages and storage buildings. The 2008 NEC was not clear that Nonmetallic Sheathed Cable was permitted in these locations, as well as in the dwelling itself. Section 334.10(1), has been changed to read: ***One- and two-family dwellings, and their attached or detached garages, and their storage buildings*** are a permitted use for Type NM, NMC and NMS cable.

The 2008 NEC would have allowed Type NM cable to be used in an attached garage because it was part of the dwelling unit, but it would not have been allowed in a ***detached*** garage because it was not a dwelling unit. Since a detached garage is used for the same purposes as an attached garage, it did not make sense to prohibit NM cable in detached garages.

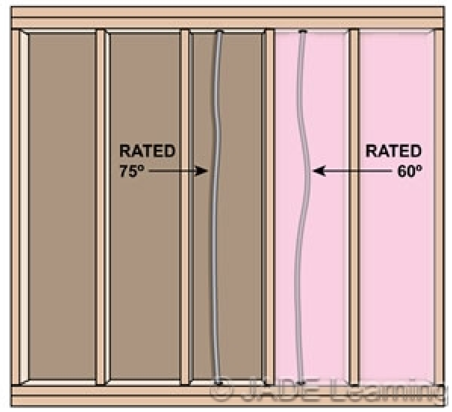
Exactly what is considered a storage building will be up to the Authority Having Jurisdiction. It cannot be a workshop, child's playhouse, game room, pool house, or farm building. It has to be associated with the dwelling unit and used to store items like yard tools, furniture and other household items.

Question 108: In which type of building is Type NM cable permitted?

A: A commercial garage having hazardous classified locations.
B: A commercial building where it is exposed in a dropped ceiling.
C: A detached garage for a single family dwelling with a workbench.
D: A storage building used as a wood working shop.

Question 109: 338.10(B)(4)(a) Uses Permitted. Branch Circuits or Feeders. Installation Methods for Branch Circuits and Feeders. Interior Installations.

Question ID#: 109



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).

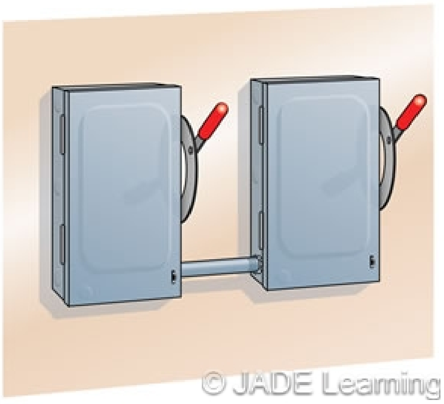
For example, if a No. 6 aluminum SE cable is installed in thermal insulation in an ambient temperature of 110Â°F, the correction factor is .87, based on a 90Â°C rating of the conductors. A 90Â°C rated aluminum conductor can carry 55 amps; 55 amps x .87 = 47.85 amps. The 60Â°C rating of a No. 6 aluminum 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 109: 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 110: 342.30 Securing and Supporting.

Question ID#: 110



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.

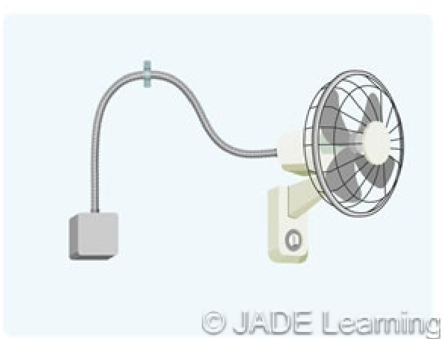
With the sections on unsupported raceways up to 18 inches in length deleted, the support requirements for these raceways goes back to the required support distance from enclosures, or 36 inches. The reasoning was that if these raceways can go unsupported for the last 36 inches before an enclosure, the 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 110: 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 111: 348.30(A) Flexible Metal Conduit. Type FMC. Ex. No. 2 Securing and Supporting. Securely Fastened.

Question ID#: 111



Where flexibility is required after the installation, the length of the flexible metal conduit permitted is measured from the last point where it is secured.

Flexible Metal Conduit must be strapped or fastened within 12 inches of each box, cabinet or conduit body. Exception No. 2 increases the required distance of the strap when flexibility is necessary after the installation, such as with a motor or crane. The flexibility requirement is for when the installation is complete, not when flexibility is needed to make the original installation.

New wording was added to the exception to make it clear the distances listed for different sizes of conduit were to be measured from the last point where the raceway is securely fastened. Without that wording it was not clear if the distance allowed was the total distance of the flexible metal conduit or just the distance from the last point of support.

Where flexibility is required after the installation, the length of the flexible metal conduit, measured from the last point where the raceway is securely fastened, cannot exceed:

- 3 ft. for sizes 1/2 inch through 1 1/4 inches.
- 4 ft. for sizes 1 1/2 inches through 2 inches.
- 5 ft. for sizes 2 1/2 inches and larger.

A similar change about securing a raceway where flexibility is required, measuring from the last point of where the raceway is securely fastened, was made in Article 350 for liquidtight flexible metal conduit.

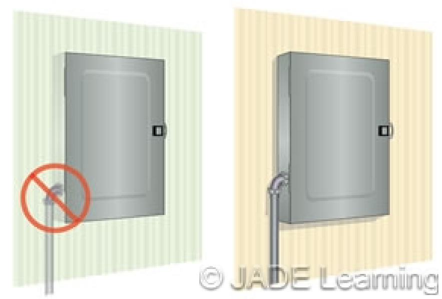
Question 111: A section of 3/4 inch flexible metal conduit is installed for flexibility due to the vibration from being connected to a motor. What is the maximum allowed spacing between the last strap that fastens the FMC to the wall before the wiring method terminates to the motor?

A: 1 foot.
B: 3 feet.
C: 4 feet.
D: 4.5 feet.

Question 112: 348.42 Couplings and Connectors.

Question ID#: 112

Angle connectors shall not be concealed. This revised statement makes it clear that angle connectors for flexible metal conduit cannot be used behind a wall covering or inside a wall or other cavity. The 2008 NEC said, ***Angle connectors shall not be used for concealed raceway installations.*** It would have been possible to interpret that statement as meaning flexible metal conduit angle connectors could not be used to extend a circuit from a flush mounted box if the conduit or cable was installed inside the wall.



Angle connectors are not permitted to be concealed.

Angle connectors for flexible metal conduit cannot be concealed because doing so makes fishing wires into the conduit impossible and risks damaging existing conductors if the conductors are pulled out from the enclosure where the angle connector is attached.

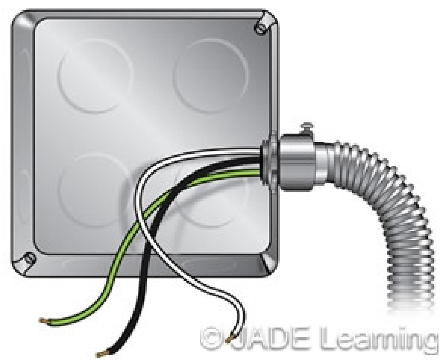
Angle connectors can be used on flexible metal conduit if the angle connector is exposed. Straight connectors are required if flexible metal conduit is terminated inside a wall. As long as the angle connector is outside the wall or cavity, and not concealed, the wires inside the flexible metal conduit are accessible, and the flexible metal conduit can be installed as a complete system before conductors are installed in the conduit.

Question 112: Which of the following installations of flexible metal conduit is a Code violation?

A: Angle connectors used to connect to a luminaire above a suspended ceiling.
B: Angle connectors used to connect to the back of a box inside a sheet rock wall.
C: Exposed angle connectors used to connect to a baseboard heater.
D: Angle connectors used to connect flexible metal conduit to a junction box mounted to the rafters in an unfinished attic.

Question 113:   348.60 Grounding and Bonding.

Question ID#: 113



Where flexibility is required after the installation, an equipment grounding conductor is required to be installed inside flexible metal conduit.

Listed flexible metal conduit is permitted as an equipment grounding conductor in lengths not greater than 6 ft. if the circuit conductors inside the conduit are protected by an overcurrent device rated 20 amperes or less, listed fittings are used, and flexibility is not required after installation.

If flexibility is required after the installation of the flexible metal conduit, an equipment grounding conductor is required to be installed inside the conduit. The 2011 NEC says: ***If used to connect equipment where flexibility is necessary to minimize the transmission of vibration from equipment or to provide flexibility for equipment that requires movement after installation, an equipment grounding conductor shall be installed.*** This makes it clear that if flexibility is necessary to simply terminate the flexible metal conduit, the conduit can be used as an equipment grounding conductor if all the other conditions for using the conduit as an equipment grounding conductor are met. Flexible metal conduit is generally used because the installation would be difficult or impossible with a rigid type of raceway.

If flexibility is required after installation, the flexible metal conduit will be in motion as the equipment that it is connected to moves. Movement may weaken the flexible metal conduit or even pull it apart. Installing an equipment grounding conductor inside the flex will add a path for fault current that does not depend on the flexible metal conduit.

Question 113:   Which of the following installations of flexible metal conduit requires an equipment grounding conductor installed inside the conduit?

A: A 5 ft. piece of flex connected to an oscillating fan.
B: A 6 ft. piece of flex connected to fixed electric space heating equipment.
C: A 4 ft. piece of flex connected to a luminaire installed in a suspended ceiling.
D: A 3 ft. piece of flex connecting two junction boxes.

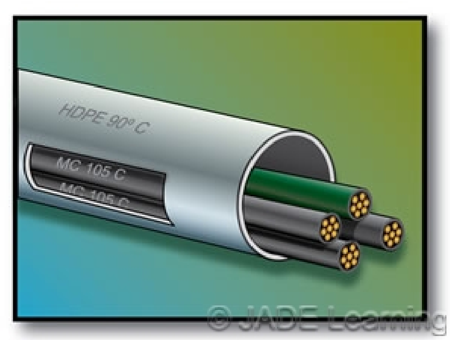
Question 114:   353.10(6) High Density Polyethylene Conduit: Type HDPE Conduit. Uses Permitted. Insulation Temperature Limitation.

Question ID#: 114

The temperature rating of a conductor can exceed the temperature rating of the conduit, provided the conductors are not operated at a temperature higher than the listed temperature rating of the conduit.

For example, MV-105 is rated at 105Â°C. MV-90 is rated at 90Â°C. HDPE conduit is rated for 90Â°C (according to the listing). A No.6 MV-105 insulated three-conductor copper cable in isolated conduit, in air based on an ambient air temperature of 40Â°C, rated at up to 5,000 volts, has an ampacity of 84 amps. A No.6 MV-90 can carry 75 amps. (From Table 310.60(C) (73)). The No.6 MV-105 conductor can be installed in the 90Â°C rated HDPE conduit, as long as it does not carry more current than the rating of the MV-90 conductor, 75 amps.

This was not clear in the 2008 NEC. The section was moved from Uses Not Permitted, with an exception that permitted conductors with higher temperature rating to be installed in lower rated conduit, to Uses Permitted with the exception deleted.



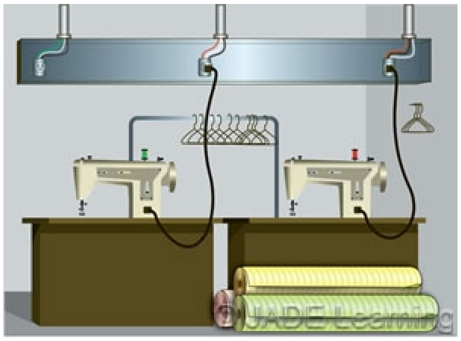
The maximum ampacity of conductors installed in HDPE conduit is limited by the temperature rating of the conduit.

Question 114: At 4160 volts, a No. 4 MV-105 conductor can carry 110 amps. A No. 4 MV-90 conductor can carry 97 amps. If the MV-105 conductor is installed in HDPE conduit with a temperature rating of 90 degrees, what is the maximum rating of the MV-105 conductor?

A: 97 amps.
B: 110 amps.
C: 120 amps.
D: 125 amps.

Question 115: 380.23 Insulated Conductors.

Question ID#: 115



The required wire-bending space at terminals of field assembled multi-outlet assemblies must be maintained.

Multi-outlet assemblies that are field assembled must maintain the conductor clearances inside the multi-outlet assembly so that the conductors are not damaged. At the ends of the multi-outlet assembly, or where conduits and raceways enter the multi-outlet assembly, there must be adequate wire-bending space. Also, if the direction of the multi-outlet assembly changes more than 30 degrees, wire-bending space must be maintained.

The correct wire bending space is taken from Table 312.6(A), Minimum Wire-Bending Space at Terminals and Minimum Width of Wiring Gutters. Wire-bending space is measured from the conductor terminal, in the direction that the wire leaves the terminal, to the wall opposite the terminal. From the Table, the wire-bending space for a No. 3 conductor is 2 inches; for a No. 8 conductor the required wire-bending space is 1 1/2 inches; for a No. 12 conductor the wire-bending space is not specified.

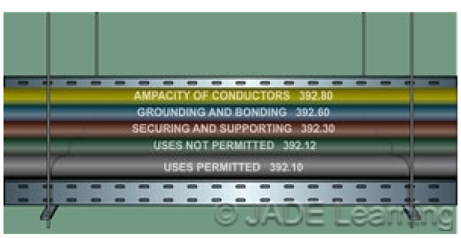
For example, if conduit containing No. 8 conductors enters a multi-outlet assembly from the top, the minimum width of the multi-outlet assembly from top to bottom is 1 1/2 inches.

Question 115: What is the minimum wire-bending space at terminals of a field assembled, multi-outlet assembly when conduit containing No. 1 conductors enters from the top of the multi-outlet assembly?

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

Question 116: Article 392 Cable Trays.

Question ID#: 116



The installation requirements for Cable Trays are found in the same locations as the installation requirements for other Articles in Chapter 3.

Article 392, Cable Trays, has been reorganized into a format that is similar to other raceway Articles in Chapter 3.

Uses Permitted	392.10
Uses Not Permitted	392.12
Securing and Supporting	392.30
Grounding and Bonding	392.60
Ampacity of Conductors	392.80

Placing similar requirements in the same location in the Articles in Chapter 3, Wiring Methods and Materials, makes it easier to find a rule in all the Articles in Chapter 3. If Uses Permitted is always in section xxx.10, and Uses Not Permitted is always in xxx.12, then whether the raceway is Rigid Metal Conduit, Electrical Metallic Tubing, Type SE cable or Cable Trays (which is not considered a raceway) the Code user knows where to look in the 2011 NEC to find the answers to installation questions.

Question 116:   What is the title to Part II in Article 392, Cable Trays?

A: General.
B: Definitions.
C: Installation.
D: Construction Specifications.

Question 117:   392.18(H) Cable Tray Installation. Marking.

Question ID#: 117

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.

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

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 117:   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.

Question 118: 392.60(A) Grounding and Bonding. Metallic Cable Trays.

Question ID#: 118

Metallic cable trays that support non-power conductors must be grounded.

Metal cable trays that contain only non-power conductors, such as telephone and computer cables, must be made electrically continuous through approved connections or the use of a bonding jumper not smaller than No. 10 AWG.

This is a new requirement. Cable trays that support electrical conductors are permitted to be used as an equipment grounding conductor, if the facility has maintenance and supervision that ensures only qualified persons service the installation. There has not been a requirement up until now that cable trays supporting non-power conductors must be electrically continuous.

Telephone, computer and TV/video systems are required to be bonded to the electrical system. If the cable tray with non-power conductors is electrically continuous, the cable tray will provide a reliable path to ground.

Question 118: Which of the following statements about cable trays that support only non-power conductors is correct?

A: A No. 10 AWG equipment grounding conductor must be installed for the entire length of the tray.
B: Communications and computer cables must be bonded to the cable tray every 100 ft.
C: The cable tray must be attached to a grounding electrode on each end of the cable tray.
D: The cable tray must be electrically continuous.

Question 119: Article 399 Outdoor Overhead Conductors over 600 Volts.

Question ID#: 119

The NEC now covers privately owned outdoor installations operated at over 600 volts.

Article 399 is new to the 2011 NEC and provides installation standards for customer owned systems that are used to distribute power that is rated over 600 volts. Non-utility, outdoor overhead conductors operating at over 600 volts are common in large industrial plants, heath care complexes, commercial properties, college campuses and other large installations.

Outdoor overhead conductors are permitted for services, feeders and branch circuits over 600 volts. They are defined as single conductors, insulated, covered, or bare, installed outdoors on support structures.

The design of these systems must be done by a professional engineer. The Authority Having Jurisdiction may request documentation about the conductor size, applied voltage, wind/ice loading, and distance between support structures. The engineer must document the types of towers, poles or structures that support the conductors, including the structure size and materials, spans between structures, strength of guys and guy anchors, foundations and soil conditions.

Question 119: What is the purpose of Article 399, Outdoor Overhead Conductors over 600 volts?

A: Bring utility wiring under the scope of the National Electrical Code.
B: Include in the NEC non-utility owned outdoor wiring methods for wiring over 600 volts.
C: Require engineered drawings on all electrical systems.
D: Prohibit outdoor overhead conductors operating at over 600 volts on customer owned systems.

Question 120: 404.2(C) Switches Controlling Lighting Loads.

Question ID#: 120

A grounded neutral conductor is required at every switch that controls lighting loads.

This is a major change to the 2011 National Electrical Code and will require a grounded neutral conductor installed to every switch supplied by a grounded general purpose branch circuit that controls lighting loads. The reason for the change was to provide the necessary wiring for electronic lighting control switches, usually occupancy sensors.

The coming years will see more and more occupancy sensors installed in commercial and residential locations. Occupancy sensors generally require approximately .5-mA of current for the electronic circuits that control their operation even when the load they control is turned off; this enables them to instantly turn on when they sense movement in the room. Up until now the equipment grounding conductor was used to complete the circuit necessary to keep the occupancy sensor active. It is never a good idea to use the equipment ground as a current carrying conductor, no matter how small the current is. The current on the equipment grounding conductor increases as more occupancy sensors are supplied by the same branch circuit.

The general rule requires that a grounded neutral conductor must be available at every switch that controls lighting loads in all residential, commercial and industrial locations. However, two exceptions permit the grounded conductor to be omitted:

- if there is a raceway connected to the switch box that is large enough to add a grounded conductor in the future.
- if cable is used and there is an opening at the top or bottom of the framing cavity, or the wall is not finished on one side.

Question 120: A set of lighting plans for a new commercial building does not include occupancy sensors for lighting supplied by a grounded general purpose branch circuit. Without application of any exception, which of the following statements is true?

A: A grounded neutral conductor is not required to be installed to switch boxes for switches that control lighting outlets.
B: A grounded neutral conductor is required to be installed to switch boxes for switches that control lighting outlets.
C: A grounded neutral conductor is only required to be installed to switch boxes for single-pole switches that control garbage disposals.
D: The equipment grounding conductor can be used to keep occupancy sensors active, if occupancy sensors are added in the future.

Question 121: 404.9(B) Exceptions 1 and 2 . Provisions for General-Use Snap Switches. Grounding.

Question ID#: 121

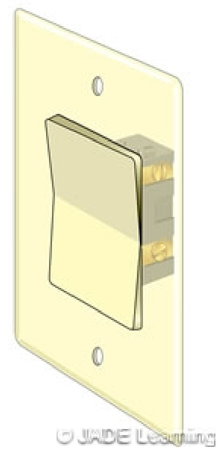
The main rule says general-use snap switches must be grounded. The equipment grounding conductor run with the branch circuit is most commonly used to ground the switch and the switch box if it is metal.

If a grounding means does not exist in the box, Exception No. 1 permits a snap switch to be ungrounded for replacement purposes only. If the switch is within 8 ft. vertically or 5 ft. horizontally from ground or exposed metal grounded objects, the faceplate must be non-metallic with non-metallic screws, or the circuit must be protected by GFCI.

New Exception No. 2 will allow a switch to be ungrounded if the switch is part of a listed kit or listed assembly provided:

- the switch has a non-metallic yoke and a non-metallic faceplate that is unique to that device.
- after installation all exposed parts are non-metallic.

New Exception No. 3 permits a switch with an integral non-metallic enclosure to be ungrounded if the enclosure meets the requirements of 300.15(E) and is wired with non-metallic-sheathed cable.



Switch assemblies or kits are available which are listed for installation without being connected to an equipment grounding conductor.

Question 121: What is required for a listed switch assembly that can be used without a connection to the equipment grounding conductor?

A: A non-metallic yoke.
B: A metal faceplate.
C: An insulated grounding terminal.
D: Manufactured for back-wiring only, with no screw terminals.

Question 122: 406.4(D)(4) General Installation Requirements. Arc-Fault Circuit-Interrupter Protection.

Question ID#: 122

Effective January 1, 2014, arc-fault circuit-interrupters (AFCIs) will be required for replacement receptacles in areas requiring AFCI protection in new construction.

Effective January 1, 2014, an arc-fault circuit-interrupter (AFCI) must be provided for a replacement receptacle installed on a branch circuit that would be required to have arc-fault circuit-interrupter (AFCI) protection when installed in new construction done under the 2011 NEC. The AFCI protection for the replacement receptacle can be provided by (1) ***a listed outlet branch-circuit type AFCI receptacle***; (2) ***a receptacle protected by a listed outlet branch circuit type AFCI receptacle***; or (3) ***a receptacle protected by a listed combination type AFCI circuit breaker.***

Outlet branch circuit type arc-fault circuit-interrupter receptacles are not available as of January 2011. Putting off the effective date until January 2014 will give manufacturers time to mass produce an AFCI receptacle.

Using branch-circuit arc-fault circuit-interrupter receptacles as replacements for standard receptacle outlets will extend AFCI protection to older homes with panelboards that will not accept AFCI circuit breakers. More fires occur in older homes than in newer construction; having circuits protected by AFCI devices will increase safety for residents of these older residences.

Question 122: When and where is it necessary to install a replacement receptacle that is arc-fault circuit-interrupter protected?

A: When replacing a receptacle on a kitchen countertop in January 2014.
B: When replacing a living room receptacle in June 2012.
C: When replacing a hallway receptacle in March 2013.
D: When replacing a bedroom receptacle in Jan 2014.

Question 123: 406.4(D)(5)&(6) General Installation Requirements. Tamper-Resistant and Weather-Resistant Receptacles.

Question ID#: 123

Tamper-resistant and weather-resistant receptacles will be required for replacement receptacles in areas where they are required in new construction.

Unless a receptacle is installed in one of the 4 areas exempted from the general requirement, section 406.12 requires all 125-volt, 15- and 20-ampere receptacles installed in the areas identified in section 210.52 to be tamper-resistant.

Section 406.4(D)(5) requires the installation of tamper-resistant receptacles when replacing receptacles that are required by other sections of the NEC to be tamper-resistant.

Section 406.4(D)(6) requires the installation of weather-resistant receptacles when replacing receptacles that are required by other sections of the NEC to be weather-resistant.

Unless exempted by the exception to 210.8(A)(3), when replacing a receptacle installed outdoors at a dwelling, it should be replaced with a GFCI protected, weather-resistant, tamper-resistant device.

The GFCI protection could be provided by using a GFCI receptacle, or by having GFCI protection provided by a GFCI circuit-breaker or GFCI receptacle installed elsewhere.

Tamper-resistant and weather-resistant receptacles were first required in the 2008 NEC for new construction. Requiring replacement receptacles in areas where they would be required in new construction to be tamper-resistant or weather-resistant will extend this protection to older homes.

Tamper-resistant receptacles prevent foreign objects from being inserted into the receptacle. Many children are injured every year by sticking keys, hair clips, or other metal objects into receptacle outlets. Weather-resistant receptacles are made to withstand the moisture and temperature changes that cause the high failure rates of non-weather-resistant receptacles installed outdoors.

Question 123: Which of the following statements about replacement receptacles is true?

A: Starting in 2014, all replacement receptacles, regardless of their location, are required to be tamper-resistant.
B: Unless exempted by the exception to 210.8(A)(3), when an outdoor receptacle outlet at a dwelling is replaced, a GFCI protected, weather-resistant, tamper-resistant receptacle must be installed as the replacement.
C: When replacing a receptacle in the living room, a tamper-resistant receptacle is not required.
D: If a single receptacle outlet on a branch circuit is replaced, all receptacle outlets must be changed to the tamper-resistant type.

Question 124: 406.9(B)(1) Receptacles in Damp or Wet Locations. Wet Locations.

Question ID#: 124

Non-locking, 15- and 20-ampere, 125- and 250-volt receptacles installed in wet locations are required to be in a weatherproof enclosure that is weatherproof whether or not the cord cap is installed. In locations other than one- and two-family dwellings, the outlet box hood must be listed, and where installed on an enclosure which is supported from grade mounted on a post or supported by conduit it must be identified as "extra duty."

Receptacle outlets installed outdoors on construction sites and in commercial locations require an "extra duty" outlet box hood.

Receptacle outlets installed outdoors on construction sites and in commercial locations are usually subject to more abuse than outdoor receptacles installed at one- and two-family dwellings. The plastic in-use covers which are commonly used on dwellings do not stand up to the constant use and rough treatment that they receive on temporary installations.

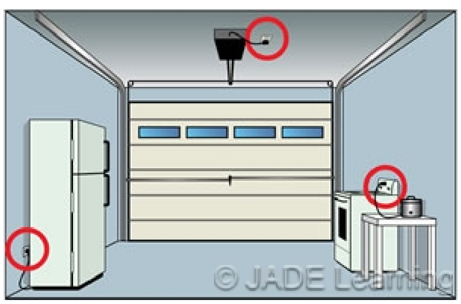
Receptacle outlets that are installed in enclosures in wet locations and are supported at grade level directly to a structure, or attached to metal or wood braces, or are supported by a raceway, are now required to have a cover which the NEC calls an outlet box-hood identified as "extra duty."

Question 124: Which installation requires a receptacle enclosure with an extra duty outlet box-hood?

A: An indoor receptacle used during a tenant remodel.
B: An outdoor receptacle on a covered restaurant patio.
C: A receptacle installed on 4 in. x 4 in. post supported from grade outdoors for temporary power.
D: A receptacle installed at the rear entrance of a single-family dwelling.

Question 125: 406.12 Tamper-Resistant Receptacles in Dwelling Units.

Question ID#: 125



Four new exceptions permit non-tamper-resistant receptacles to be installed in dwelling units where they are not likely to be reached by children.

Four new exceptions will allow non-tamper-resistant, non-locking, 125-volt, 15- and 20-ampere receptacles to be installed in dwelling unit locations that required tamper-proof receptacles in the 2008 NEC.

(1) Tamper-resistant receptacles are not required if located more than 5 1/2 ft. above the floor. Tamper-resistant receptacles are installed to protect small children, and if a receptacle is located more than 5 1/2 ft. above the floor, it is clearly out of the reach of young children. Receptacles for garage door openers will no longer be required to be tamper-resistant.

(2) Receptacles that are part of a luminaire or appliance are not required to be tamper-resistant. Current product standards for luminaires and appliances do not specify tamper-resistant receptacles.

(3) A single receptacle in dedicated space or a duplex receptacle in dedicated space for two appliances does not need to be tamper-resistant. Receptacles for refrigerators, dish washers, washing machines and similar appliances will not need to be tamper-resistant because the appliance blocks access to them.

(4) Non-grounding receptacles used as replacements for existing non-grounding receptacles.

Only non-locking type receptacles are required to be tamper-resistant.

Question 125: Which of the following non-locking, 125-volt, 15 or 20-ampere receptacles are required to be tamper-resistant?

A: A receptacle located behind the headboard of a bed in a bedroom.
B: A receptacle mounted 7 ft. above the floor that is used for a wall clock in a kitchen.
C: A receptacle installed in dedicated space for a cord and plug connected trash compactor in the kitchen.
D: A factory installed receptacle in a metal medicine cabinet.

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

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1.) A B C D	19.) A B C D	37.) A B C D	55.) A B C D	73.) A B C D	91.) A B C D	109.) A B C D
2.) A B C D	20.) A B C D	38.) A B C D	56.) A B C D	74.) A B C D	92.) A B C D	110.) A B C D
3.) A B C D	21.) A B C D	39.) A B C D	57.) A B C D	75.) A B C D	93.) A B C D	111.) A B C D
4.) A B C D	22.) A B C D	40.) A B C D	58.) A B C D	76.) A B C D	94.) A B C D	112.) A B C D
5.) A B C D	23.) A B C D	41.) A B C D	59.) A B C D	77.) A B C D	95.) A B C D	113.) A B C D
6.) A B C D	24.) A B C D	42.) A B C D	60.) A B C D	78.) A B C D	96.) A B C D	114.) A B C D
7.) A B C D	25.) A B C D	43.) A B C D	61.) A B C D	79.) A B C D	97.) A B C D	115.) A B C D
8.) A B C D	26.) A B C D	44.) A B C D	62.) A B C D	80.) A B C D	98.) A B C D	116.) A B C D
9.) A B C D	27.) A B C D	45.) A B C D	63.) A B C D	81.) A B C D	99.) A B C D	117.) A B C D
10.) A B C D	28.) A B C D	46.) A B C D	64.) A B C D	82.) A B C D	100.) A B C D	118.) A B C D
11.) A B C D	29.) A B C D	47.) A B C D	65.) A B C D	83.) A B C D	101.) A B C D	119.) A B C D
12.) A B C D	30.) A B C D	48.) A B C D	66.) A B C D	84.) A B C D	102.) A B C D	120.) A B C D
13.) A B C D	31.) A B C D	49.) A B C D	67.) A B C D	85.) A B C D	103.) A B C D	121.) A B C D
14.) A B C D	32.) A B C D	50.) A B C D	68.) A B C D	86.) A B C D	104.) A B C D	122.) A B C D
15.) A B C D	33.) A B C D	51.) A B C D	69.) A B C D	87.) A B C D	105.) A B C D	123.) A B C D
16.) A B C D	34.) A B C D	52.) A B C D	70.) A B C D	88.) A B C D	106.) A B C D	124.) A B C D
17.) A B C D	35.) A B C D	53.) A B C D	71.) A B C D	89.) A B C D	107.) A B C D	125.) A B C D
18.) A B C D	36.) A B C D	54.) A B C D	72.) A B C D	90.) A B C D	108.) A B C D	

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Name ______________________________ WI License #____________________

Mailing Address ______________________________ Phone ____________________

City, State, Zip Code ______________________________ CC Code ________________

Credit Card Number ______________________________ Expiration Date ______________

Email Address ____