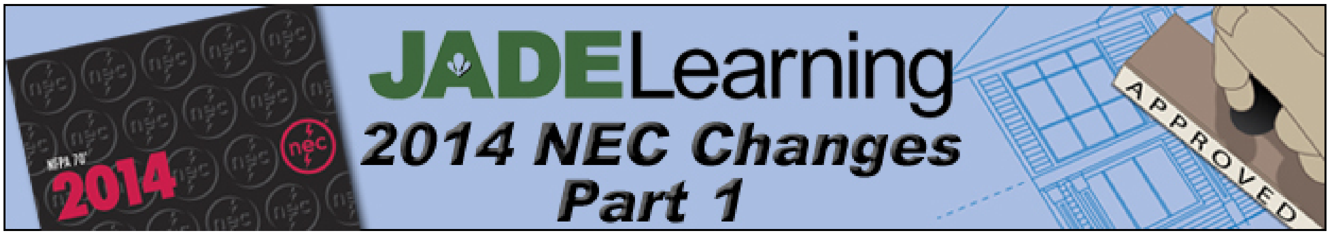


2014 NEC Changes Part 1 (Homestudy)

Wisconsin Electrical License

This course will review the first half of the most important National Electrical Code changes from the 2014 NEC. Changes in Articles 100 - 404.2 will be covered.

Course# 17015   8 CEI, IJE, J, M, RE, RJE, RME, UDC Credit Hours $90.00

This course is currently approved by the Wisconsin Department of Safety and Professional Services under course number 17015.

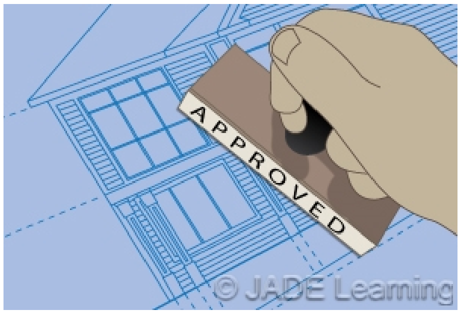
Completion of this continuing education course will satisfy 8.000 credit hours of course credit type 'CEI, IJE, J, M, RE, RJE, RME, UDC' for Electrical license renewal in the state of Wisconsin. Course credit type 'CEI, IJE, J, M, RE, RJE, RME, UDC'. Board issued approval date: 3/25/2015. Board issued expiration date: 3/25/2020.

2014 NEC Changes Part 1 (Homestudy) - WI

Chapter 1

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

Question ID#: 615.0



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

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

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

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

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

Other examples:

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

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

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

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

Question ID#: 616.0

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

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

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

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

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

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

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

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

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

Question 3: Article 100 Definitions. Battery System.

Question ID#: 617.0

A battery system includes one or more storage batteries and battery chargers as well as associated electrical equipment.

A new definition for Battery Systems has been added to Article 100.

Interconnected battery subsystems consisting of one or more storage batteries and battery chargers, and can include inverters, converters, and associated electrical equipment.

The definition makes it clear that there must be at least one or more storage batteries and a charger present in order to fit the description of a "Battery System."

A Stand-Alone Solar Photovoltaic (PV) System uses battery systems to store power; however, a battery system is not an integral component of a PV system. In addition to the PV modules, which convert solar power to DC electricity, a Stand-Alone PV system supplies power to storage batteries and battery chargers as well as either an inverter or a converter. PV systems which are not stand-alone feed AC power back to the utility grid.

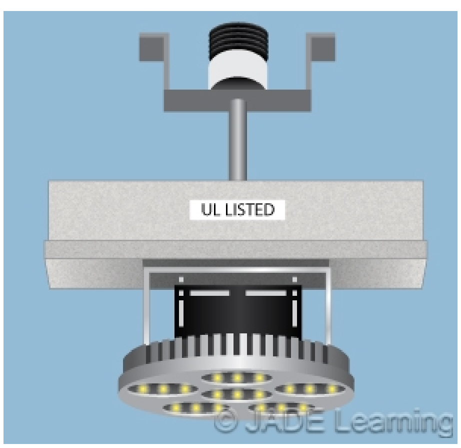
This new definition was added to the NEC in Article 480 of the 2011 Code cycle and is used in six different Code articles. Based on the scope of Article 100, the definitions for technical terms that appear in two or more Code articles are placed in Article 100. Placing the definition of a Battery System in Article 100 helps keep the NEC consistent and reduces repetitive Code language throughout different Code articles.

Question 3: Which of the following is considered a battery system?

A: A utility-interactive PV system that has no provisions for storing power.
B: A wind generating system that includes storage batteries and a battery charging system.
C: A utility-interactive PV inverter.
D: A converter that turns alternating current into direct current.

Question 4: Article 100 Definitions. Retrofit Kit.

Question ID#: 618.0



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

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

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

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

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

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

Question 4: Why should retrofit kits, as defined in Article 100, be listed?

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

Question 5: Article 100 Definitions. Switchgear.

Question ID#: 619.0

The term switchgear is now used throughout the National Electrical Code.

Metal-enclosed power switchgear is now referred to as "switchgear." Switchgear includes "Low-Voltage Power Circuit Breaker Switchgear," "Metal-Enclosed Switchgear," or "Metal-Clad Switchgear." The new term can be used in all locations where "switchgear" is already used.

Switchgear is defined as:

An assembly completely enclosed on all sides and top with sheet metal (except for ventilating openings and inspection windows) and containing primary power circuit switching, interrupting devices, or both, with buses and connections. The assembly may include control and auxiliary devices. Access to the interior of the enclosure is provided by doors, removable covers or both.

"Switchgear" is now used throughout the NEC instead of "Metal-Enclosed Power Switchgear." Examples of where "switchgear" is used in the NEC:

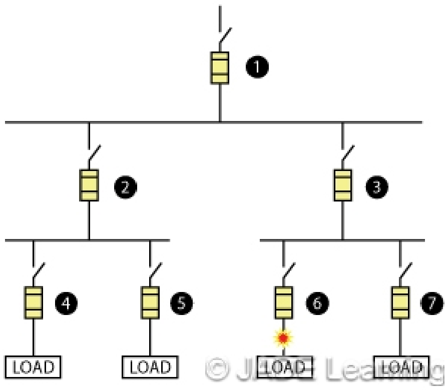
- 110.16. Switchboards, ***switchgear***, and panelboards require an arc-flash hazard warning.
- 110.26(A)(1)(a) Working space is not required in the back of switchboards, ***switchgear***, or motor control centers.
- 230.211 ***Switchgear*** shall consist of a substantial metal structure and a sheet metal enclosure.
- 240.21(B)(1) For feeder taps not over 10 ft. long, the taps cannot extend beyond the switchboard, ***switchgear***, panelboard or disconnecting means.
- Article 408 Switchboards, ***Switchgear***, and Panelboards.
- 490.47 ***Switchgear*** Used as Service Equipment
- 694.22 The wind turbine disconnecting means shall consist of a group of separate enclosures, or in or on a ***switchgear.***
- 695.4(B)(3) Disconnecting means shall not be located within the same enclosure, panelboard, switchboard, ***switchgear,*** that supplies loads other than the fire pump.

Question 5: Which of the following statements about switchgear is true?

A: Switchgear must be enclosed with sheet metal on all sides, including any inspection windows.
B: Switchgear can include power and control devices.
C: Switchgear and panelboards are the same thing.
D: Switchgear must be arc resistant.

Question 6: Article 100 Definitions. Selective Coordination.

Question ID#: 620.0



The purpose of selective coordination is to minimize damage caused by the fault and to prevent a fault from affecting components of the system on the line side of a fault.

Selective Coordination:

Localization of an overcurrent condition to restrict outages to the circuit or equipment affected, accomplished by the selection and installation of overcurrent protective devices and their ratings or settings for the full range of available overcurrents, from overload to the maximum available fault current, and for the full range of overcurrent protective device opening times associated with those overcurrents.

The definition of ***Coordination (Selective)*** was clarified in the 2014 Code by replacing the word "***choice"*** with the words "***installation and selection."*** Obviously, in addition to "choosing" the correct type of overcurrent protective device (OCPD), it must be installed correctly. The new definition retains the previous requirement that a selectively coordinated system restricts or limits power outages to only those parts of the system directly affected by a fault.

The definition was expanded to include a statement indicating that a selectively coordinated system must be able to handle all overcurrent conditions to which the system can be exposed - from a simple overload to the maximum available fault current. In a selectively coordinated system, the time/current characteristics of an OCPD are required to be selected and installed to both minimize damage caused by the fault and to prevent a fault from affecting components of the system on the line side of (up-stream of) the fault.

For example, in a selectively coordinated system, a fault condition in a branch circuit that originates in a panelboard supplied by a feeder will open the branch circuit OCPD closest to the fault without opening the feeder OCPD that supplies the panel. However, a fault condition in the feeder will open the OCPD that supplies the feeder without opening the service OCPD. In all cases the OCPD is selected and installed to localize the power outage and to open fast enough to minimize damage caused by the fault.

The NEC requires selective coordination of overcurrent protection for systems supplying elevators, emergency systems, legally required standby systems, and fire pumps. Some industrial processes may also require such systems.

Question 6: Selectively coordinated systems are required to:

A: Provide protection only for the service overcurrent protective device when a fault condition anywhere on the electrical system.
B: Provide protection only for feeders affected by a fault condition.
C: Provide protection for only branch circuits affected by a fault condition.
D: Both limit power outage to the parts of the system where a fault occurs, and to minimize damage to parts of the system affected by the fault.

Question 7: Article 100 Definitions. Device.

Question ID#: 621.0

A wire is not a device.

Device
A unit of an electrical system, other than a conductor, that carries or controls electric energy as its principal function.

The definition of "device" has been revised by adding "***other than a conductor***" to the previous definition. This change clarifies that the term "device" does not include any conductors. Conductors are not considered devices even though parts of a device such as terminals and other energized parts of a device serve the same function as a conductor. Although conductors carry electricity, this change makes it clear that conductors are not considered to be devices.

Most devices control and carry electrical energy without consuming any electrical power. However, some devices such as occupancy sensors, dimmer switches, GFCI receptacles, AFCI receptacles, and switches with pilot lights do consume very small amounts of power. Other devices such as fuseholders, circuit breakers, receptacles, and snap switches control and carry electrical energy but do not consume any power.

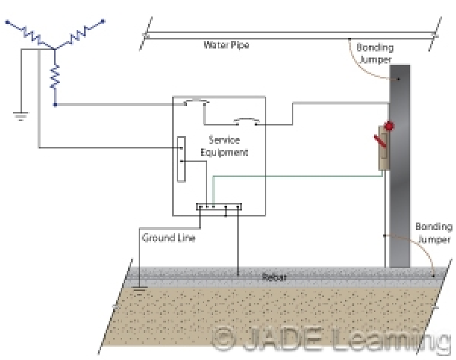
Some of the more common devices are circuit breakers, duplex and single receptacles, dimmer switches, fan speed controls, GFCI receptacles, AFCI receptacles, snap switches, and occupancy sensors. In each case, the primary function of all of these devices is to carry and/or control electricity to circuits and loads that they supply.

Question 7: Which of the following is considered a device?

A: An incandescent light bulb.
B: A green equipment conductor.
C: A circuit breaker.
D: A bathroom vent fan.

Question 8: Article 100 Definitions. Ground-Fault Current Path.

Question ID#: 622.0



Ground-fault current paths include equipment grounding conductors, metallic equipment, and any other electrically conductive material.

The term "ground-fault current path" is now included in Article 100 of the 2014 NEC. In previous editions of the NEC, this term was defined in Article 250.2. Because the term is used in two or more Articles, the definition and its accompanying Informational Note were relocated without change to Article 100.

A "ground-fault current path" is defined as an electrically conductive path from the place where a ground fault occurs in an electrical system to the electrical source. A "ground-fault current path" is very different than an "effective ground-fault current path." An effective ground-fault current path is intentionally constructed and low impedance. Its purpose is to carry ground-fault current back to the source so the circuit breaker on the faulted circuit will trip. A "ground-fault current path" may not be intentionally created, but it is the path of least resistance. Current wants to go to back to the source, and it will get there along any path that leads back to the source but the majority of it will always flow along the path with the lowest resistance. Fault current will travel on building steel, raceways, or any metal surface. If lightning hits a tree, the ground-fault current path is through the tree to the earth. The human body can also become part of the ground-fault current path, sometimes with fatal results.

Fault current may return to the source through conductive materials that are not part of the electrical system such as equipment enclosures, metal gutters, drain pipes, metal roofing, and metal siding.

Although grounded electrical systems include a path for ground-fault current such as equipment grounding conductors, the fault current will take any electrically conductive low resistance path back to a grounded source of electrical energy.

Question 8: Ground-fault current will flow back to the source of electrical energy:

A: Only on an ungrounded conductor.
B: Only on a grounded neutral conductor.
C: By any electrically conductive material that is connected to a grounded source of electrical energy.
D: Only on an equipment grounding conductor.

Question 9: Article 100 Definitions. Grounding Conductor, Equipment (EGC).

Question ID#: 623.0

The definition of "grounding conductor, equipment (EGC)" has changed in the 2014 NEC.

There is a revised definition of the Equipment Grounding Conductor.

The conductive path(s) that provides a ground-fault current path and connects normally non-current-carrying metal parts of equipment together and to the system grounded conductor or to the grounding electrode conductor, or both.

The definition was changed to include the phrase ***that provides a ground-fault current path.*** The main purpose of the equipment grounding conductor is to provide a low impedance ground-fault current path. This is done so if an ungrounded conductor contacts a grounded surface, the fault current will travel on the equipment grounding conductor and return to the service or transformer. If the equipment grounding conductor does not provide a continuous path for fault current, the overcurrent device on the faulted circuit might not trip, and the metal parts of the equipment will remain energized causing a dangerous electrocution hazard.

The equipment grounding conductor must accomplish the following:

(1) Provide a ground-fault current path.

(2) Bond together the non-current-carrying metal parts of equipment.

(3) Connect the non-current-carrying parts of equipment to the system grounded conductor.

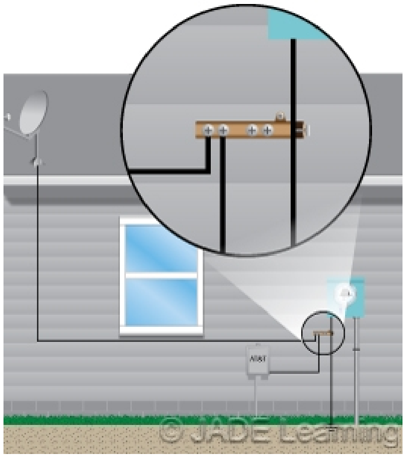
Item (3) is done at the service equipment or the source of a separately derived system. Items (1) and (2) are generally done after the first disconnecting means.

Question 9: Which of the following conductors is considered an equipment grounding conductor?

A: Connects the grounded conductor to the grounding electrode conductor.
B: Connects the grounding electrode to the grounded conductor.
C: Connects two grounding electrodes together.
D: Connects non-current-carrying metal parts to the grounded conductor.

Question 10: Article 100 Definitions. Intersystem Bonding Termination.

Question ID#: 624.0



Only intersystem bonding conductors are to be connected to an intersystem bonding terminal.

The definition of "intersystem bonding termination" was revised by inserting the word "intersystem" in front of the words "bonding conductors". The definition now reads:

A device that provides a means for connecting intersystem bonding conductors for communications systems to the grounding electrode system.

The way the term was defined in previous Codes did not make it clear that only bonding conductors from communications systems were to be connected to the intersystem bonding termination. This change makes it clear that only intersystem bonding conductors are to be landed on an intersystem bonding termination.

Although the intersystem bonding termination bar was not designed for general bonding and grounding purposes, because it was easily accessible, some individuals were using the intersystem bonding termination bar to bond gas piping and other metal pipes to the electrical system.

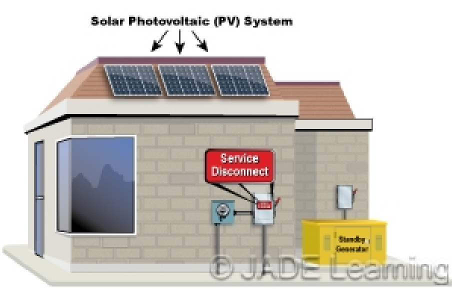
This change makes it clear that the intersystem bonding termination is only to be used to bond intersystem bonding conductors for systems such as data, voice, cable, and satellite systems.

Question 10: Which of the following is permitted to be terminated on an intersystem bonding termination?

A: An equipment grounding conductor for a branch circuit.
B: A bonding conductor from a window air-conditioner near the termination.
C: A bonding conductor for a TV satellite dish.
D: A bonding conductor for a propane gas line near the termination.

Question 11: Article 100 Definitions. Premises Wiring (System). Informational Note.

Question ID#: 625.0



A new informational note provides example power sources.

A new Informational Note was added to the definition of a premises wiring system:

Power sources include, but are not limited to, interconnected or stand-alone batteries, solar photovoltaic systems, other distributed generation systems, or generators.

These examples of alternate energy sources are getting increasingly common.

By definition a premise wiring system includes: ***(a) wiring from the service point or power source to the outlets or (b) wiring from and including the power source to the outlets where there is no service point.***

The service point, according to Article 100, is the point of connection between the facilities of the serving utility and the premises wiring. So by definition the service point is where the premise wiring connects to the utility wiring.

When an alternate source of power is present, such as a solar photovoltaic system or a generator, the wiring from the alternate source is considered part of the premises wiring. If the alternate power source is a stand-alone system, and there is no service point because there is no utility wiring present, the wiring from the alternate power source is also considered part of the premises wiring.

The scope of the NEC, from section 90.2, says the Code covers ***public and private premises, including buildings, structures, mobile homes, recreational vehicles, and floating buildings.***

At these premises, ***interior and exterior wiring, including power, lighting,***

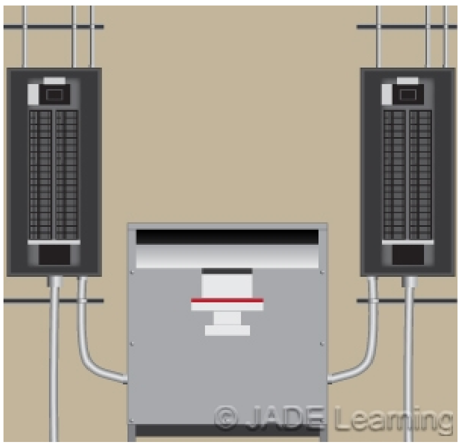
control, and signal circuit wiring together with all their associated hardware, fittings, and wiring devices, both permanently and temporarily installed is covered by the National Electrical Code. The internal wiring of appliances, luminaires, motors, or other equipment is not considered premise wiring.

Question 11: Which of the following types of wiring is considered premises wiring?

A: Underground utility wiring from a transformer to the utility meter.
B: Wiring from a generator to a transfer switch.
C: Supplemental heat strips in an electric furnace.
D: Wiring to the line side of a generator overcurrent device inside a generator.

Question 12: Article 100 Definitions. Separately Derived System.

Question ID#: 626.0



Grounding and bonding conductors of separately derived systems are permitted to be connected together as required for grounding and bonding the equipment.

Separately Derived System

The NEC defines a Seperately Derived System as: An electrical source, other than a service, having no direct connection(s) to circuit conductors of any other electrical source other than those established by grounding and bonding connections.

The definition of a separately derived system is much simpler now. According to the revised definition, an electrical system is considered to be a separately derived system if its source of electrical power is something other than a service, and except for those conductors connected for grounding and bonding purposes, has no direct electrical connection to conductors of circuits from any other source.

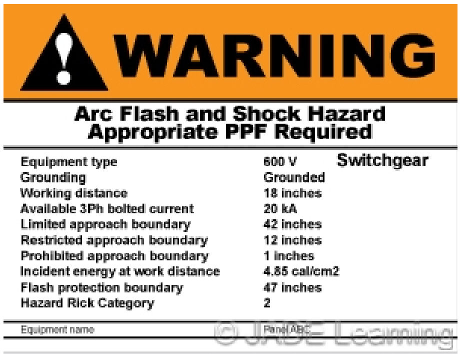
Under the previous definition, in some installations, the required bonding and grounding connections disqualified the system from being considered as a separately derived system. Under the revised definition, this is no longer the case. For example, it is now clear that having the bonding and grounding conductors of multiple separately derived systems connected together by a common grounding electrode conductor no longer prevents the separate systems from being considered as separately derived systems.

Question 12: Which of the following is never considered a separately derived system?

A: A transformer.
B: A generator.
C: A service.
D: An uninterruptible power supply.

Question 13: 110.16 Arc-Flash Hazard Warning.

Question ID#: 627.0



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

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

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

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

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

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

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

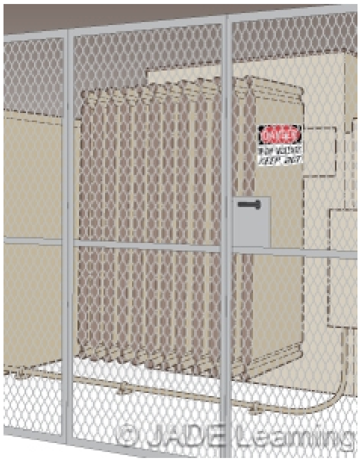
Arc-flash warning labels must alert personnel to the danger of an arc-flash, but there is still not a requirement that the label include approach distances, incident energy, or the arc-flash boundary.

Question 13: Which of the following is true regarding the marking required on electrical equipment when there is a potential arc-flash hazard?

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

Question 14: 110.21(B) Field-Applied Hazard Markings.

Question ID#: 628.0



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

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

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

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

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

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

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

Effective words in 110.21(B)(1) refers to the words, DANGER, WARNING, and CAUTION, which must appear on the warning label.

Question 14: Which of the following is an example of a sign that is permitted to include variable handwritten information?

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

Question 15: 110.24 Available Fault Current.

Question ID#: 629.0

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

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

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

A new Informational Note has been added to section 110.24:

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

Question 15: Which of the following statements about marking the available fault current is true?

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

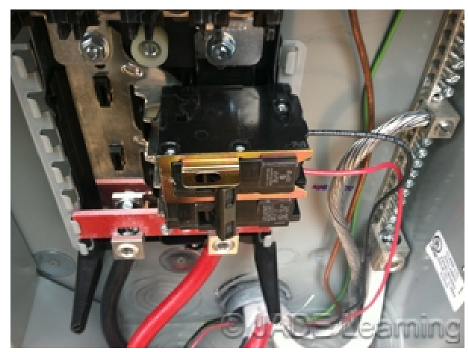
Question 16: 110.25 Lockable Disconnecting Means.

Question ID#: 630.0

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

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

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



<u>A lockable disconnecting means must be capable of being locked in the open position.</u>

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

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

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

Question 16: Which of the following is a lockable disconnecting means?

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

Question 17: 110.26(C)(3) Entrance to and Egress from Working Space. Personnel Doors.

Question ID#: 631.0

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

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

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

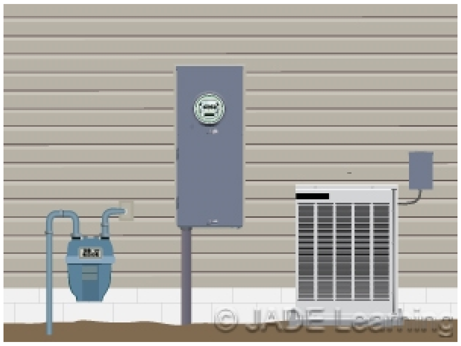
The last change to this section clarifies what type of door hardware may be used in rooms that meet the criteria above. The previous Code text allowed "pressure plates or other devices that are normally latched but open under simple pressure". This Code language left the door hardware requirements open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

Question 17: Which of the following electrical rooms requires listed panic hardware on the exit door?

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

Question 18:   110.26(E)(2) Dedicated Equipment Space. Outdoor.

Question ID#: 632.0



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

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

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

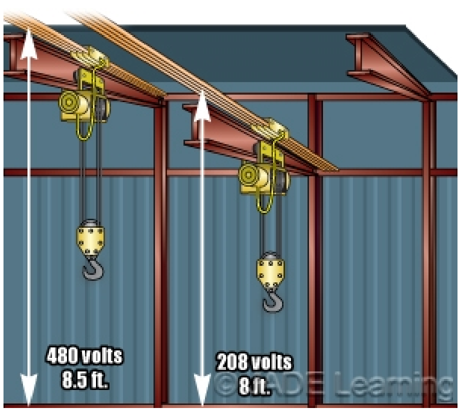
Designers and architects often want all the equipment in the same location. Gas piping, water piping, mechanical refrigeration lines, phone equipment, cable and satellite equipment and many other types of equipment are often found alongside the electrical service. All this equipment can interfere with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

Question 18:   What is the minimum dedicated space around electrical equipment installed outdoors?

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

Question 19:   110.27(A) Guarding of Live Parts. Live Parts Guarded Against Accidental Contact.

Question ID#: 633.0



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

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

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

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

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

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

Question 19: Which of the following options is an acceptable way to provide protection from accidental contact for a 480-volt exposed terminal knife switch that does not have an enclosure?

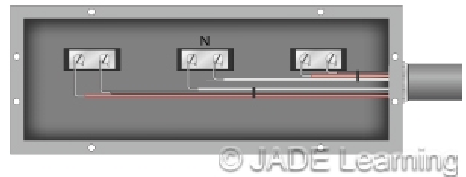
A: Locating the switch 8 feet above the work surface.
B: Locating the switch in a location that is accessible to all occupants of the building.
C: Locating the switchÂ 8.5 feetÂ above the work surface.
D: Locating the switch 5 feet above the floor in a room accessible to unqualified persons.

Chapter 2

Question 20: 200.4 Neutral Conductors.

Question ID#: 634.0

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



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

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

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

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

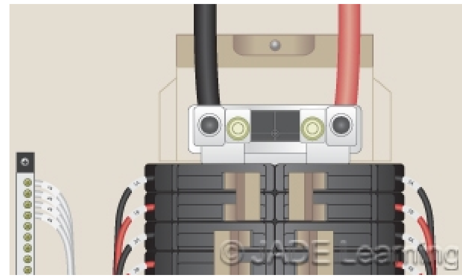
Question 20: When must neutral conductors associated with ungrounded conductors be grouped or marked within a junction box?

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

Question 21: 210.4(D) Multiwire Branch Circuits. Grouping.

Question ID#: 635.0

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



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

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

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

Question 21: Under the revised exception in the 2014 NEC, which of the following is true when using wire markers to identify the grounded or ungrounded conductors of a multiwire branch circuit in a panelboard?

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

Question 22: 210.5(C) Identification for Branch Circuits. Identification of Ungrounded Conductors.

Question ID#: 636.0

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

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

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

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

The conductor with positive polarity is identified by:

(1) A continuous red outer finish.

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

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

The conductor with negative polarity is identified by:

(1) A continuous black outer finish.

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

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

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

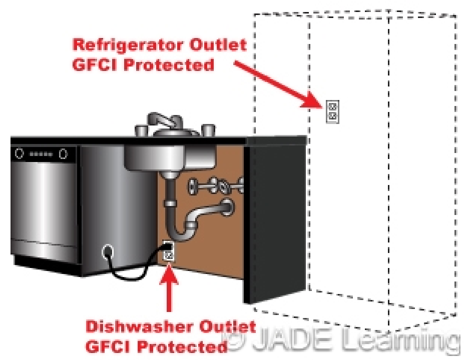
Question 22: Which of the following types of identification for ungrounded DC circuit conductors operating at more than 50 VDC is a Code Violation?

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

Question 23: 210.8(A)(7) Ground-Fault Circuit-Interrupter Protection for Personnel. Dwelling Units.

Question ID#: 637.0

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



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

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

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

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

Question 23: Which of the following dwelling unit receptacles is required to have GFCI protection?

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

Question 24: 210.8(A)(9) Ground-Fault Circuit-Interrupter Protection for Personnel. Dwelling Units. Bathtubs or Shower Stalls.

Question ID#: 638.0

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

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

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

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

Question 24: Which of the following 125-V, 15 & 20-A receptacle outlets would NOT require GFCI protection at a dwelling unit?

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

Question 25: 210.8(A)(10) Ground-Fault Protection for Personnel. Dwelling Units. Laundry Areas.

Question ID#: 639.0

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

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

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

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

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

GFCI receptacles in the laundry area must be readily accessible.

Question 25: Which of the following is an area that is NOT required to have all 125-volt, 15- and 20- ampere receptacle outlets protected by a GFCI type device in a residential dwelling?

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

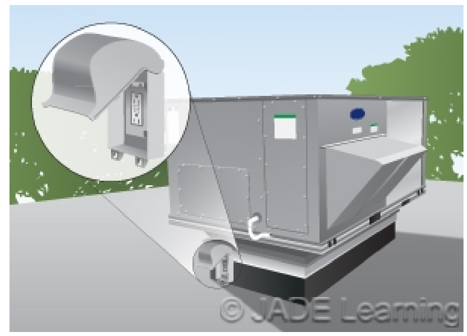
Question 26: 210.8(B) GFCI Protection for Personnel. Other Than Dwelling Units. Exception No. 1 to (3). Rooftops.

Question ID#: 640.0

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

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

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



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

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

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

Question 26: Which of the following statements about rooftop receptacles on non-dwelling rooftops is true?

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

Question 27: 210.8(B)(8) GFCI Protection for Personnel. Other Than Dwelling Units. Garages.

Question ID#: 641.0

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

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

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

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

Question 27: Which of the following receptacles does NOT require ground-fault circuit-interrupter protection?

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

Question 28: 210.8(D) GFCI Protection. Kitchen Dishwasher Branch Circuit.

Question ID#: 642.0

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

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

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

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

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

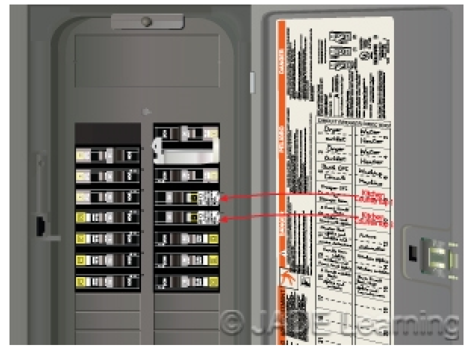
Question 28: Which of the following is a true statement?

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

Question 29: 210.12(A) Arc-Fault Circuit-Interrupter Protection. Dwelling Units.

Question ID#: 643.0

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



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

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

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

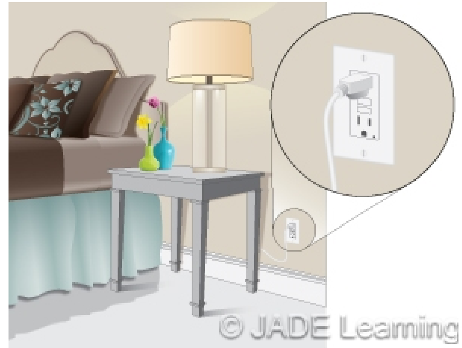
In the rooms and areas that require AFCI protection, devices and outlets must be protected. A device is a part of an electrical system, like a light switch, that carries or controls electric energy. An outlet, like a receptacle, is used to supply utilization equipment. In the 2014 edition of the NEC,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

Question 29: Which statement about Arc-Fault Circuit-Interrupter protection is true?

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

Question 30: 210.12(A)(1)-(6) Arc-Fault Circuit-Interrupter Protection. Dwelling Units.

Question ID#: 644.0



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

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

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

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

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

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

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

Question 30: A listed supplemental arc protection circuit breaker is installed at the origin of the branch circuit and a listed outlet branch-circuit type arc-fault circuit interrupter is installed at the first outlet box on the branch circuit.
If No. 14 AWG conductors are used for the branch circuit, what is the maximum distance between the branch-circuit overcurrent device and the first outlet?

A: 40 feet.

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

Question 31: 210.12(B) Exception. Branch Circuit Extensions or Modifications - Dwelling Units.

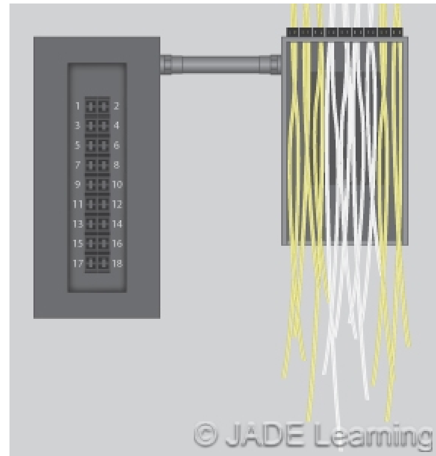
Question ID#: 645.0

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

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

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

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



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

Question 31: Which of the following installations will require AFCI protection?

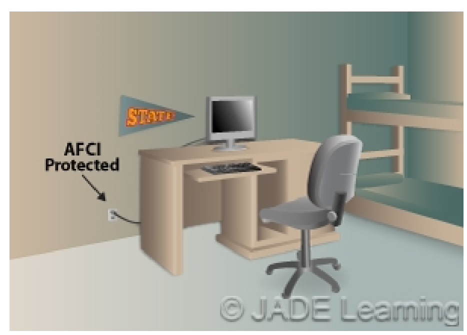
A: A 7 foot extension of an existing branch circuit serving an unfinished attic to add a new receptacle in the attic.
B: A 7 foot extension of an existing branch circuit to add a new receptacle in a family room.
C: A 7 foot extension of an existing branch circuit located in a bathroom to add an additional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

Question 32: 210.12(C) Dormitory Units.

Question ID#: 646.0

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

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



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

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

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

Question 32: In a college dormitory, which of the following locations requires AFCI protection?

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

Question 33: 210.13 Ground-Fault Protection of Equipment.

Question ID#: 647.0

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

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

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

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

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

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

Question 33: Which of the following installations will require ground-fault protection of equipment?

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

 (c)2025 JADE Learning, LLC

Question 34: 210.17 Electric Vehicle Charging Circuit.

Question ID#: 648.0

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

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

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

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

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

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

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

Question 34: How many different types of loads, other than electric vehicle chargers, are permitted on the electric vehicle charging circuit?

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

Question 35: 210.19(A)(1) Conductors - Minimum Ampacity and Size. Branch Circuits Not More than 600 Volts. General.

Question ID#: 649.0

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

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

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

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

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

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

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

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

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

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

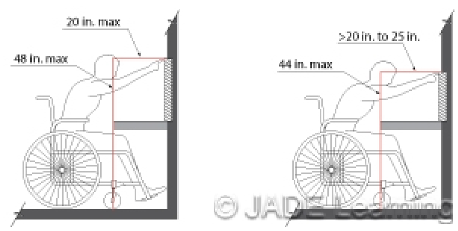
Question 35: What is the minimum size THWN cu. conductor required to supply a 50-amp continuous load with 7 current-carrying conductors in conduit (75Â°C terminals)?

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

Question 36: 210.50 Required Outlets. General.

Question ID#: 650.0

A new informational note has been added to section 210.50 that refers users to new Informative Annex J, ADA Standards for Accessible Design. ADA is the Americans with Disabilities Act. Informational notes contain explanatory information, are not written in mandatory language and do not contain requirements, interpretations, or recommendations.



A new Annex J contains information on ADA accessibility and recommendations. Obstructed High Forward Reach measurements shown above.

Annex J can be used as a reference by electrical installers when locating receptacle outlets in buildings that are required to be Accessible by the Standards for Accessible Design.

Annex J provides illustrations and Code references that come directly from ANSI/ICC A117.1-2009 ***Accessible and Usable Buildings and Facilities***.

The information contained in Annex J is general in nature and helps the user to understand reach range limitations based on front or side approach from those using wheelchairs as well as possible obstructions and how they affect those with physical disabilities. This information is helpful when considering where to locate receptacles, switches, or panelboards, especially when obstructions are present. Some jurisdictions do not adopt the ANSI standard referenced in Annex J and may have their own provisions that outline any special height requirements for electrical receptacles and switches as well as location or height of electrical panelboards and operable parts installed for those that are physically impaired.

Question 36: Which of the following locations in the NEC provides information useful to those installing receptacles in a building where ADA accessibility needs to be taken into consideration?

A: Annex B.
B: Annex C.
C: Annex J.
D: Annex D.

Question 37: 210.52(E)(1) Outdoor Dwelling Unit Receptacles.

Question ID#: 651.0

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

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

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

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

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

Question 37: If a receptacle outlet is installed on an outdoor deck, when can it be counted as one of the required outdoor receptacle outlets at a one-family dwelling?

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

Question 38: 210.52(E)(3) Balconies, Decks, and Porches.

Question ID#: 652.0

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

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

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

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

Question 38: Which of the following statements about the required receptacle outlet at a balcony, deck, or porch is true?

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

Question 39: 210.52(G) Receptacle Outlets. Basements, Garages, and Accessory Buildings.

Question ID#: 653.0

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

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

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

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

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

Question 39: What is the MINIMUM number of receptacle outlets required for a three car garage in a one-family dwelling?

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

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

Question ID#: 654.0

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

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

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

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

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

Question 40: How many receptacle outlets are required in a foyer that has an area greater than 60 sq. ft. and has a 4 foot wall space on each side of the front door and two 2 foot wall spaces opposite the door?

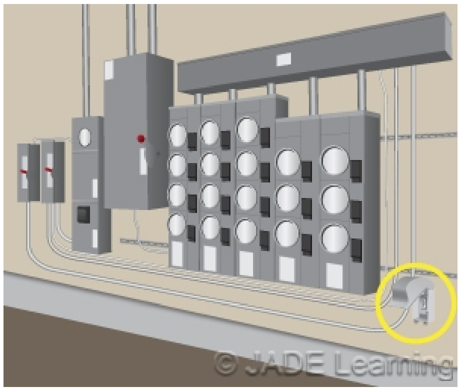
A: 1 receptacle outlet.
B: 2 receptacle outlets.
C: 3 receptacle outlets.
D: 4 receptacle outlets.

Question 41: 210.64 Electrical Service Areas.

Question ID#: 655.0

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

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



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

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

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

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

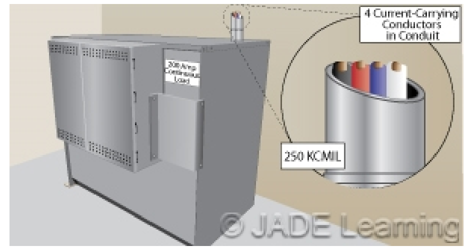
The 15- or 20-ampere rated receptacle outlet must be installed in the "electrical service area," whether that is indoors or outdoors. If outdoors, the receptacle must be weather- resistant and the enclosure suitable for a wet location.

Question 41: Which of the following receptacle outlets complies with the minimum requirements for receptacles installed in the electrical service area?

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

Question 42: 215.2(A)(1) Minimum Rating and Size. Feeders Not More Than 600 Volts.

Question ID#: 656.0



Conductors will be sized to carry not less than the larger of 215.2(A)(1)(a) or (b).

This Code change for feeders, like the one for branch circuits in 210.19(A)(1), clears up how to determine the correct size conductor when the load on the feeder is (1) continuous and (2) there are more than 3 current-carrying conductors in a raceway or the ambient temperature is above 86Â°F.

The conductor size for a feeder is determined by comparing the size needed to supply the continuous load with the size needed because of the "conditions of use" (more than 3 current carrying conductors or an ambient temperature above 86Â°F), and ***selecting the larger of the two conductors***.

For example: What size THWN cu. conductor is needed to supply a 200 amp continuous load when there are 4 current-carrying conductors in conduit?

Step 1 200 amp continuous load x 125% = 250 amps (125% from 215.2(A)(1)(a))
Conductor size = 250 kcmil cu. chosen from Table 310.15(B)(16).

Step 2 4 current-carrying conductors in conduit = 80% adjustment (from Table 310.15(B)(3)(a))
250 kcmil cu. = 255 amps. 255 amps x 80% = 204 amps. The 250 kcmil conductor can carry the 200 amp load after being derated.

Step 3 Select the larger of the two conductors
Both calculations result in a 250 kcmil, THWN cu. conductor chosen from Table 310.15(B)(16)

A calculation that added the continuous load (250 amps) and the adjustment factor for 4 current-carrying conductors in conduit (250 amps / .8 = 312.5 amps) would require a 400 kcmil, THWN cu. conductor which is larger than necessary.

Question 42: Assuming 75Â° terminals are used, what minimum size THWN cu. conductor is needed to supply a 75 amp continuous load when there are 4 current-carrying conductors in conduit?

A: No. 4 THWN cu.
B: No. 3 THWN cu.
C: No. 2 THWN cu.
D: No. 1 THWN cu.

Question 43: 215.12(C)(2) Identification for Feeders. Identification of Ungrounded Conductors. Feeders Supplied from Direct-Current Systems.

Question ID#: 657.0

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

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

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

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

The conductor with positive polarity is identified by:

(1) A continuous red outer finish.

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

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

The conductor with negative polarity is identified by:

(1) A continuous black outer finish.

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

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

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

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

Question 43: If a feeder conductor with black insulation is used as a "positive" conductor to carry 80 volts DC, which of the following must apply so that it could be re-identified with red tape?

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

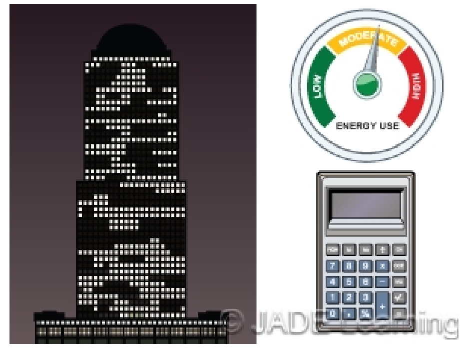
Question 44:   220.12 Lighting Load for Specified Occupancies. Exception.

Question ID#: 658.0

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

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

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



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

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

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

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

Question 44:   When can the exception to Section 220.12 be used?

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

Question 45: 225.10 Wiring on Buildings (Or Other Structures).

Question ID#: 659.0

Many times wiring is installed on structures other than buildings, such as walls, poles, towers, or tanks that are not by definition "buildings". The phrase "or other structures" has been added in many locations in the NEC when "wiring on buildings" is discussed.

Also, with DC system voltages such as those used with larger solar photovoltaic arrays and wind generation systems now having output voltages above 600 volts, the voltage threshold limit has been increased from 600 volts to 1,000 volts.

As per 225.10, the approved outside wiring methods on buildings or other surfaces for circuits not over 1,000 volts are allowed to be installed as open wiring on insulators, multiconductor cable, MC cable, Type UF cable, MI cable, messenger-supported wiring, rigid metal conduit (RMC), intermediate metal conduit (IMC), rigid polyvinyl chloride (PVC), reinforced thermosetting resin conduit (RTRC), cable trays, cablebus, wireways, auxiliary gutters, electrical metallic tubing (EMT), flexible metal conduit (FMC), liquidtight flexible metal conduit LFMC), liquidtight flexible nonmetallic conduit (LFNC), and in busways. The abbreviations for wiring methods, RMC, IMC, EMT, FMC, LFMC and LFNC have been added.

225.10 requirements for wiring on buildings have been expanded to other structures including towers and poles.

Question 45: Which of the following wiring methods is NOT approved for wiring on the outside of a building or other structure?

A: Electrical Metallic Tubing (EMT).
B: Nonmetallic Sheathed Cable (NMC).
C: Polyvinyl Chloride (PVC).
D: Flexible Metal Conduit (FMC).

Question 46: 225.36 Buildings or Other Structures Supplied By a Feeder or Branch Circuit. Type.

Question ID#: 660.0

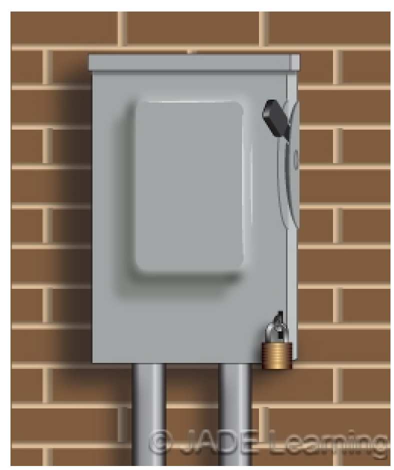
Two important changes have been made to this section about the disconnecting means for buildings supplied by an outside branch circuit or feeder.

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

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

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

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



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

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

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

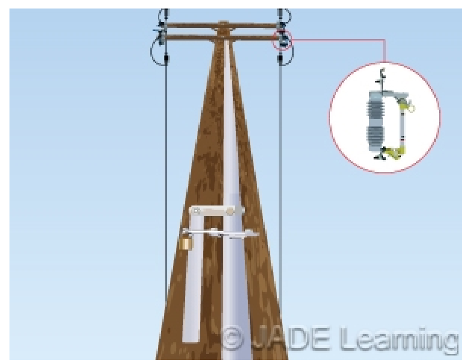
Question 46:   Which of the following is NOT permitted to be used to disconnect a single phase, 120/240-volt, 20-amp branch circuit that supplies power to a new residential outbuilding?

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

Question 47:   225.52(A) Disconnecting Means. Location.

Question ID#: 661.0

There are now three options for locating the disconnecting means for outside feeders and branch circuits rated over 1000 volts. The same options existed for services rated over 1000 volts in the 2011 NEC.



The disconnecting means can be operable by mechanical linkage from a readily accessible point.

The disconnecting means for outside feeders and branch circuits rated over 1000 volts can be installed:

- Inside or outside of the building or structure served or where the conductors pass through the building or structure at a readily accessible location nearest the point of entrance of the conductors.
- If not readily accessible, the disconnecting means can be operable by mechanical linkage from a readily accessible point.
- For multibuilding industrial installations under single management, the disconnecting means can be electrically operated by a readily accessible, remote-control device in a separate building or structure.

What is common to all three methods for disconnecting outside feeders and branch circuits rated over 1000 volts is that the disconnecting means must be readily accessible. Whether the disconnect is manually operated from a switch, is located out of reach but operated by a mechanical linkage, or located in an industrial location and operated by a remote-control device, the disconnecting means must be readily accessible.

Readily accessible means the disconnect can be reached quickly without climbing over or removing obstacles, or using portable ladders or tools.

With high voltage feeders and branch circuits rated over 1000 volts, it is critical to provide extra protection for energized circuits. Allowing the disconnecting means to be operated remotely or by a mechanical linkage keeps the physical disconnect out of reach but quickly accessible if the need arises.

Question 47: When can the disconnecting means for a 12,470-volt outside feeder be located 15 feet above grade on the wall of a building?

A: When it is equipped with mechanical linkage to operate the disconnect switch that extends down to a readily accessible location.
B: When it is equipped with mechanical linkage to operate the disconnect switch that is also located 15 feet above grade.
C: When it is located in a commercial building and operable by remote control.
D: When it is located in an industrial building under single management.

Question 48: 225.56 Inspections and Tests.

Question ID#: 662.0

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

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

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

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

Question 48: Which of the following items are required to undergo pre-energization tests after the initial installation is complete?

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

Question 49: 225.70 Substations (Deleted).

Question ID#: 663.0

The section on substations operating at over 1000 volts has been moved from 225.70 to 490.48. Article 490, which deals with equipment over 1000 volts, is a more appropriate location for substations, since they can be located inside or outside, and Article 225 is relevant to branch circuits and feeders located ***outside only***.

Most electrical substations are owned and operated by the serving utility company. According to Section 90.2(B), installations under the exclusive control of an electric utility are not within the scope of the NEC. There are, however, many large industrial buildings and facilities that contain indoor or outdoor substations that are on ***private*** property and therefore do fall within the requirements of the NEC.

Many of the user-owned substations are installed to supply electric power within a certain voltage or frequency range, providing electrical energy at the lowest cost to large industrial facilities, contributing to an electrical design that creates the shortest possible fault duration, and providing for optimum energy usage and efficiency for a specific client. The NEC requires posting of permanent, legible signs warning of electrical hazards present at these user-owned substations.

The requirements for substations in 225.70 have been moved to 490.48.

NEC section 490.48 requires documentation regarding substation design, to be available to the Authority Having Jurisdiction.

Question 49: Which of the following statements about substations is true?

A: In the 2014 NEC information about substations is located in Article 225.
B: The National Electrical Code provides guidelines for the design of substations owned by the utility company.
C: Requirements for substations installed outdoors are located in Article 225. Regulations for substations installed indoors are located in Article 490.
D: The Authority Having Jurisdiction can request a set of substation design drawings.

Question 50: 230.28 Service Masts as Supports.

Question ID#: 664.0

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

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

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

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

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

Question 50: Which of the following statements about a rigid metal conduit service mast is true?

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

Question 51: 230.30 Underground Service Conductors. Installation.

Question ID#: 665.0

Section 230.30 now includes requirements about the installation of underground service conductors rather than only the conductor insulation requirements. The section has been reorganized to include subsections (A) and (B).

The term "service lateral conductors" has been replaced with "underground service conductors" in section 230.30(A) but the remaining text within the section regarding underground service conductor insulation requirements as well as the 4 exceptions that follow remain unchanged.

230.30(B) lists the specific wiring methods that are permitted to be used when installing underground service conductors and refers the user to the appropriate Code sections for the requirements based on the type of wiring method chosen. The following ten wiring methods are currently the only permitted wiring methods that can be used when installing underground service conductors:

There are currently 10 permitted wiring methods for underground service conductors.

- Type RMC conduit
- Type IMC conduit
- Type NUCC conduit
- Type HDPE conduit
- Type PVC conduit
- Type RTRC conduit
- Type IGS cable
- Type USE conductors or cables
- Type MV or type MC cable identified for direct burial applications
- Type MI cable, where suitably protected against physical damage and corrosive conditions.

It is important not to confuse the requirements in 230.30 with similar Code language found in section 230.43 which outlines 19 different wiring methods permitted to be used for service-entrance conductors of 1000 volts or less. Section 230.30 is in part III of Article 230 which is titled Underground Service Conductors. Section 230.43 is in part IV of Article 230 which is titled Service-***Entrance*** Conductors.

Service conductors and service-entrance conductors, underground or overhead, have different definitions in Article 100. Applying the appropriate code section can be tricky. For example, underground service conductors can enter a dwelling through a foundation wall into a basement where the service equipment is located. On the exterior of the dwelling, below grade, the conductors are considered underground service conductors and are subject to the requirements in 230.30. As soon as the conductors pass through the wall and are no longer underground, they are considered service-entrance conductors and subject to the requirements in 230.43.

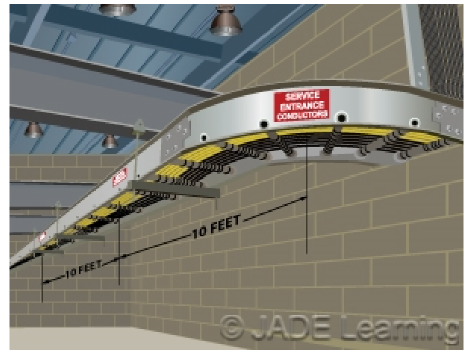
Question 51: Which of the following wiring methods is permitted to be used for underground service conductors?

A: Type RTRC conduit.
B: Type FMC conduit.
C: EMT.
D: Type LFNMC conduit.

Question 52: 230.44 Cable Trays.

Question ID#: 666.0

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



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

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

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

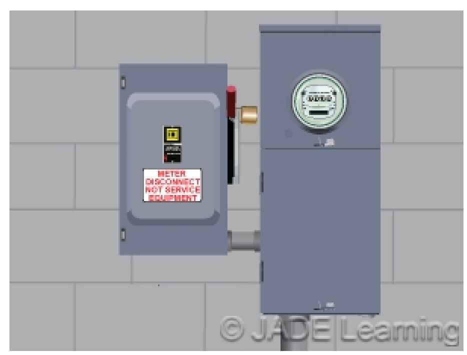
Question 52: What is required when a cable tray is used to support 350 kcmil copper service-entrance conductors?

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

Question 53: 230.82 Equipment Connected to the Supply Side of Service Disconnect.

Question ID#: 667.0

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



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

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

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

METER DISCONNECT
NOT SERVICE EQUIPMENT

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

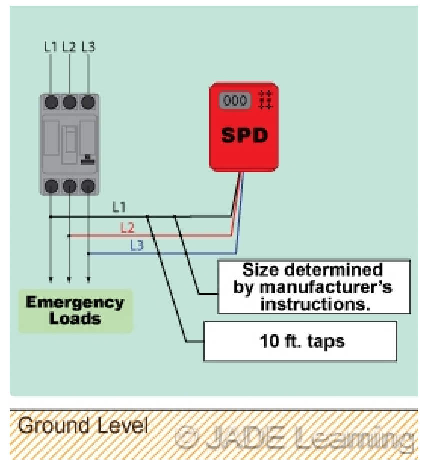
An agreement between installers and inspectors about where exactly the service disconnecting means is located is very important. With meter disconnects located on the supply side of the service clearly labeled, there is less chance that the meter disconnect will be mistaken for the service disconnect.

Question 53: Which of the following meter disconnect installations would be acceptable to the Authority Having Jurisdiction?

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

Question 54: 240.21(B)(1) Location in Circuit. Feeder Taps. Taps Not Over 3 m (10 ft.) Long.

Question ID#: 668.0



Listed equipment with specific instructions on conductor sizing can use the manufacturer's instructions to determine conductor ampacity for feeder taps not over 10 ft. long.

The ten foot tap rule found in section 240.21(B)(1) has been revised for clarity, and a new exception has been added about the conductor ampacity requirements for listed equipment such as surge protective devices (SPD).

A feeder tap is when a smaller conductor receives its power from a larger conductor that is protected at a higher ampacity than the smaller conductor. In this type of installation, there is no overcurrent protection required at the tap connection (the point where the smaller conductor receives its supply) as long as all of the tap rules are followed.

There are four provisions that must be met in order to comply with the ten foot tap rule requirements in 240.21(B)(1).

Section 240.21(B)(1)(1)(b) previously required the ampacity of the tap conductors to be not less than the rating of the "device" supplied by the tap conductors or not less than the rating of the overcurrent protective device at the termination of the tap conductors.

The revised text clarifies that the ampacity of the tap conductors shall not be less than the rating of the "equipment containing an overcurrent device(s)" supplied by the tap conductors or not less than the rating of the overcurrent protective device at the termination of the tap conductors.

For example, if 150 amp fuses are used in a 200 amp fusible disconnect, the tap conductors are required to be rated for 150 amps.

A new exception has been added which allows listed equipment, such as surge protective devices (SPDs) that are provided with specific instructions on minimum conductor sizing, to have the ampacity of the tap conductors supplying such equipment to be determined based on the manufacturer's instructions.

Question 54: A 125 amp main breaker is installed in a 150 amp rated panelboard. The panelboard is supplied by an 8 ft. feeder tap. What is the minimum required ampacity ratingÂ of the 8 ft. tap conductors?

A: At least the same ampacity as the feeder.
B: 150 amps.
C: 400 amps.
D: 125 amps.

Question 55: 240.87 Arc Energy Reduction.

Question ID#: 669.0

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

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

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

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

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

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

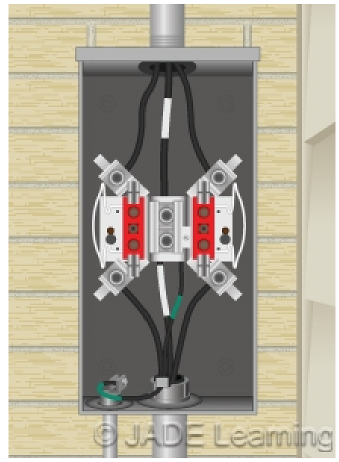
Question 55: Which of the following installations will require that documentation about the location of the circuit breaker be made available to those authorized to inspect the installation?

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

Question 56: 250.24(A)(1) Grounding Service-Supplied Alternating-Current Systems. System Grounding Connections. General.

Question ID#: 670.0

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



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

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

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

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

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

Question 56: Which of the following is an acceptable location for proper termination of a grounding electrode conductor?

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

Question 57: 250.30 Grounding Separately Derived Alternating-Current Systems.

Question ID#: 671.0

Multiple separately derived systems connected in parallel must comply with 250.30.

A new sentence has been added which reminds installers that multiple separately derived systems that are connected in parallel must be installed according to 250.30.

In section 250.30(A) for grounded systems, a system bonding jumper or supply-side bonding jumper must be installed. A grounded conductor and grounding electrode are required. A grounding electrode conductor can be installed for a single separately derived system, or a common grounding electrode for multiple separately derived systems is permitted.

If a common grounding electrode conductor is installed for multiple separately derived systems, the common grounding electrode conductor is used to connect the grounded conductor of the separately derived systems to the grounding electrode. The minimum size of the common grounding electrode conductor is 3/0 AWG copper or 250 kcmil aluminum. A grounding electrode conductor tap is installed from each separately derived system to the common grounding electrode conductor. Each tap conductor is sized in accordance with 250.66 based on the derived ungrounded conductors of the separately derived system it serves.

Often, large facilities choose to install multiple separately derived systems that operate in parallel with one another. It is much more efficient to install several smaller generators and connect them in parallel than to have one large generator carrying the total load.

Other benefits of these parallel systems include the following:

- Multiple transformers or generators operating in parallel increases power reliability since failure of any one of them does not cause a total loss of power.
- Multiple transformers or generators operating in parallel allow one or more of them to be shut down during servicing without affecting the entire electrical system.

Question 57: What is the minimum size grounding electrode conductor required if used as a common grounding electrode conductor to interconnect multiple separately derived systems connected in parallel?

A: 250 kcmil aluminum.
B: 250 kcmil copper.
C: 3/0 aluminum.
D: 2/0 copper.

Question 58: 250.64(B) Grounding Electrode Conductor Installation. Securing and Protection Against Physical Damage.

Question ID#: 672.0

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

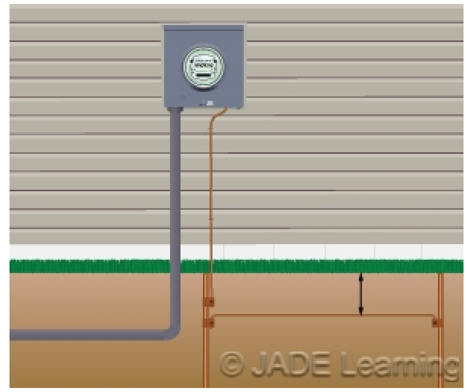


Table 300.5 does not apply to buried grounding electrode bonding jumpers.

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

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

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

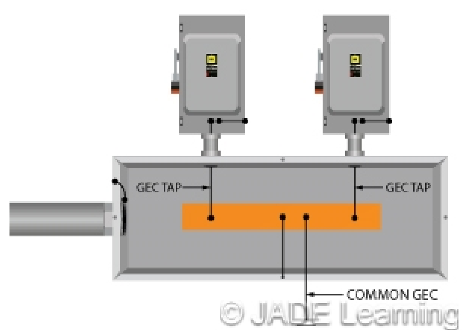
Question 58: What is the minimum burial depth required for a No. 4 AWG copper grounding electrode bonding jumper that connects two ground rods spaced 6 feet apart and not subject to physical damage?

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

Question 59: 250.64(D) Grounding Electrode Conductor Installation. Building or Structure with Multiple Disconnecting Means in Separate Enclosures.

Question ID#: 673.0

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



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

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

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

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

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

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

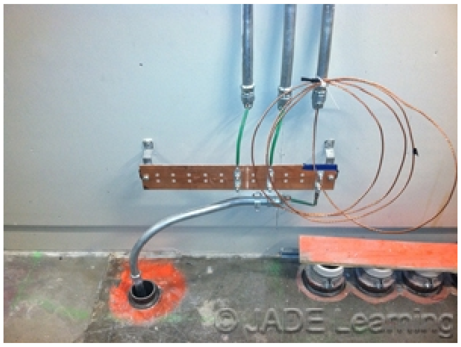
Question 59: A service location at a building consists of 3 individual service enclosures connected to a common wireway which contains service-entrance conductors. If a grounding electrode conductor tap is used for one of the individual service enclosures, how is the tap required to be sized?

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

Question 60: 250.64(E) Raceways and Enclosures for Grounding Electrode Conductors.

Question ID#: 674.0

Most of the changes to this section are editorial. A single long paragraph in the 2011 NEC has been broken into 4 parts. The title to the section also has been changed to include raceways as well as enclosures that contain a grounding electrode conductor.



Ferrous metal raceways and enclosures shall be bonded at each end of the raceway or enclosure to the grounding electrode or grounding electrode conductor.

The main point of the section remains the same: ferrous metal raceways and enclosures that contain a grounding electrode conductor must be electrically continuous from the point of attachment to the cabinet or equipment all the way to the grounding electrode. The raceways or enclosures must be bonded at each end of the raceway or enclosure to the grounding electrode or the grounding electrode conductor.

The method for bonding at each end of the raceway or enclosure can be done by any 1 of 3 ways, according to 250.92(B)(2)-(4):

- Connections utilizing threaded couplings or threaded hubs on enclosures if made up wrenchtight.
- Threadless couplings and connectors if made up tight for metal raceways and metal-clad cables.
- Other listed devices, such as bonding-type locknuts, bushings, or bushings with bonding jumpers.

When a bonding jumper is used, it must be the same size or larger than the enclosed grounding electrode conductor.

Question 60: WhereÂ must ferrous metal raceways containing grounding electrode conductors be bonded?

A: To either end of the metal raceway enclosing the grounding electrode conductor.
B: To an equipment grounding conductor.
C: At each end of the metal raceway enclosing the grounding electrode conductor.
D: By exothermic welding only.Â Â

Question 61: 250.66 (A)&(B) Connections to a Rod, Pipe, or Plate and Concrete-Encased Electrode(s).

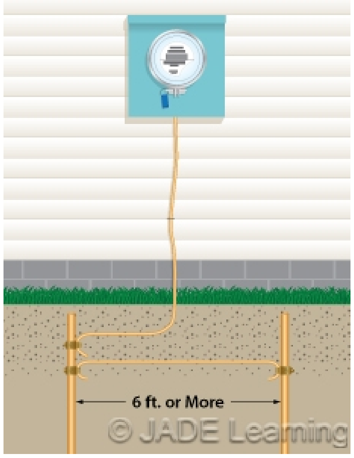
Question ID#: 675.0

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

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

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

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



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

Question 61: If two ground rods are installed for a 400 amp service, what is the maximum required size for a copper grounding electrode conductor connected to a rod, pipe, or plate electrode?

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

Question 62: 250.68(C) Grounding Electrode Connections.

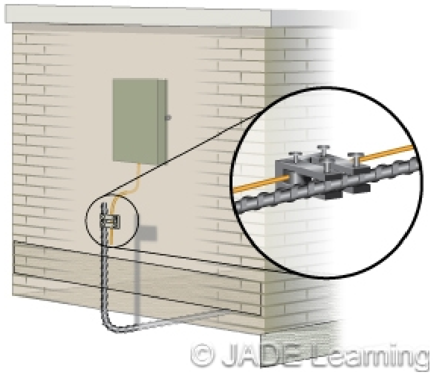
Question ID#: 676.0

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

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

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

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



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

Question 62: Which of the following statements about a concrete-encased electrode is true?

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

Question 63: Table 250.102(C)(1) Grounded Conductor, Main Bonding Jumper, System Bonding Jumper, and Supply Side Bonding Jumper for Alternating-Current Systems.

Question ID#: 677.0

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

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

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

© JADE Learning

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

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

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

Question 63: What is the minimum size, (copper) main bonding-jumper that is required when the ungrounded conductor size is 500 kcmil copper?

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

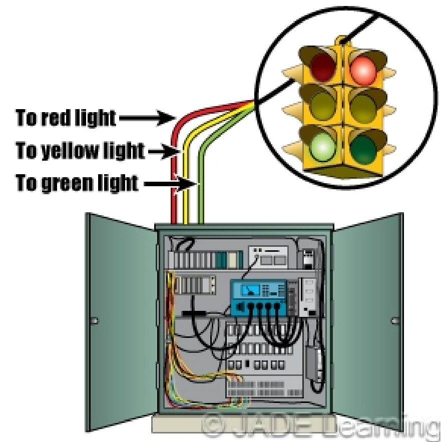
Question 64: 250.119 Identification of Equipment Grounding Conductors.

Question ID#: 678.0

The identification of equipment grounding conductors has always been understood to be either green in color, green with one or more yellow stripes, or a bare conductor.

The exception has been for power-limited Class 2 or Class 3 cables used in fire alarm or communications systems that operate at less than 50 volts. These applications are allowed to have a current-carrying conductor green in color where the equipment served does not need to be grounded.

A new exception has been added for flexible cords. The outer finish of a cord can be green in color if there is no equipment grounding conductor in the cord, and the insulation and jacket are integral to the cord. Without an equipment grounding conductor, the cord can only be used for connecting equipment which is not required to be grounded, and the cord with the green outer finish is not likely to be confused with an equipment grounding conductor.



In traffic signals, wire-type equipment grounding conductors can be bare or green with one or more yellow stripes.

Another new exception has been added for traffic signal work. Signaling circuits for this industry have a standing practice of using a green conductor as a signaling circuit conductor for the green traffic signal light. Since traffic signal work is performed and maintained by qualified technicians, an exception for this application can now be applied.

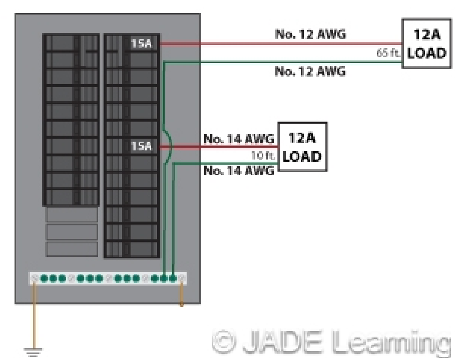
Question 64: When can the outer finish of a cord be green?

A: When the grounded conductor is green with a yellow stripe.
B: When the cord is part of a listed assembly.
C: When the cord is connected to a grounded power source and does not contain an equipment grounding conductor.
D: When the cord has integral insulation and no equipment grounding conductor.

Question 65: 250.122(B) Size of Equipment Grounding Conductors. Increased in Size.

Question ID#: 679.0

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



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

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

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

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

Question 65: If the copper ungrounded conductors for a circuit are increased in size by 25% because there are 4 current-carrying conductors in conduit, which of the following statements about the equipment grounding conductor is true?

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

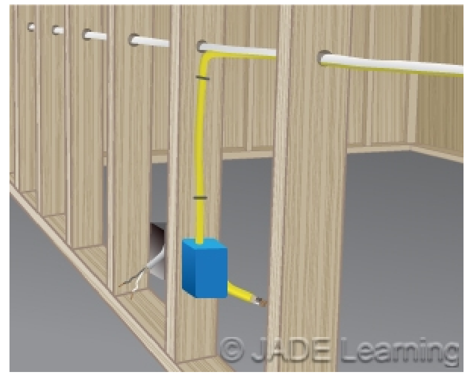
Question 66: 250.130(C) Nongrounding Receptacle Replacement or Branch Circuit Extensions.

Question ID#: 680.0

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

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

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



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

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

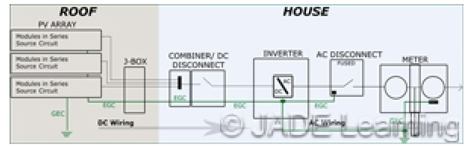
Question 66: Which of the following is NOT an acceptable method to properly ground a grounding-type receptacle installed to replace a non-grounding receptacle in an existing branch-circuit which does not include an equipment grounding conductor?

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

Question 67:   250.166 Size of the Direct-Current Grounding Electrode Conductor.

Question ID#: 681.0

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



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

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

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

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

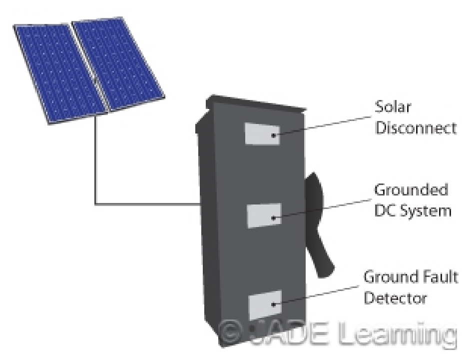
Question 67:   What is the required size for a copper grounding electrode conductor connected to building steel in a DC system with two, 250 kcmil ungrounded conductors connected in parallel per phase?

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

Question 68:   250.167 Direct-Current Ground-Fault Detection.

Question ID#: 682.0

With new technology advancements associated with solar photovoltaic systems, battery systems, and other DC systems, the NEC is updating articles relating to these systems.



Ungrounded DC systems now require ground-fault detection systems.

The 2011 NEC did not address ground-fault detection for DC systems. Some DC systems don't utilize a grounded system, and a method of sensing ground faults is especially necessary to prevent fires and shock hazards.

New Section 250.167 requires that ungrounded DC systems have ground-fault detection, and grounded systems shall be permitted to have ground fault detection.

Section 250.167(C) spells out how the marking for direct-current systems must be done.   DC systems must be legibly marked to indicate the grounding type at the DC source or at the first disconnecting means. The type of marking used must be suitable for the environment involved.

Question 68: Which type of DC system is required to have ground-fault sensing equipment?

A: An ungrounded system.
B: A grounded system.
C: A grounded system with a neutral conductor.
D: A grounded system without a neutral conductor.

Question 69: 250.186 Ground-Fault Circuit Conductor Brought to Service Equipment.

Question ID#: 683.0

The purpose of 250.186 is to provide a ground-fault circuit path for fault current that will open an overcurrent device if there is a ground-fault on the system.

Section 250.186 is in Part X of Article 250, Grounding of Systems and Circuits of over 1kV. This is the first time in the NEC that the requirements for a ground-fault circuit conductor at the service equipment have been spelled out. Similar requirements for ac systems operating at 1000 volts or less are found in 250.24(C).

There are two parts to 250.186. Section 250.186(A) is for when a grounded conductor is brought to the service equipment. Section 250.186(B) is for systems without a grounded conductor at the service point.

The purpose of both sections is to provide a ground-fault circuit path for fault current that will open an overcurrent device if there is a ground-fault on the system.

If a grounded conductor is brought to the service equipment, 250.186(A), then a grounded conductor must be installed and routed with the ungrounded conductors to each service disconnecting means and connected to the grounded conductor terminal or bus. A main bonding jumper is required to connect the grounded conductor to the service disconnecting means enclosure.

If a grounded conductor is not brought to the service point, 250.186(B), a supply-side bonding jumper must be installed and routed with the ungrounded conductors to each service disconnecting means, and connected to each disconnecting means equipment grounding terminal or bus.

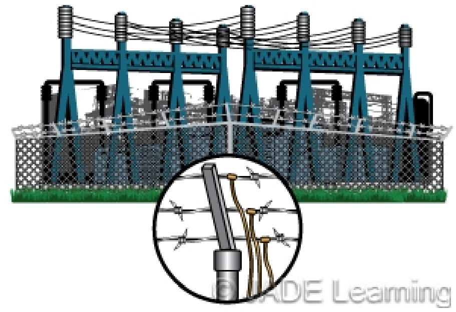
The requirements for sizing the grounded conductor or the supply-side bonding jumper are similar to the requirements for systems of 1000 volts or less. The grounded conductor or supply-side bonding jumper cannot be smaller in size than the grounding electrode conductor from Table 250.66. For parallel raceways, the size of the grounded conductor or supply side bonding jumper is based on the size of the ungrounded conductors in the raceway.

Question 69: If a grounded conductor is provided at the service point for a 12,470-volt alternating- current electrical service, which of the following is required?

A: A system bonding jumper must connect the grounded conductor to each service disconnecting means enclosure.
B: A main bonding jumper must connect the grounded conductor to each service disconnecting means enclosure.
C: An aluminum busbar must connect the grounded conductor to each service disconnecting means enclosure.
D: An insulated busbar must connect the equipment grounding conductor to each service disconnecting means enclosure.

Question 70: 250.194 Grounding and Bonding of Fences and Other Metal Structures.

Question ID#: 684.0



Metallic fences around substations are now required to be grounded and bonded.

Section 250.194 is new in the 2014 NEC and was added to address the grounding of metal fences and structures around substations. These requirements are located in Part X of Article 250, Grounding of Systems and Circuits of over 1 kV.

The new section requires that metal fences and other metal structures in or surrounding a substation with exposed electrical conductors and equipment shall be grounded and bonded to limit step, touch, and transfer voltages. The intent of the new section is to provide protection to the general public that may come in contact with the enclosures that are put in place to guard the energized equipment from unauthorized personnel.

250.194(A) requires that when metal fences are located within 5 m (16 ft.) of the exposed electrical conductors or equipment, the fence shall be bonded to the grounding electrode system with wire-type bonding jumpers as follows:

- Bonding jumpers shall be installed at each fence corner and at maximum 50m (160 ft.) intervals along the fence.
- Where bare overhead conductors cross the fence, bonding jumpers shall be installed on each side of the crossing.
- Gates and gate support posts shall be bonded to the grounding electrode system.
- Any gate or other opening in the fence shall be bonded across the opening by a buried bonding jumper.
- The grounding grid or grounding electrode systems shall be extended to cover the swing of all gates.
- The barbed wire strands above the fence shall be bonded to the grounding electrode system.

Alternate designs performed under engineering supervision shall also be permitted for grounding or bonding of metal fences. Section 250.194(B) specifies that ***all exposed conductive metal structures, including guy wires within 2.5 m (8 ft.) vertically or 5 m (16 ft.) horizontally of exposed conductors or equipment and subject to contact by persons, shall be bonded to the grounding electrode systems in the area***.

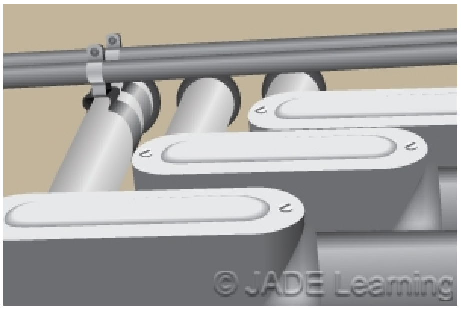
Question 70: Which of the following items is required to be bonded at a 15,000-volt substation?

A: A wooden gate located 10 feet from exposed electrical conductors.
B: A metal fence located 25 feet from exposed electrical conductors.
C: A metal gate post located 15 feet from exposed electrical conductors.
D: A metal gate located 16.5 feet from exposed electrical conductors.

Chapter 3

Question 71: 300.11(B)(1) Securing and Supporting. Raceways Used as Means of Support.

Question ID#: 685.0



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

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

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

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

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

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

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

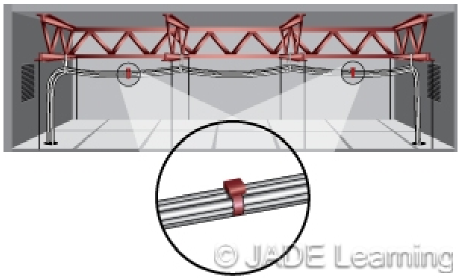
- Where the raceway or means of support is identified ***as a means of support.***
- Where the raceway contains power supply conductors for electrically controlled equipment and is used to support Class 2 circuit conductors or cables that are solely for the purpose of connection to the equipment control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

Question 71: Which of the following is required for raceways to support luminaires?

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

Question 72: 300.22(C)(1) Other Spaces Used for Environmental Air (Plenums). Wiring Methods.

Question ID#: 686.0



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

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

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

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

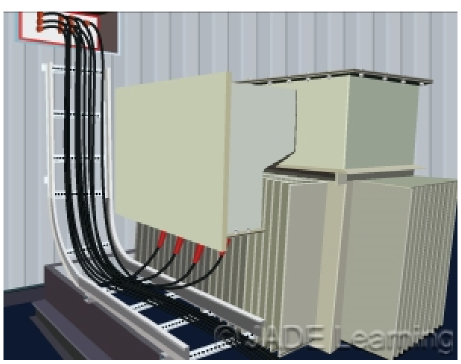
The new informational note after this section refers to ANSI/UL 2043-2008, ***Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces*** which is a publication commonly used to determine flame spread and smoke density levels of products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

Question 72: Which of the following wiring methods is permitted to be installed in a plenum?

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

Question 73: 300.38 Raceways in Wet Locations Above Grade.

Question ID#: 687.0



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

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

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

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

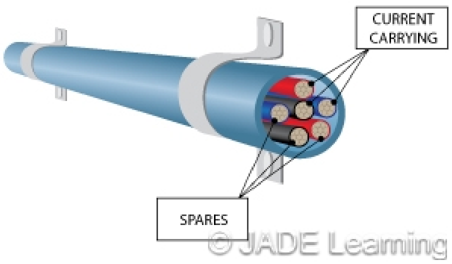
Conductors and cables for circuits over 1000 volts are required to be listed for wet locations, have a moisture-impervious metal sheath, or have an outer insulation which is type MTW, RHW, RHW-2, TW, THW, THW-2, THHW, THWN, THWN-2, XHHW, XHHW-2, ZW.

Question 73: Which of the following conductor insulation types could be used for an outdoor 480 volt feeder installed in a raceway?

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

Question 74: Table 310.15(B)(3)(a) Adjustment Factors for More Than Three Current-Carrying Conductors.

Question ID#: 688.0



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

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

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

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

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

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

Question 74: According to Table 310.15(B)(3)(a), what percentage is required to be used when applying correction factors to 12 current-carrying conductors and 9 spare conductors within the same 10 foot length of electrical metallic tubing?

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

Question 75: 310.15(B)(3)(c) Exception And Table. Raceways and Cables Exposed to Sunlight on Rooftops.

Question ID#: 689.0

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

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

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

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

A study of XHHW-2 conductors installed in raceways on rooftops found they were not damaged by extreme heat.Â A new exception allows XHHW-2 conductors to be used in raceways on rooftops without adding the increased temperatures of Table 310.15(B)(3)(c).

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

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

Question 75: What is the total ambient temperature that must be used for conductors (that are NOT type XHHW-2) in a raceway that is mounted 6 inches above a rooftop and the ambient temperature is 80Â°F?

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

Question 76: 310.15(B)(7) 120/240-Volt, Single-Phase Dwelling Services and Feeders.

Question ID#: 690.0

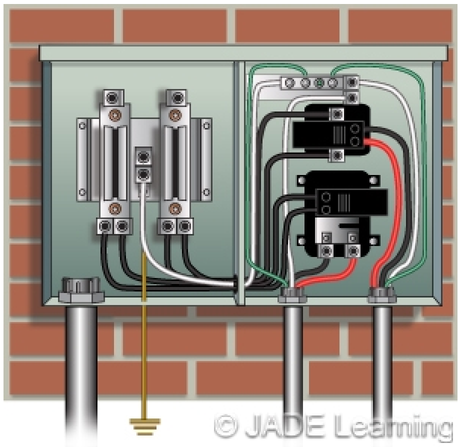


Table 310.15(B)(7) had been deleted, and now the sizes are calculated to be not less than 83% of the service or feeder rating.

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

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

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

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

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

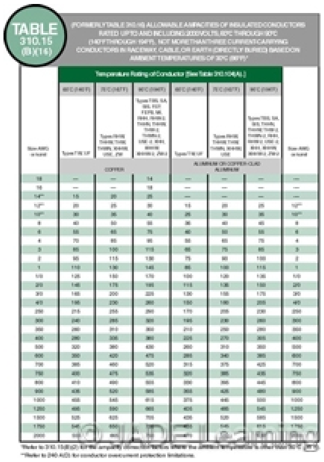
Because using the 83% calculation is limited to service conductors and feeders that supply the entire load, the service conductors that feed a one-family dwelling can be selected based on 83% of the rating of the service, but the feeder conductors that supply a subpanel that does not carry the total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

Question 76: What are the minimum size copper, THWN service conductors for a 200-amp service, 120/240 volt, 3-wire, single-phase, where the conductors carry the entire load of the dwelling? Assume 75 degree C terminals.

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

Question 77: 310.15(B)(7) and Informative Annex D. Example D7. Sizing of Service Conductors for Dwellings(s).

Question ID#: 691.0



Section 310.15(B)(7) has replaced Table 310.15(B)(7).Â Service and feeder conductors can be selected that have an ampacity of 83% of the service or feeder rating if the conductors carry the entire load.

A new example, D7 in Annex D, refers to 310.15(B)(7).Â Section 310.15(B)(7) has replaced Table 310.15(B)(7) and is used to select a service or feeder conductor for dwellings that are supplied by a 120/240 volt, 3-wire, single-phase system rated between 100 and 400 amps.Â

Service and feeder conductors can be selected that have an ampacity of 83% of the service or feeder rating if the conductors carry the entire load associated with the dwelling unit.Â

Example D7 is based on a 175-ampere rated dwelling service where the conductors are supplied by a 120/240 volt, 3-wire, single-phase system.

- 175-amperes x 0.83 = 145.25 amperes per 310.15(B)(7).
- If no other adjustments or corrections are required for the installation, then, in accordance with Table 310.15(B)(16), a 1/0 AWG Cu or a 3/0 AWG Al meets this rating at 75Â°C.

Conductors for circuits rated over 100 amps are selected from the 75Â°C column of Table 310.15(B)(16), unless the equipment terminals are rated 60Â°C.

Question 77: What are the minimum size copper service conductors for a 150-amp service, 120/240 volt, 3-wire, single-phase, where the conductors carry the entire load of the dwelling and are connected to terminals rated for 75Â°C?

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

Question 78: 314.15 Damp or Wet Locations.

Question ID#: 692.0

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

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

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

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

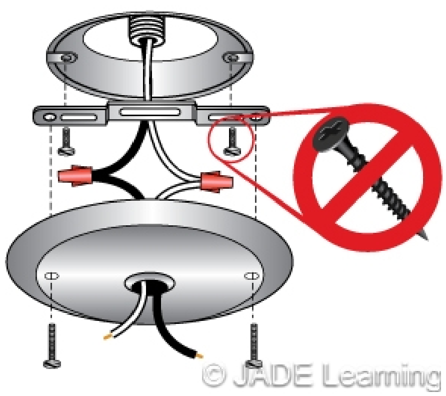
Section 314.15 now states that: ***approved drainage openings not larger than 6 mm (1â•„4 in.) shall be permitted to be installed in the field in boxes or conduit bodies listed for use in damp or wet locations. For installation of listed drain fittings, larger openings are permitted to be installed in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

Question 78: Which of the following installations meets the intent of section 314.15?

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

Question 79: 314.25 Covers and Canopies.

Question ID#: 693.0



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

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

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

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

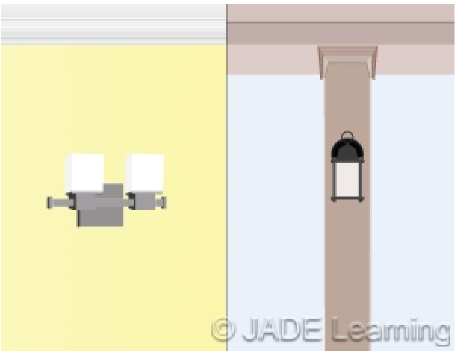
It is all too common for an installer to use drywall screws or other screws that may be convenient when fastening a cover, faceplate, or fixture canopy to a junction box rather than using the correct machine screw for the application. Boxes that have had a drywall screw used for this purpose instead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

Question 79: If a junction box is equipped with threaded holes with an 8-32 thread pitch for the purpose of securing the cover, what can be used to secure the cover to the box?

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

Question 80: 314.27(A)(1) Vertical Surface Outlets.

Question ID#: 694.0



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

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

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

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

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

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

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

Question 81: 314.27(C) Boxes at Ceiling-Suspended (Paddle) Fan Outlets.

Question ID#: 695.0

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

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

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

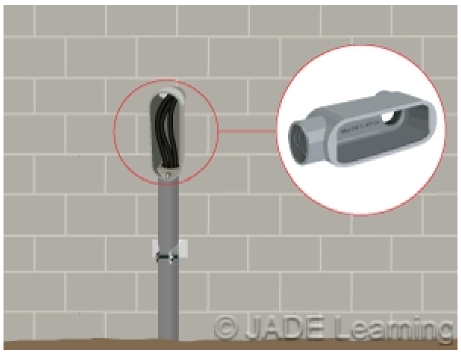
It has become a common practice during new home construction for a homebuilder to offer prewiring for future ceiling fans as part of an upgrade package to new homeowners. Prior to the 2011 Code, it was also commonplace to find that an electrician had provided spare separately switched ungrounded conductors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

Question 81:   Which of the following ceiling boxes are required to be fan rated?

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

Question 82:   314.28(A)(3) Pull and Junction Boxes and Conduit Bodies.   Minimum Size. Smaller Dimensions.

Question ID#: 696.0



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

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

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

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

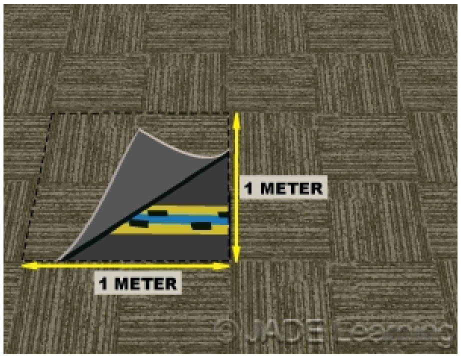
For example, if considering using an angle pull with 2 inch conduit and a pull box, and the rule in 314.28(A)(2) requires the distance from the entering raceway and the opposite wall of the box to be at least 12 inches (2 inch raceway X 6 = 12 inches to opposite wall). A smaller conduit body would be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

Question 82:   What is required of a 2 inch conduit body with dimensions less than those required for an angle pull in a pull box that is being used to enclose an angle pull with No. 4 AWG aluminum conductors?

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

Question 83: 324.41 Floor Coverings.

Question ID#: 697.0



Floor-mounted FCC cable cannot be covered with carpet squares larger than 1.0 m square.

Section 324.41 spells out requirements for carpet squares installed over flat conductor cables (FCC) and has been revised to be more consistent with common sizes of carpet squares based on the metric system.

The previous Code language required flat conductor cables to be covered with carpet squares not larger than 914 mm or 36 inches square. The revised text states that ***floor-mounted Type FCC cable, cable connectors, and insulating ends shall be covered with carpet squares not larger than 1.0 meters (39.37 inches) square. Carpet squares that are adhered to the floor shall be attached with release-type adhesives***.

In the NEC, the International System of Units (SI) is used for metric units of measurement. The SI units appear first, and the English System units immediately follow in parentheses. Example: 1.0 m (39.37 in.) square.

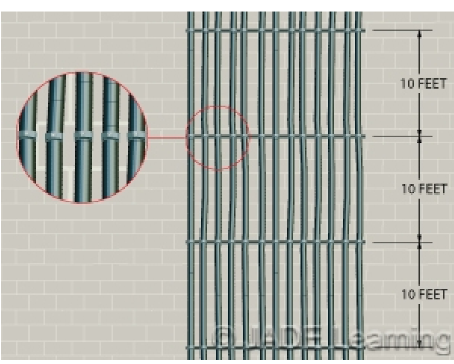
The previous carpet square size requirements in section 324.41 were based on 36 inches square which had a metric equivalent of 914 mm. These measurements conflicted with commonly sized carpet squares that are manufactured according to the SI system. Outside of the United States, the metric system is the most widely used system of measurement. Changing to allow carpet squares no larger than 1.0 meters or 39.37 inches square permits a greater number of manufacturers that produce modular carpet products to make common sizes of carpet squares based on metric measurements that will comply with section 324.41 without having to produce special size carpet squares measured in inches square that are likely to be used only in the United States.

Question 83: Which of the following carpet squares can be used to cover a section of flat conductor cable?

A: One that is 40 inches X 40 inches.
B: One that is 1 meter x 1 meter.
C: One that is 1.1 meters square.
D: One that is 1600 square inches.

Question 84: 330.30(B) Securing and Supporting. Securing.

Question ID#: 698.0



For large cables, vertical installations of MC cable can be secured at intervals not exceeding 10 feet.

The requirements for securing vertical installations of Type MC Cable have been modified by changing the spacing requirement for supports for cables that contain ungrounded conductors ***250 kcmil and larger***. The 2014 NEC now permits a maximum interval of ***10 feet*** between supports securing vertical installations of Type MC cable that contain ungrounded conductors that are 250 kcmil or larger. In previous editions of the NEC, the maximum interval between supports for Type MC cable was 6 feet regardless of the size of conductors.

Type MC cable is being used extensively in high rise construction projects primarily because of the lower installation costs compared to the cost of installing metal raceways and then pulling conductors into the raceways. Because of special manufacturing techniques used for MC cable that contains larger conductors, securing the MC cable every 10 ft. would still support the cable, would be adequate to limit movement of the cable during fault conditions, and would meet the requirements of 110.12 for mechanical execution of work.

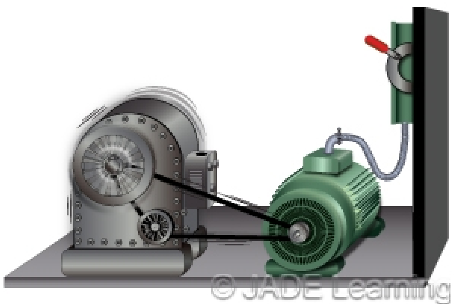
The requirements for supporting and securing horizontal runs of Type MC cable through metal or wood framing members have not changed. The cable is considered as supported and secured provided the interval between such supports does not exceed 6 feet. Type MC cable with fewer than 5 conductors No. 10 AWG and smaller are still required to be secured within 12 inches of boxes, cabinets, fittings, and other cable terminations.

Question 84: What is the maximum interval between supports used to secure vertical runs of Type MC cable that contain 3 ungrounded 400 kCMIL conductors?

A: 12 inches.
B: 3 feet.
C: 6 feet.
D: 10 feet.

Question 85: 330.30(D)(3) Securing and Supporting. Unsupported cables.

Question ID#: 699.0



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

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

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

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

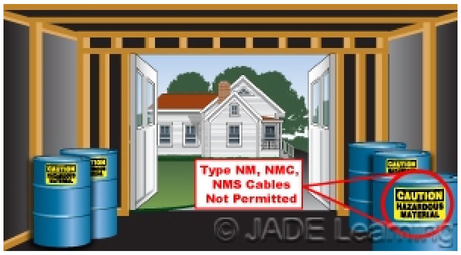
An additional allowance has now been made in 330.30(D)(3) for the installation of MC cable where flexibility is important. The new Code change states that MC cable can remain unsupported if it is of the interlocked armor type in lengths not exceeding 900 mm (3 ft.). The 3 ft. is measured from the last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

Question 85: A section of interlocked type MC cable, used to supply an air compressor, can be unsupported from the last fastening point for what maximum distance?

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

Question 86: 334.10 Installation. Uses Permitted.

Question ID#: 700.0



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

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

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

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

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

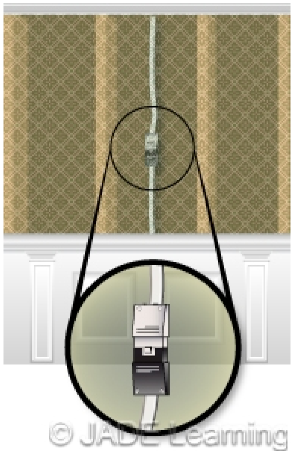
Changing the location of the phrase "except as prohibited in 334.12" to the introductory sentence in 334.10 makes it clear that these types of cables can be installed in any of the above 5 locations as long as none of the 5 locations conflict with the rules in 334.12 for uses not permitted. For example,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

Question 86: When is type NMC cable permitted to be used in a cable tray, installed in an office building of type IV construction?

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

Question 87: 334.40(B) Boxes and Fittings. Devices of Insulating Material.

Question ID#: 701.0



Listed self-contained switches, self-contained receptacles, and nonmetallic-sheathed cable interconnector devices can be used without boxes in exposed cable wiring.

For many years the NEC has allowed nonmetallic-sheathed cable to be joined by splicing-type devices without boxes and concealed within walls of existing buildings. Although not a very widespread practice, and most commonly seen in repair wiring for mobile homes, section 334.40(B) permits the use of these types of splicing devices but only under certain conditions.

The new changes in section 334.40(B) specify (1) what types of splicing devices are permitted to be used, (2) add a listing requirement, and (3) clarify that the concealed wiring repaired by these splicing devices is not limited to only those cables that have been fished.

The revised text states that ***self-contained switches, self-contained receptacles, and nonmetallic-sheathed cable interconnector devices made of insulating material that are listed shall be permitted to be used without boxes in exposed cable wiring and for repair wiring in existing buildings where the cable is concealed. Openings in such devices shall form a close fit around the outer covering of the cable, and the device shall fully enclose the part of the cable from which any part of the covering has been removed.*** Where connections to conductors are by binding-screw terminals, there must be at least one available terminal for each conductor.

Question 87: Which of the following devices are NOT allowed to be used to repair nonmetallic-sheathed cables if concealed within a wall of an existing building without a junction box?

A: Listed nonmetallic sheathed cable interconnector devices.
B: Listed self-contained switches.
C: Listed self-contained receptacles.
D: Listed electrical wire nuts.

Question 88: 344.2 Definition. Rigid Metal Conduit. Construction.

Question ID#: 702.0

RMC can be threaded and used for grounding equipment as well as routing and protecting cable and conductors.

This minor revision took the 4 types of RMC out of the definition of rigid metal conduit at 344.2 and created a new section at 344.100 which is in Part III, Construction Specifications.

The 4 types of rigid metal conduit (RMC) are:

- Steel (ferrous) with or without a protective coating.
- Aluminum (nonferrous).
- Red brass.
- Stainless-steel.

According to 344.10, galvanized steel and stainless steel RMC can be used under all atmospheric conditions and occupancies. Red brass RMC is permitted for direct burial and swimming pool applications. Aluminum RMC is permitted where judged suitable for the environment. When encased in concrete or in direct contact with the earth, aluminum RMC must be provided with supplementary corrosion protection.

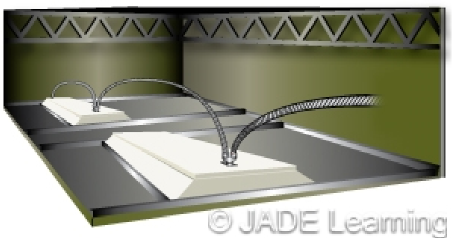
The revised definition of RMC in Section 344.2 defines it as a metal raceway that has a circular cross-section that can be threaded. Rigid metal conduit is permitted to be used for routing and protecting both cables and conductors. When installed according to Article 250, rigid metal conduit can also be used as an equipment grounding conductor.

Question 88: Which of the following statements about rigid metal conduit (RMC) is correct?

A: RMC is manufactured to have both a rectangular and a circular cross-section.
B: The NEC does not permit cables to be installed in RMC.
C: RMC is threadable.
D: The NEC does not permit RMC to be used as an equipment grounding conductor.

Question 89: 348.30(A) Exception No. 4. Flexible Metal Conduit. Securing and Supporting. Securely Fastened.

Question ID#: 703.0



According to Exception 4, listed flexible metal conduit fittings can be used as a means of support for 6 ft. lengths of FMC.

Section 348.30(A) specifies the requirements for installing and securing Flexible Metal Conduit (FMC). The change to Exception No. 4 clarifies how FMC can be connected to lay-in type luminaires and other equipment above a suspended ceiling. The general requirements for installing FMC are that it be ***secured*** within 12 inches of where it connects to cabinets, boxes, conduit bodies, or other equipment and that it be ***secured and supported*** at least every 4 1/2 feet.

There are four exceptions to these general requirements.

Exceptions 1 - 3 are unchanged:

- Ex. No. 1 permits FMC to be unsupported where it is "fished" and supports are impracticable.
- Ex. No. 2 permits different sizes of FMC to be unsupported for various lengths where flexibility is required after it is installed (3 ft. for 1/2 to 1-1/4 in. trade size, 4 ft. for 1-1/2 to 2 in. trade size, 5 ft. for trade size 2-1/2 in. and larger).
- Ex. No. 3 permits lengths of up to 6 feet to be unsupported from where it is connected to a luminaire to where conductors are tapped.

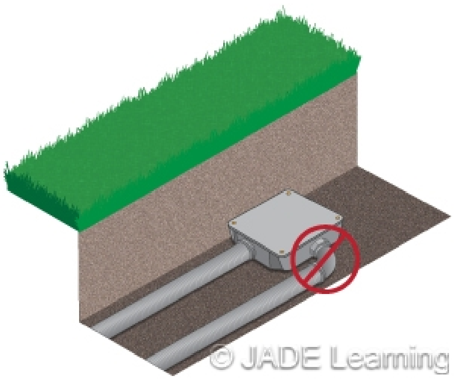
Exception No. 4 allows lengths of FMC, commonly called "fixture whips," to be installed in lengths of up to 6 feet and be unsupported between the last point where the flex is secured and the luminaire itself. The last sentence in Exception No. 4 mentions that listed FMC ï¬•ttings, used to secure the FMC to a box or luminaire, are considered as a means of support. This change brings the requirements for installing FMC in line with the requirements for installing Type AC and Type MC cable.

Question 89: When installed above an accessible suspended ceiling, and listed fittings are used, what is the maximum length of a piece of unsupported FMC between a junction box and a luminaire?

A: 12 inches.
B: 3 feet.
C: 4 1/2 feet.
D: 6 feet.

Question 90: 350.42 Liquidtight Flexible Metal Conduit. Couplings and Connectors.

Question ID#: 704.0



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

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

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

Section 350.42 Couplings and Connectors now reads:

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

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

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

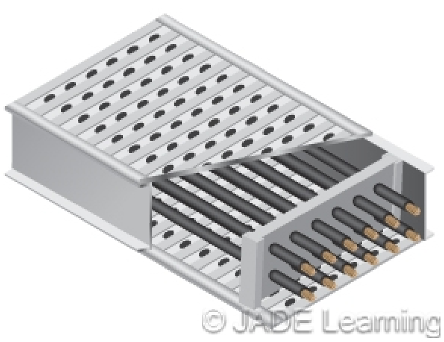
LFMC and LFNC are permitted for direct burial. Flexible metal conduit (FMC) and flexible metal tubing (FMT) are not permitted for direct burial, and misapplication of these wiring methods could require extensive rework or create a hazardous condition.

Question 90: Which of the following is permitted for direct burial?

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

Question 91: Article 370 Cablebus.

Question ID#: 705.0



Article 370 has been reorganized to a more user-friendly format.

Article 370, Cablebus, has been reorganized to follow the format used for other wiring methods in Chapter 3. There are not technical changes to the Article, but now Article 370, Cablebus, is similar to Article 392, Cable Trays, (the other cable support system) and the rest of Chapter 3, Wiring Methods and Materials.

A common standard format for Chapter 3 Wiring Methods and Materials makes the NEC much more user-friendly. If similar information is located in the same place, no matter what type of wiring method is being used, the information becomes a lot easier to find. For example, a question about how Cablebus or Cable Tray should be secured or supported can be answered in 370.30 for Cablebus and 392.30 for Cable Tray. Like many Articles in Chapter 3, Uses Permitted for Cablebus is located in 370.10 and Uses Not Permitted is in 370.12.

The new format for Article 370 is:

Part I General
.1 Scope
.2 Definition

Part II Installation

.10 Uses Permitted
.12 Uses Not Permitted
.18 Installation
.20 Conductor Size and Termination
.22 Number of Conductors
.23 Overcurrent Protection
.30 Securing and Supporting
.42 Fittings
.60 Grounding
.80 Ampacity of Conductors

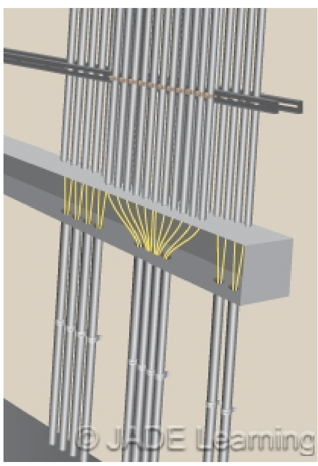
Part III Construction Specifications
.120 Marking

Question 91: Where is the following statement located? "Cablebus framework, where bonded, shall be permitted to be used as the equipment grounding conductor for branch circuits and feeders."

A: 370.23.
B: 370.60.
C: 370.18.
D: 370.22.

Question 92: 376.22(B) Number of Conductors and Ampacity. Adjustment Factors.

Question ID#: 706.0



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

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

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

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

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

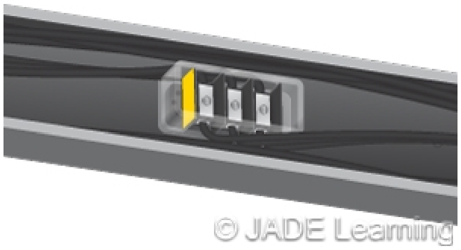
Another example: if there are 42 conductors at any cross section of a wireway, and each conductor is rated at 130 amps, the maximum amount of current each conductor can carry is 45.5 amps (130 amps x 0.35).

Question 92: How much current can a conductor which is rated for 65 amps carry if it is installed in a metal wireway with 35 other conductors, but there are never more than 20 conductors at any cross section of the wireway?

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

Question 93: 376.56(B)(5) Power Distribution Blocks. Conductors.

Question ID#: 707.0



Power distribution blocks on the line side of service equipment need to be listed for the purpose.

Section 376.56(B)(5) now states:
Conductors. Conductors shall be arranged so the power distribution block terminals are unobstructed following installation.

At times it becomes necessary to service or test the terminals on a power distribution block that is installed in a metal wireway. If wires that don't terminate in the wireway obstruct the power distribution block terminals, the individual performing the servicing or testing process would have to move the wires, which can cause an arc-flash or shock hazard.

In the initial installation, if the wires are arranged so as to not block the terminals, servicing and testing can be done safely. A good preventive maintenance program will include torqueing the terminals. If the terminals are partially blocked by conductors passing through the wireway, it's possible for the electrician's wrench to slip and ground out the live terminals. The language in Section 376.56(B)(5) is intended to reduce the possibility of this safety hazard.

Power distribution blocks with setscrews are an improvement over the older method of connecting conductors by means of split-bolt connectors wrapped in electrical tape. However, as this new wording suggests, a proper installation can prevent trouble later on when the equipment must be serviced.

Power distribution blocks that are listed for the location and purpose for which they are used are permitted to be installed in wireways on the line or on the load side of service equipment. Whether or not the wireway covers are installed, power distribution blocks are not permitted to have uninsulated live(energized) parts exposed.

Question 93: Which of the following statements about installing conductors in metal wireways is correct?

A: When terminal blocks are installed in a wireway, conductors which pass through the wireway are not permitted.
B: A 3 inch clearance above and below terminal blocks must be maintained.
C: All conductors in a metal wireway must terminate at terminal blocks.
D: Conductors which pass through a wireway cannot interfere with servicing the terminal blocks.

Question 94: 386.120 Surface Metal Raceways. Marking.

Question ID#: 708.0

Surface metal raceway needs to be clearly marked with the manufacturer's name.

Section 386.120 was revised to require that surface metal raceways be marked to indicate the name of the manufacturer, the manufacturer's trademark, or other markings to identify the company that manufactured the raceway. Prior to this change no marking was required for surface metal raceway. Now the requirements for surface metal raceway are in line with the requirements for other electrical equipment; Section 110.21 requires that electrical products be marked to identify the manufacturer in some way.

Unlike clothing manufacturers, who have turned putting their names and logos on shoes, jackets, and t-shirts into a fashion statement, manufacturers of surface metal raceway have never put identifying markings on their product. This is probably because surface metal raceway such as WiremoldÂ® is commonly installed without being painted; it comes in colors that blend well with existing wall surfaces.

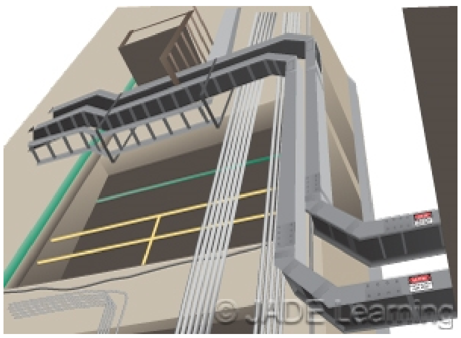
It is impossible for installers and inspectors to know whether a product is listed for use in a particular installation if they cannot identify the product. Requiring surface metal raceway to be marked to identify its manufacturer makes it easier for both installers and inspectors to avoid accepting imitation products that are being imported and sold without having been evaluated by a recognized testing organization such as ETLÂ®, or ULÂ®.

Question 94: Surface metal raceway is required to be marked with:

A: The manufacturer's name only.
B: The manufacturer's logo only.
C: The manufacturer's trademark only.
D: The manufacturer's name, trademark, or other descriptive marking that identifies the manufacturer.

Question 95: 392.18(H) Cable Tray Installation. Marking.

Question ID#: 709.0



An exception to the marking requirements for cable trays has been added for industrial establishments.

Cable trays containing conductors rated over 600 volts that are installed in industrial establishments where only qualified persons service the installation, and where the cable trays are not accessible, are not required to have high voltage warnings posted every 10 ft.

This is a new exception to the requirement that warning signs that read, DANGER - HIGH VOLTAGE - KEEP AWAY, are to be posted at least every 10 ft. on cable trays that contain conductors rated over 600 volts. The exception is for industrial locations where qualified persons service the installation. In these facilities, the warning signs shall be located where necessary for the installation to ensure safe maintenance and operation.

If the cable tray is not accessible (as applied to equipment), the warning signs are not required at least every 10 ft. As applied to equipment, accessible means the equipment is not guarded by locked doors, elevation, or other effective means.

Most cable trays are mounted high enough that a ladder or lift would be required to inspect the cable tray. At such an elevation the cable tray would not be considered accessible, and the high voltage warning signs are not necessary within every 10 ft.

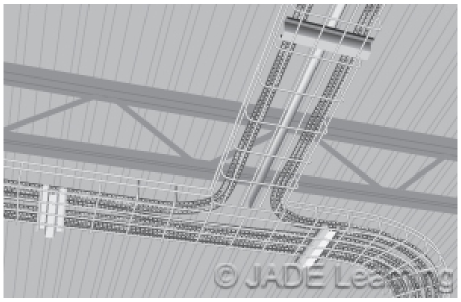
Industrial establishments that have professional engineering and maintenance personnel are allowed exceptions to certain standard Code installation standards. For example, industrial manufacturing plants are permitted to use a wider range of installation practices for high voltage and hazardous location equipment than would be allowed in non-industrial locations.

Question 95: Which of the following installations complies with Section 392.18(H)?

A: A cable tray installation containing conductors rated over 600 volts in a commercial establishment with warning notices spaced 15 ft. apart.
B: A cable tray installation containing conductors rated over 600 volts in a commercial establishment with warning notices spaced 12 ft. apart.
C: A cable tray installation in an industrial establishment that is not accessible and contains conductors rated over 600 volts and the warning notices are adequate for the site to ensure safe maintenance and operation.
D: A cable tray installation containing conductors rated over 600 volts in an industrial facility where there are no warning notices.

Question 96:   392.20(A)&(B) Multiconductor Cables Operating at 600 Volts or Less. Cables Operating at Over 600 Volts.

Question ID#: 710.0



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

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

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

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

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

Question 96:   The OPERATING VOLTAGE for all cables in a cable tray is 480 volts. One cable in the tray is RATED for 2000 volts and the other is RATED at 600 volts. Which of the following statements is correct?

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

Question 97:   Article 393 Low Voltage Suspended Ceiling Power Distribution Systems.

Question ID#: 711.0

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

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

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

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

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

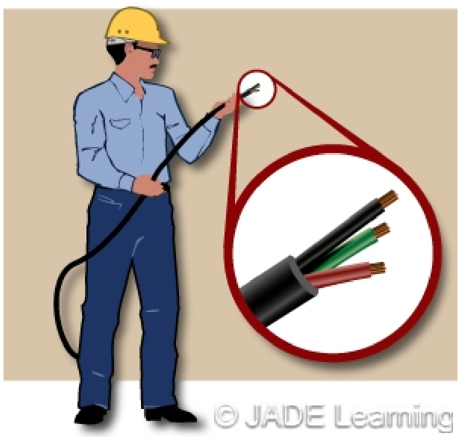
Question 97: Where can low-voltage suspended ceiling power distribution systems be installed?

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

Chapter 4

Question 98: 400.4 Flexible Cords and Cables. Types.

Question ID#: 712.0



Special use of flexible cords and cables needs to be approved by the AHJ.

Section 400.4 and Table 400.4 are easier to understand in the 2014 NEC. In the 2011 NEC, section 400.4 read:

Flexible cords and flexible cables shall conform to the description in Table 400.4. Types of flexible cords and flexible cables other than those listed in the table shall be the subject of special investigation.

In the 2014 NEC section 400.4 reads:

The use of flexible cords and flexible cables other than those in Table 400.4 shall require permission by the authority having jurisdiction.

The 2014 version is better because the use of the term "listed" was confusing. Also, "the subject of special investigation" was very unclear. Who was going to do the investigation? The FBI? The Authority Having Jurisdiction is clearly the agency that should determine if a special type of cord or cable can be used.

Table 400.4 has been changed to include No. 15 AWG conductors. For each type of cord or cable, the size in AWG or kcmil did not include 15 AWG. The size of the conductors inside the cord were listed in ranges that did not include 15 AWG. For example, the sizes of cable were listed as 18-16 and 14-10 AWG. The ampacity of a 15 AWG conductor inside a flexible cord or cable is given in Table 400.5(A)(1), so it makes sense that a 15 AWG conductor size is included in Table 400.4.

Question 98: Which of the following statements about flexible cords and cables is true?

A: If a type of cord or cable is in Table 400.4, it can be used without special permission.
B: 15 AWG conductors are not permitted in flexible cords and cables.
C: Flexible cords and cables that are in Table 400.4 require special permission.
D: The insulation thickness for conductors inside flexible cords and cables is the same for all conductor sizes.

Question 99: 400.7(A)(11) Flexible Cords and Cables. Uses Permitted.

Question ID#: 713.0

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

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

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

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

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

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

Question 99: When connecting a wall-mounted flat screen TV to a receptacle outlet which of the following methods is not permitted?

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

Question 100: 404.2(C) Switches Controlling Lighting Loads.

Question ID#: 714.0

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

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

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

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

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

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

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

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

(5) Where there is more than one switch location, such as for 3-way or 4-way

switches, and the entire floor area of the room is visible from a single or combined switch locations.

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

(7) Where a switch controls a receptacle load.

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

Question 100: Assume the switches are wired with NM-Cable not installed in a raceway and that the switch boxes will be enclosed in a finished wall.
When is a grounded conductor required at a switch location for a lighting load?

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

 (c)2025 JADE Learning, LLC

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

WI 2014 NEC Changes Part 1 Course# 17015 8 CEI, IJE, J, M, RE, RJE, RME, UDC Credit Hours $90.00

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

Please fill out the following information and mail this answer sheet along with payment to:
JADE Learning 225 E Robinson St #570, Orlando, FL 32801
Phone: 1 (800) 443-5233
This course is $90.00
We accept: checks, cash, money orders, credit or debit cards. Visa, MasterCard, AMEX or Discover.

Name ________________________ WI License #________________

Mailing Address ________________________ Phone ________________

City, State, Zip Code ____

Credit Card Number ________________________ Expiration Date ____________

Email Address ____