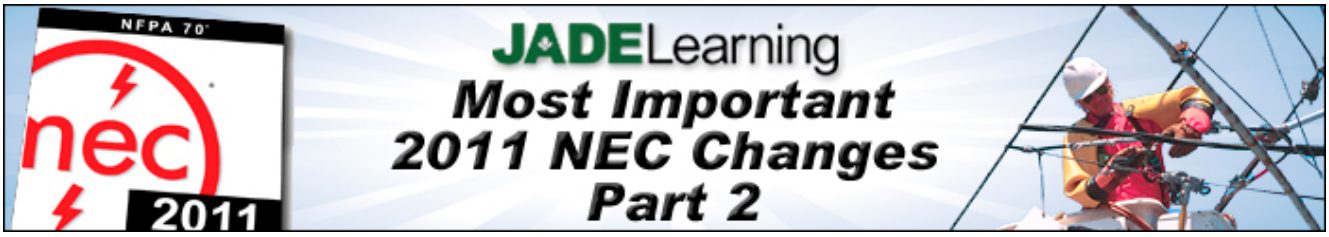


2011 NEC Changes Part 2 (Homestudy) (Homestudy)

North Carolina Electrical License

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

Course# 1081113 4 Homestudy Credit Hours $50.00

This course is currently approved by the North Carolina State Board of Examiners of Electrical Contractors under course number 1081113.

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

JADELearning

2011 NEC Changes Part 2 (Homestudy) (Homestudy) - NC

Question 1: 392.60(A) Grounding and Bonding. Metallic Cable Trays.

Question ID#: 118.0

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

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

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

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

Question 1: Which of the following statements about cable trays that support only non-power conductors is correct?

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

Question 2: Article 399 Outdoor Overhead Conductors over 600 Volts.

Question ID#: 119.0

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

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

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

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

Question 2: What is the purpose of Article 399, Outdoor Overhead Conductors over 600 volts?

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

Question 3: 404.2(C) Switches Controlling Lighting Loads.

Question ID#: 120.0

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

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

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

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

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

Question 3: A set of lighting plans for a new commercial building does not include occupancy sensors for lighting supplied by a grounded general purpose branch circuit. Without application of any exception, which of the following statements is true?

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

Question 4: 404.9(B) Exceptions 1 and 2 . Provisions for General-Use Snap Switches. Grounding.

Question ID#: 121.0

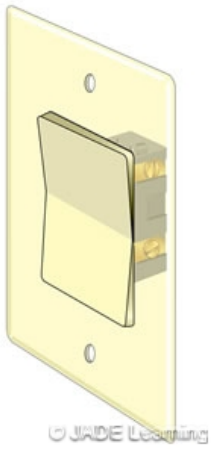
The main rule says general-use snap switches must be grounded. The equipment grounding conductor run with the branch circuit is most commonly used to ground the switch and the switch box if it is metal.

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

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

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

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



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

Question 4: What is required for a listed switch assembly that can be used without a connection to the equipment grounding conductor?

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

Question 5: 406.4(D)(4) General Installation Requirements. Arc-Fault Circuit-Interrupter Protection.

Question ID#: 122.0

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

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

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

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

Question 5: When and where is it necessary to install a replacement receptacle that is arc-fault circuit-interrupter protected?

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

D: When replacing a bedroom receptacle in Jan 2014.

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

Question ID#: 123.0

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

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

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

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

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

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

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

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

Question 6: Which of the following statements about replacement receptacles is true?

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

Question 7: 406.9(B)(1) Receptacles in Damp or Wet Locations. Wet Locations.

Question ID#: 124.0

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

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

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

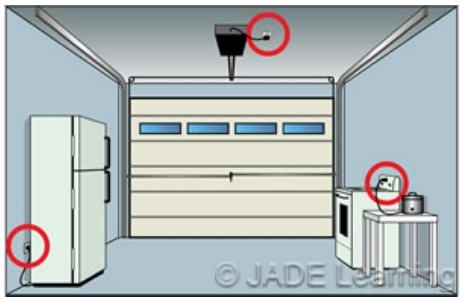
Receptacle outlets installed outdoors on construction sites and in commercial locations require an "extra duty" outlet box hood.

Question 7: Which installation requires a receptacle enclosure with an extra duty outlet box-hood?

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

Question 8: 406.12 Tamper-Resistant Receptacles in Dwelling Units.

Question ID#: 125.0



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

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

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

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

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

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

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

Question 8: Which of the following non-locking, 125-volt, 15 or 20-ampere receptacles are required to be tamper-resistant?

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

Question 9: 406.13 Tamper-Resistant Receptacles in Guest Rooms and Guest Suites.

Question ID#: 126.0

All non-locking type, 125-volt, 15- and 20-ampere receptacles in guest rooms and guest suites are required to be listed tamper-resistant receptacles.

All non-locking type, 125-volt, 15- and 20-ampere receptacles located in guest rooms and guest suites shall be listed tamper-resistant receptacles.

Tamper-resistant receptacles protect young children from inserting metal objects into the openings of receptacles. Children often travel with their parents and spend the night in hotel rooms or suites and motels. The new requirement will guarantee that children in guest rooms and suites have the same protection from the electrical shock hazards of receptacles that they do at home.

A guest suite can be classified as a dwelling unit if it has permanent provisions for living, sleeping, cooking, and sanitation. As a dwelling unit, a guest suite would have required tamper-resistant receptacles under the 2008 NEC. Guest rooms generally do not have permanent provisions for cooking, but under the 2011 NEC all the non-locking, 125-volt, 15- and 20-ampere receptacles in a guest room are required to be tamper-resistant.

Question 9: In a guest room, where are tamper-resistant receptacles required?

A: In the living areas, but not in the bathroom.
B: In the bathroom only.
C: For the space heater, if over 125 volts and cord-and-plug connected.
D: In all areas if they are non-locking, 125-volt, 15- or 20- ampere receptacles.

Question 10: 406.14 Tamper-Resistant Receptacles in Child Care Facilities.

Question ID#: 127.0

All non-locking-type 125-volt, 15- and 20-ampere receptacles in child care facilities are required to be tamper-resistant.

In all child care facilities, all non-locking-type 125-volt, 15- and 20-ampere receptacles shall be listed tamper-resistant receptacles.

This is a common sense change that extends the protection of tamper-resistant receptacles to child care facilities. Tamper-resistant receptacles are required in dwellings, guest rooms and guest suites, and in pediatric areas of health care facilities. They are now also required in child care facilities that are defined as a facility that provides services for more than four children that are age seven or younger.

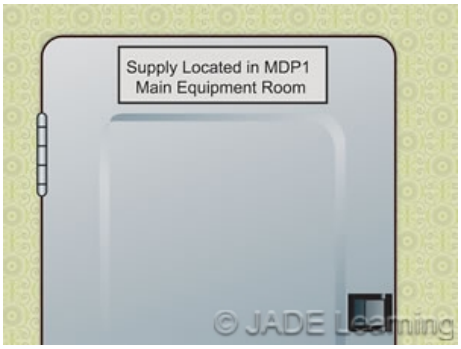
Design documents for child care facilities place most receptacle outlets out of the reach of small children. However, with this change all non-locking, 125-V, 15- & 20-ampere receptacles in child care facilities are required to be tamper-resistant regardless of their location. Consumer Product Safety Commission reports indicate that approximately 2,400 children are injured each year when they put metal objects like hair-pins or paper clips in receptacle outlets. This change is particularly important in a child care facility because of the number of children in these locations. Tamper-resistant receptacles provide the best protection for children against electrical shock and burns.

Question 10: Which areas of a child care facility require 125-volt, 15- and 20-ampere receptacles to be tamper-resistant?

A: Only areas where receptacles are mounted within 24 inches of the floor.
B: All areas.
C: Play areas only.
D: Napping areas only.

Question 11: 408.4(B) Field Identification Required. Source of Supply.

Question ID#: 129.0



Except for 1- and 2-family dwellings, markings on switchboards and panelboards supplied by a feeder are required to show where the feeder originates.

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

In commercial and industrial locations there are many panelboards and switchboards located throughout the building. It can be difficult to find the circuit breaker or fused switch that supplies the feeder to a panelboard. In an emergency it is dangerous not to be able to locate and de-energize the source of power to a panelboard. When performing maintenance on a panelboard it is time consuming and frustrating to search for the power source in order to remove power from the panelboard. Identifying the source of power for panelboards and switchboards simplifies implementing lockout/tagout procedures when necessary for servicing electrical equipment.

The more detail that is included on the directory and/or sign, the more helpful it will be. The requirement says the "device or equipment" must be identified, so a general description of where the source is located is not good enough. A sign that said, "Panelboard supply located in Main Electrical Room" is not adequate. Likewise, identifying the supply circuit without including where the supply is located, "Panelboard supply fed from circuit breaker 20" is not helpful. A sign that said, "This panelboard fed from circuit 20 in Main Distribution Panel, 1st floor electrical room" would meet the requirements of this section and be an aid to troubleshooting and maintaining the switchboard or panelboard.

Question 11: If the following panelboards are supplied by feeders, which one is not required to be marked to indicate the device and location of the source of the power supplied to the panelboard?

A: A panelboard on the first floor of a multi-family dwelling.
B: A panelboard on the second floor of a three story single family dwelling.
C: A panelboard in an equipment room of a factory.
D: A panelboard in a restaurant.

Question 12: 410.16(C)(5) Luminaires in Clothes Closets. Luminaire Types Permitted.

Question ID#: 132.0

The way the NEC defines Closet Storage Space, it is not the entire closet. Luminaires can be installed in Closet Storage Space only if they are identified as suitable for installation within the Closet Storage Space.

Although the Closet Storage Space includes the area below clothes hanging rods, luminaires are generally installed in the upper part of a closet higher than the clothes hanging rod and higher than any shelves above the rod to provide better illumination for the entire closet.

As defined in 410.2, Closet Storage Space in the upper part of a closet is that portion of the closet that is more than 6-feet above the floor, or that is above the highest clothes hanging rod whichever is greater. The Closet Storage Space extends vertically above the rod or shelf up to the ceiling and is parallel to the back and side closet walls for 12-inches or the width of the shelf, whichever is greater.

LED luminaires are permitted in clothes closets and within the Closet Storage Space inside a closet. This is a clarification from 2008 that was being interpreted to mean LEDs were only permitted in the storage space of a clothes closet.

The LED luminaire can be installed in the Closet Storage Space if it is identified as suitable for installation within this space. A surface-mounted or recessed LED luminaire with a completely enclosed light source can also be installed in other locations within the clothes closet. If the LED luminaire is not within the closet storage space, it does not need special marking.

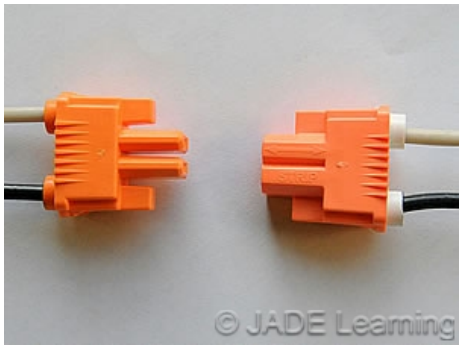
LED luminaires are permitted in clothes closets and within the Closet Storage Space.

Question 12: Which LED luminaire would require a marking to identify it as being suitable for installation within the closet storage space?

A: Surface-mounted above the closet door.
B: Recessed mounted in the middle of the closet, 36 inches from the closet storage space.
C: Surface-mounted on the ceiling of the closet above the clothes hanging rod, and within the closet storage space.
D: Recessed, in the wall opposite the clothes hanging rod.

Question 13: 410.130(G) Special Provisions for Electric-Discharge Lighting Systems of 1000 Volts or Less. General. Disconnecting Means.

Question ID#: 134.0



When ballasts are replaced, a means of disconnecting power is required to be installed for electric-discharge lighting systems of 1000 volts or less.

For existing installed luminaires without disconnecting means, at the time a ballast is replaced, a disconnecting means shall be installed.

Unless exempted by the general requirement or by one of the 5 exceptions to section 410.130(G), in other than dwelling units, disconnecting means are required to be installed when replacing the ballast of fluorescent luminaires in indoor locations that use double-ended lamps. The disconnecting means can be either internal or external to the luminaire. When connected to a multiwire branch circuit, the disconnecting means must disconnect all the supply conductors to the ballast, including the grounded conductor.

The general rules apply to indoor locations not to luminaires installed outdoors. In addition there are 5 exceptions which are exempt from the rule requiring installation of a disconnect when replacing the ballast in an existing luminare. The 5 exceptions exempt the following from the general requirements:

- luminaires in hazardous locations
- luminaires for emergency illumination required in 700.16.
- cord-and-plug connected luminaires

- luminaires in industrial establishments with written procedures that guarantee restricted access and supervision ensures maintenance is performed by qualified personnel
- luminaires where two or more luminaires are supplied by other than a multiwire branch-circuit if the installation is designed so that the work space is illuminated when the circuit supplying the luminaire being serviced is turned off.

Unless exempted by section 410.130(G), when a fluorescent ballast is changed, a disconnecting means must be added. Most electricians have been changing ballasts with the power on, which can be a dangerous experience. Not only is there a shock hazard, but often when workers are shocked while changing a ballast they are injured when they fall off of a ladder.

Since the requirement to install disconnects for individual luminaires has only been enforced for two Code cycles, most of the fluorescent luminaires in use do not have disconnecting means. Installing a disconnect when the ballast is changed will begin the process of upgrading these older luminaires and making them safer to maintain.

Question 13: Unless excluded by the general requirement or by one of the five exceptions, when replacing a ballast in fluorescent luminaires that have double-ended lamps, disconnects are required to be installed for luminaires in which of the following locations?

A: In all hazardous locations.
B: Outdoors.
C: In a dwelling.
D: In an office which has only one luminaire and no other light source.

Question 14: 422.30 Disconnecting Means for Appliances.

Question ID#: 136.0

This change clarifies the requirement for disconnecting power from appliances. The 2008 NEC required only that a disconnecting means be provided for removing all ungrounded power for appliances. The 2008 requirement did not require the disconnect to simultaneously remove all power from the appliance.

This was seen as a potential safety hazard, and the 2011 NEC now requires that "***A means shall be provided to simultaneously disconnect each appliance from all ungrounded conductors in accordance with the following sections of Part III."***

Disconnects are required to simultaneously remove all ungrounded conductors from appliances.

Simultaneous removal of power from the appliance does not mean that separate disconnects supplying two or more branch circuits to the same appliance have to simultaneously remove power. However, disconnects for separate branch circuits supplying the same appliance are required to be grouped together and identified as the disconnect for the appliance.

For example, the disconnect for an appliance supplied by a single 240-V circuit is required to simultaneously remove both ungrounded conductors from the appliance. However, two disconnects for an appliance supplied by 2 branch circuits are not required to open simultaneously. For example, if an appliance is supplied by a 120-V branch circuit and a 240-V branch circuit, each disconnect is required to open the conductors it supplies simultaneously. The two disconnects are not required to open simultaneously; however, both disconnects are required to be grouped and identified as disconnects for the appliance.

Question 14: If the disconnect is listed for the application and is correctly identified, which of the following does not comply with the requirement for disconnecting electrical power from an appliance?

A: A 120-V appliance supplied by a single pole, 120-V circuit breaker.
B: A 240-V appliance supplied by a double pole, 240-V circuit breaker.
C: A 240-V appliance supplied by a two pole, fusible disconnect.
D: An appliance supplied by a branch circuit from a subpanel located near the appliance and a panelboard located on another floor.

Question 15: 422.31(C) Disconnection of Permanently Connected Appliances. Motor-Operated Appliances Rated Over 1/8 Horsepower.

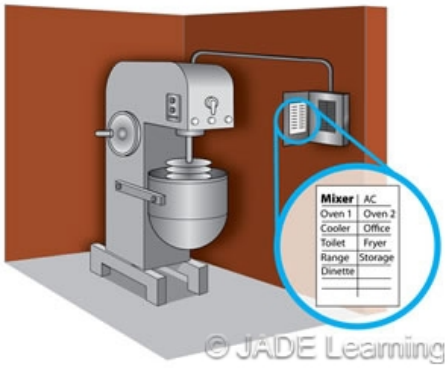
Question ID#: 137.0

In the 2008 NEC, circuit breakers and branch-circuit switches were permitted to serve as the disconnecting means for permanently connected appliances only if they were in sight from the appliance or were capable of being locked.

In the 2011 NEC, disconnects located within sight of permanently connected appliances are still required. However, an exception permits disconnects that are not located within sight of permanently connected appliances rated more than 1/8 HP. In order for the exception to apply the appliance must have a unit switch with a marked "off" position, and the appliance disconnecting means must be located according to 422.34 (A)(B)(C) or (D).

The location of the disconnecting means according to 422.34 depends on the type of occupancy: In a ***multifamily dwelling*** it is required to be within the dwelling unit or on the same floor as the dwelling unit. In a ***two-family dwelling*** it is permitted to be either inside or outside the dwelling unit where the appliance is installed. Section 422.34(C) specifically permits the service disconnect in a single-family dwelling to serve as the other disconnect required by 422.31(C). In ***other occupancies*** it is permitted to be a readily accessible branch-circuit switch or circuit breaker.

Appliances that have motors rated over 1/8 HP are capable of sudden movement when power is applied. Clarifying the requirements for appliance disconnects provides an increased level of safety for personnel who service them.



Under certain conditions an appliance disconnecting means is not required to be located within sight of the appliance.

Question 15: If a listed appliance has a unit switch with a marked "Off" position, which of the following disconnecting means is permitted if the appliance has a 1/4 horsepower motor?

A: A circuit breaker in a panelboard inside a dwelling unit if the motor it supplies is located inside a detached garage.
B: In a commercial occupancy, a listed motor-circuit breaker rated in horsepower installed in a panelboard that is not readily accessible to the tenant.
C: In a single-family dwelling, the service disconnect is used as the other disconnect.
D: In a multifamily dwelling on the 1st floor of a building, the other disconnecting means is on the 2nd floor.

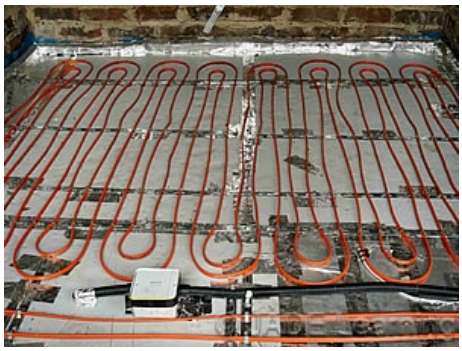
Question 16: 424.44(G) Heating Cables. Installation of Cables in Concrete or Poured Masonry Floors.

Question ID#: 140.0

Section 424.44(G) was revised to add kitchens to the areas requiring GFCI protection of heating cables installed in electrically heated floors. GFCI protection for receptacle outlets in kitchens, bathrooms, and areas where hydromassage tubs are installed has been required for a number of years because of the shock hazard potential when electricity is used in wet locations. Now GFCI protection is required for heating cables installed in concrete and poured masonry floors of kitchens, bathrooms, and areas where hydromassage tubs are installed.

The floors of kitchens are often wet from spills and mopping. GFCI protection of embedded heating cables is needed for a wet kitchen floor just like it is needed for a wet bathroom floor or a wet floor near a hydromassage tub.

People in bathrooms and in areas where hydromassage tubs are installed are even more vulnerable to shock from a broken heating cable because they are not only wet, they are usually barefoot. Although there were no fatalities recorded, the Consumer Product Safety Commission reports indicate that some thermostats for electrically heated floor systems were recalled because of potential shock/electrocution hazards.



GFCI protection is now required for embedded heating cables installed in concrete and poured masonry kitchen floors.

Requiring GFCI protection for heating cables in floors of kitchens, bathrooms, and areas where hydromassage tubs are used will reduce the likelihood of shocks caused by faulty or damaged heating cables and thermostats.

Question 16: Which of the following requires GFCI protection for heating cables?

A: A heating cable in a bathroom ceiling.
B: A heating cable installed in a poured concrete kitchen floor under ceramic tile.
C: A heating cable in the poured concrete floor of a greenhouse.
D: A heating cable in a wall where a hydromassage tub is installed.

Question 17: 430.22(G)(1) Conductors for Small Motors. 18 AWG Copper.

Question ID#: 144.0

The NEC now includes a section covering conductors for small motors.

Section 430.22(G) was added to cover conductors for small motors. Generally, the smallest motor circuit conductor is a No. 14 AWG copper conductor. However, 430.22(G)(1) permits No. 18 AWG copper conductors in a jacketed multiconductor cable or a flexible cord to be installed in a cabinet or enclosure if certain conditions are met:

- If the motor full-load current is over 3.5 amps and not over 5 amps, the overload protection must be a Class 10 (trips in 10 seconds at 600% of its rating).
- If the motor full-load current is less than 3.5 amps, the overload protection must be a Class 20 (trips in 20 seconds at 600% of its rating).
- Branch-circuit rated circuit-breakers are marked and listed for No. 18 AWG copper.
- Branch-circuit fuses are rated Class CC, Class J, or Class T and are listed for No. 18 AWG copper.
- Overcurrent protection is selected according to 430.52.

Question 17: When installed in a cabinet in compliance with Article 430, which of the following is the smallest motor circuit conductor permitted if the motor has a full-load current rating of 4 Amps?

A: A No. 14 AWG copper conductor in a jacketed multiconductor cable.
B: A No. 14 AWG copper conductor in a flexible cord.
C: A No. 18 AWG copper conductor in a jacketed multiconductor cable.
D: A No. 16 AWG copper conductor in a flexible cord.

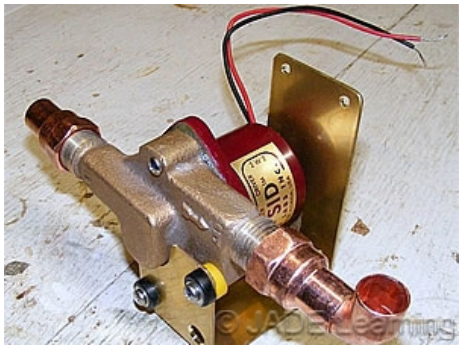
Question 18: 430.22(G)(2) Conductors for Small Motors. 16 AWG Copper.

Question ID#: 145.0

The requirements for supplying small motors with No. 16 AWG copper conductors are similar to the requirements for supplying small motors with No. 18 AWG conductors.

Section 430.22(G)(2) permits a No. 16 AWG copper in a jacketed multiconductor cable or a flexible cord to be installed in a cabinet under the following conditions:

- If the motor full-load current is greater than 5.5 amperes and less than or equal to 8 amperes, the overload protection must be a Class 10 (trips in 10 seconds at 600% of its rating).
- If the motor full-load current is 5.5 amperes or less, the overload protection must be a Class 20 (trips in 20 seconds at 600% of its rating).
- Branch-circuit rated circuit-breakers are marked and listed for No. 16 AWG copper.
- Branch-circuit fuses are rated Class CC, Class J, or Class T and are listed for No. 16 AWG copper.
- Overcurrent protection is selected according to 430.52.



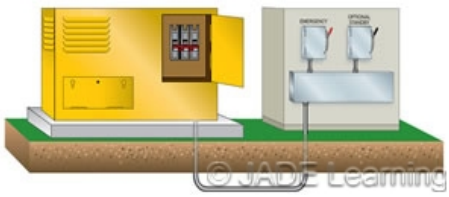
Small motors are now permitted to be supplied with No. 16 & No. 18 AWG conductors.

Question 18: When installed in a cabinet in compliance with Article 430, which of the following is the smallest motor circuit conductor permitted if the motor has a full-load current rating of 7 amps?

A: A No. 14 AWG copper conductor in a jacketed multiconductor cable.
B: A No. 14 AWG copper conductor in a flexible cord.
C: A No. 18 AWG copper conductor in a jacketed multiconductor cable.
D: A No. 16 AWG copper conductor in a flexible cord.

Question 19: 445.19 Generators Supplying Multiple Loads.

Question ID#: 153.0



Generators must provide overcurrent protection in each ungrounded conductor for feeders supplying individual enclosures with overcurrent protection.

Since 2008 a single generator has been permitted to supply more than one load. This allows a large generator to supply emergency systems, legally required standby systems, optional standby systems, fire pumps, or other backup loads. The feeder from the generator is connected to either (1) a vertical switchboard with separate sections, or (2) individual enclosures with overcurrent protection that are tapped from the generator feeder.

The 2011 NEC has added a requirement that if individual enclosures with overcurrent protection are tapped to the generator feeder, the generator itself must provide overcurrent protection in each ungrounded conductor of the generator feeder. Without this overcurrent protection at the generator, the feeder to the individual enclosures would not have overcurrent protection.

The change in 445.19(2) makes it clear that ungrounded feeder conductors supplied by a generator are required to have overcurrent protection at the generator if tap conductors are terminated in enclosures with overcurrent protection to supply different loads.

Question 19: If a feeder from a generator supplies multiple loads, as in the image above, which of the following statements is correct?

A: Overcurrent protection at the generator is not permitted.
B: Overcurrent protection at the generator is optional.
C: Taps for each of the multiple loads are permitted if the generator feeder has overcurrent protection at the generator.
D: The generator feeders are not permitted to be tapped.

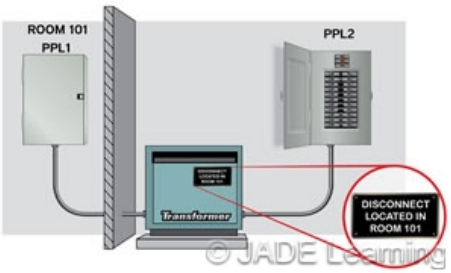
Question 20: 450.14 Transformers. Disconnecting Means.

Question ID#: 154.0

This new section requires disconnects for all transformers, except Class 2 and Class 3 transformers. The transformer disconnect can be mounted within sight of the transformer or mounted remotely from the transformer. If the disconnect is remote from the transformer, it must be lockable, and the location of the disconnect must be field marked on the transformer.

A transformer primary can be supplied by a tap conductor, per 240.21(B)(3). Several transformers, or a transformer and other loads, can be supplied as taps from a single feeder. Before this new requirement for a transformer disconnect, there was no way to disconnect power from a transformer without disconnecting all the loads on the feeder. Now a transformer will have its own disconnect and the transformer can be de-energized without removing power from other loads.

The main reason for requiring a transformer disconnect is to protect the individual working on the transformer. Requiring the disconnect to be lockable if located remotely from the transformer and field marking the transformer with the location of the disconnect will add another layer of protection for electrical maintenance personnel.



Disconnects are now required for transformers and the location of the disconnect must be marked on the transformer.

Question 20: Which of the following is acceptable wording for the field marking on the transformer?

A: Transformer primary disconnect located in main floor equipment room, circuit 4, MDP 1.
B: Transformer secondary supplies PPL 23, located on mezzanine.
C: Transformer rated 225 kVA, 480 volts, 3-phase primary, 208 volts, 3-phase secondary.
D: Transformer supplied from PPL 203.

Question 21: 503.10(A) Wiring Methods. Class III, Division 1.

Question ID#: 159.0

A Class III, Division 1 area is a location in which easily ignitable fibers/flyings are handled, manufactured, or used. Some parts of textile mills, woodworking plants, and factories where clothing is manufactured are usually classified as Class III locations.

Class III locations are hazardous because easily ignitable fibers and combustible flyings are handled, manufactured, or used in these locations, but they are not likely to be in suspension in the air in quantities sufficient to produce ignitable or explosive concentrations.

The 2008 NEC permitted the following wiring methods in Class III, Division 1 locations: RMC, RNC, IMC, EMT, dusttight wire ways and MC & MI cable with listed fittings. The 2011 NEC expands this list to include PVC and Reinforced Thermosetting Resin Conduit (RTRC). Cable tray systems and cable tray wiring, such as Power Limited Tray Cable (PLTC) and Instrumentation Tray Cable (ITC) are permitted. Type MC, MI, or TC cable can be installed in cable tray in a single layer if spacing is maintained between the cables; however, an exception also permits Type MC cable listed for Class II, Division 1 locations to be used in Class III, Division 1 locations without spacing. For flexible connections, jacketed, interlocked armor Type MC cable with dusttight fittings is acceptable, as is liquidtight flexible metal conduit, liquidtight flexible non-metallic conduit and flexible cord.

Additional types of wiring methods are now permitted in Class III, Division 1 locations.

Question 21: Which of the following wiring methods is not permitted in a Class III, Division 1 location?

A: MC cable installed in a cable tray.
B: Electrical Non-metallic Tubing (ENT).
C: PVC conduit.
D: Rigid metal conduit.

Question 22: 514.11 Circuit Disconnects.

Question ID#: 164.0

An emergency stop button at a service station is required to disconnect all circuits to dispensers and pumps.

An emergency stop button which disconnects the AC power to the gasoline pump at a service station is no longer the only disconnect required. All of the circuits, including AC and DC power, low voltage, voice and data communications, computer circuits, and video, running to the dispensing pump must have a simultaneous disconnecting means. In an emergency situation, if the dispensing device was damaged there could be gasoline all around the gasoline pump. A spark from any of these circuits could ignite the spilled gasoline. Now all these circuits must be able to be simultaneously disconnected from the gasoline pump.

The pump manufacturers do not usually supply illustrations of the installation of a disconnecting means for circuits other than the AC power circuit. However, now the switch or other device that controls the approved disconnecting means selected to remove power from all circuits must be clearly identified, readily accessible, and remotely located from the dispensing equipment. All conductors for power, data, voice, and video circuits, including any grounded conductors, leading to or passing through a dispensing device, must be simultaneously disconnected.

Question 22: Which of the following statements about circuit disconnects for motor fuel dispensing equipment is true?

A: The disconnecting means can be located adjacent to the dispensing equipment.
B: All disconnecting means shall be located inside the building.
C: All types of electrical circuits including voice and data communications, computer circuits, and video circuits as well as power circuits at the dispensing equipment must be simultaneously disconnected by a disconnecting means operated by a control device located remotely from fuel dispensers.
D: Circuits operating at less than 50 volts are not required to have a disconnecting means.

Question 23: 517.13(B) Grounding of Receptacles and Fixed Electrical Equipment in Patient Care Areas. Insulated Equipment Grounding Conductor.

Question ID#: 165.0

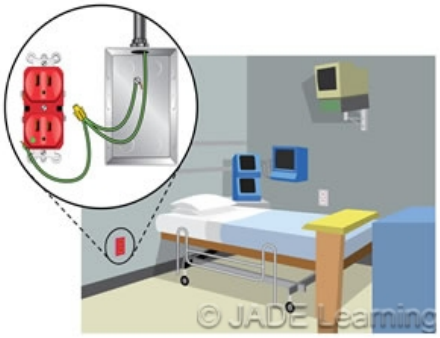
Section 517.13(B) was reorganized in a list format; it now specifies that the insulated copper grounding conductor in a branch circuit supplying a patient care area must be connected to:

- receptacle grounding terminals.
- metal enclosures and boxes containing receptacles.
- non-current carrying metal surfaces of fixed equipment operated at over 100 volts, if the surfaces touched by people are likely to become energized.

A new exception permits an insulated equipment bonding jumper to connect the box and receptacle to the insulated equipment grounding conductor. This requirement is part of the redundant "double" grounding required for patient care areas.

It is still necessary to install a separate insulated equipment grounding conductor back to the panel where the circuit originates.

The revisions to this section are a clarification, rather than a new requirement. Its purpose is to emphasize that the insulated equipment grounding conductor must be connected to the metal box and to the receptacle's grounding terminal. The exception specifically permits the practice of using equipment bonding jumpers sized according to section 250.122 to connect the grounding terminal of the receptacle to the metal box and to the insulated equipment grounding conductor.



Equipment and devices in a patient care area must be connected to an insulated equipment grounding conductor.

Question 23: In Patient Care Areas, which of the following practices is a Code violation?

A: Using an equipment bonding jumper to connect the insulated equipment grounding conductor to the receptacle.
B: Using an equipment bonding jumper to connect the metal box to the insulated equipment grounding conductor.
C: Using Table 250.122 to select the proper size equipment bonding jumper.
D: Using the grounded metal box as the sole means to ground the receptacle.

Question 24: 517.16 Receptacles with Insulated Grounding Terminals.

Question ID#: 166.0

Isolated Ground (IG) receptacles are not permitted in patient care areas.

In patient care areas, r***eceptacles with insulated grounding terminals, as described in 250.146(D) shall not be permitted.*** This controversial change will eliminate Isolated Ground (IG) receptacles in patient care areas.

IG receptacles are used for sensitive electronic equipment to prevent electrical noise (electromagnetic interference), which can be present on the equipment grounding system, from interfering with the equipment.

The grounding terminal of IG receptacles is insulated from the metal box and the metal conduit system. The insulated equipment grounding conductor is connected directly to the grounding terminal of the receptacle. The mounting strap of the isolated receptacle is insulated from the receptacle's equipment grounding terminal.

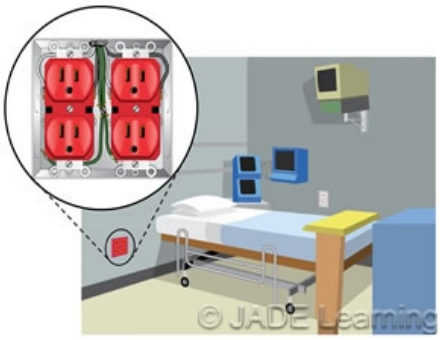
In patient care areas of health care facilities redundant grounding is required. The raceways and enclosures and the insulated equipment grounding conductor are all used as a ground-fault return path. If the IG receptacle is insulated from the raceway and enclosure, it compromises the redundant grounding required in patient care areas and increases the hazard to patient safety. Very small amounts of fault current can be fatal to a patient connected to medical equipment and instruments operating at 120 volts AC. An effective redundant grounding and bonding means minimizes these hazards.

Question 24: In health care facilities, where are isolated ground receptacles prohibited?

A: In data processing areas.
B: In patient care areas.
C: At nursing stations.
D: In facilities maintenance areas.

Question 25: 517.18(A) General Care Areas. Patient Bed Location.

Question ID#: 168.0



Multiwire branch circuits are not permitted to supply patient bed locations.

The branch circuit serving patient bed locations shall not be part of a multiwire branch circuit.

At least two branch circuits are required for the patient bed location in a general care area. The general rule requires one circuit to be supplied from the emergency system and the other by the normal system. All branch circuits supplied by the normal system are required to come from the same panelboard. A branch circuit supplying a patient bed location cannot be part of a multiwire branch circuit because handle-ties or multi-pole circuit breakers are required by 210.4 for multiwire branch circuits. If one circuit trips, the other circuits could trip, leaving other patient bed locations without power.

For example, what would happen if a 3 circuit multiwire branch circuit supplied power to a patient bed location in three different rooms? Monitoring or treatment equipment that is important for the patient's care is plugged into the patient bed location circuits. If one circuit trips, de-energizing this equipment, it is a serious problem. If all the circuits in a multiwire branch circuit trip, in three different patient bed locations, it can be a disaster.

A similar requirement prohibits multiwire branch circuits in patient bed locations in critical care areas.

There are three exceptions to the general rule:

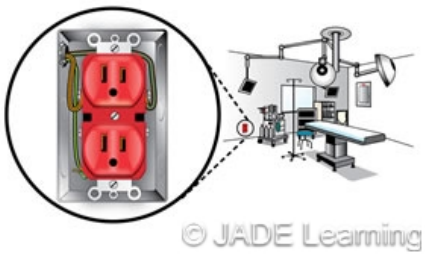
- Permits normal circuits serving specialized equipment to originate in different panels.
- Exempts medical facilities like clinics and doctor's offices from the requirements in 517.18(A).
- Exempts patient bed locations in general care areas supplied by two transfer switches on the emergency system from having circuits supplied by the normal system.

Question 25: Which of the following violates the requirements for branch circuits for patient bed locations?

A: One branch circuit in a patient bed location general care area supplied by the normal system and another circuit supplied by the emergency system.
B: Two branch circuits supplying a patient bed location.
C: A multiwire branch circuit supplying a patient bed location in a hospital.
D: All branch circuits from the normal system shall originate in the same panelboard.

Question 26: 517.160(A)(5) Isolated Power Systems. Installations. Conductor Identification.

Question ID#: 171.0



Conductors of isolated power systems must be identified differently from other conductors.

An Isolated Power System as defined in 517.2 is ***"A system comprising an isolating transformer or its equivalent, a line isolation monitor, and its ungrounded circuit conductors."*** Because there are ***no grounded conductors*** in circuits originating from Isolated Power Systems, conductors of isolated power systems must be identified differently from other conductors. Isolated conductor No. 1 must be orange with at least one distinctive stripe along its entire length. Isolated conductor No. 2 must be brown with at least one distinctive stripe along its entire length. For 3-phase systems, isolated conductor No. 3 must be yellow with at least one distinctive stripe along its entire length.

The wording in the 2008 NEC allowed the isolated conductors to be taped at the terminations with a distinctive color. In 2011 a conductor used on an isolated system must be manufactured with a stripe (other than white, green or gray) along its entire length. When the isolated circuit supplies 125-volt, single-phase, 15- and 20-ampere receptacles, ***the striped orange conductor is connected to the terminal on the receptacles identified for a grounded conductor even though it is technically an ungrounded conductor***.

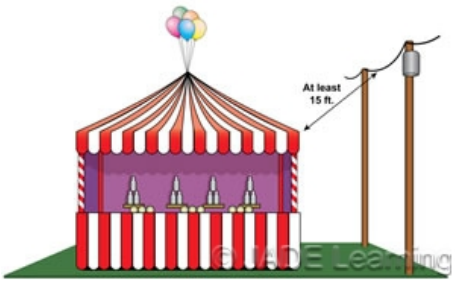
Isolated power systems are supplied by isolation transformers, or their equivalent, and are ungrounded. Isolated circuits are used to supply operating rooms and other areas where even small ground fault currents can be fatal. Isolated circuits have a line isolation monitor that indicates the total hazard current. A green signal lamp indicates the system is isolated from ground. A red signal lamp indicates the hazard current to ground is above 5 mA.

Question 26: A 125-volt, 20-ampere receptacle in an operating room is supplied by an Isolated Power Circuit. Excluding equipment grounding conductors, how many grounded conductors are connected to the receptacle?

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

Question 27: 525.5(B)(2) Carnivals, Circuses, Fairs, and Similar Events. Overhead Conductor Clearances. Clearance to Portable Structures. Over 600 Volts.

Question ID#: 174.0



A 15-ft. clearance is required between overhead conductors rated over 600 volts and portable structures at carnivals, circuses, fairs and similar events. The 15-ft, clearance is measured horizontally and extends vertically to grade.

At fairs, carnivals, circuses, and similar events portable structures and amusements are not permitted to be located under or within 15 feet horizontally of overhead conductors operated at over 600 volts. The 15 foot dimension extends on each side of the conductors vertically from the conductor's height to grade level.

For example, for a 2400 volt power line that is 24 feet above grade, portable structures are not permitted to be placed under or within 15 feet horizontally of either side of the line; from grade level up to the power line (24 feet) there is a 30 foot wide space centered under the power line in which no portable structures are permitted.

Keeping portable structures well away from conductors operating at over 600 volts will help protect contractors and carnival or fair employees from contacting the high voltage lines when they are setting up the booth, ride or structure. It will also protect customers by ensuring that amusements like Ferris wheels and merry-go-rounds are not near overhead conductors.

Question 27: Which of the following installations at a traveling fair is a 2011 NEC Code violation?

A: A 10 ft. tall concession stand located directly underneath overhead conductors operating at 2400 volts.
B: An 8 ft. tall ticket booth located 20 ft. horizontally away from high voltage conductors.
C: A Ferris wheel that is 25 ft. horizontally from overhead conductors operating at 1000 volts.
D: A circus tent located 50 ft. horizontally from overhead high voltage conductors.

Question 28: 547.5(G) Agricultural Buildings. Wiring Methods. Receptacles.

Question ID#: 175.0

Areas that require GFCI protection in agricultural buildings for 125-volt, single-phase, 15 and 20-ampere devices have been expanded.

In agricultural buildings, all 125-volt, single-phase, 15 and 20-ampere devices located in an area with an equipotential plane, outdoors, in a damp or wet location, or in a dirt confinement area for livestock are required to be GFCI protected.

The 2008 NEC did not require GFCI protection for accessible receptacles serving dedicated loads, provided that a GFCI protected receptacle was located within 3 ft. of the non-GFCI receptacle. The 2011 NEC deleted this permission. Now, a receptacle outlet that supplies a dedicated piece of equipment, such as an automatic feeder, must be GFCI protected if the receptacle is located in an area requiring GFCI protection.

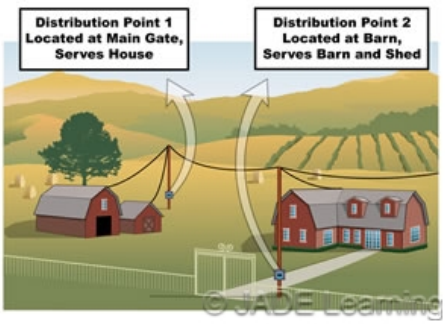
Older farm equipment has leakage currents high enough to trip a GFCI device. Newer farm equipment, which is built according to current product standards, has much less leakage current and will not cause nuisance tripping of GFCI devices. Even though there is a great deal of older farm equipment still in service, the NFPA Code panel did not want non-GFCI protected receptacles in areas where there is an increased shock hazard.

Question 28: In an agricultural building, where is a 125-volt, 15- or 20-ampere receptacle required to be GFCI protected?

A: In a dry, hay storage loft.
B: In an animal wash down area.
C: In a room with a wooden floor where saddles and feed are stored.
D: In the office ceiling for plug-in luminaires.

Question 29: 547.9(D) Electrical Supply to Building(s) or Structure(s) from a Distribution Point. Identification.

Question ID#: 176.0



The arrows in the drawing point to the close up view of the label on each service. In this drawing, Distribution Point No. 2 is located near the barn. Distribution Point No. 1 is located near the main gate. On farm properties, a plaque at each distribution point is required to indicate the location and structures supplied by other distribution points.

People sometimes confuse the purpose of the plaque or notice required by 547.9(D) with the purpose of the circuit directory required by 408.4(A). They have very different purposes!

The question below is based on this illustration which represents a farm that has two distribution points supplied by a single service. The two plaques required by 547.9(D) do not serve the same purpose as a circuit directory required by 408.4(A). The required plaques are represented by the white notes in the drawing.

Basically, the plaques are there to tell someone where other distribution points are located on the property and what they supply.

There are two purposes for these plaques:

- to indicate the location of the other distribution points on the property and to identify the loads these other distribution points supply.
- to warn service personnel that there is more than one source of power for various buildings and structures on the property.

Distribution Point Number 1 is located near the main gate leading to the house. The information on the plaque located at ***Distribution Point Number 1*** should ***indicate the location of Distribution Point Number 2*** and the buildings or structures distribution point Number 2 serves.

Distribution Point Number 2 is located near a shed close to the barn. At ***Distribution Point Number 2*** a plaque should indicate ***the location of Distribution Point Number 1*** and what buildings or structures distribution point number 1 supplies.

The circuit directory required by 408.4 (A) on panelboards supplied by a distribution point is required to indicate what loads are supplied by each branch circuit and feeder originating in the panelboard supplied by that distribution point.

Question 29: Refer to the above illustration to answer this question.

A farm has two distribution points:

Distribution point No. 1 supplies the house and is located on a pole near the main gate.

Distribution point No. 2 supplies the barn and a small shed; it is located on a pole near the barn and the shed.

Which of the following statements includes all information required to be on the plaque at distribution point #1 near the main gate?

A: Distribution Point No. 1 is located near the main gate.
B: Distribution Point No. 2 is located near the shed by the barn.
C: Distribution Point No. 1 is located near the main gate and it supplies the main house.
D: Distribution Point No. 2 is located to the right of the shed near barn; it supplies the barn and the shed.

Question 30: 555.3 Marinas and Boatyards. Ground-Fault Protection.

Question ID#: 181.0

Two different types of ground-fault protection are permitted for marinas and boat yards.

The NEC allows ground-fault protection for marinas and boat yards to be provided in two different ways:

- The main overcurrent device for the supply to a marina is permitted to provide ground-fault protection not exceeding 100 mA.
- Each feeder or branch circuit can be individually provided with ground-fault protection not greater than 100 mA.

Marinas can be dangerous places. Receptacles providing shore power for boats are rated 30 amps, 50 amps, 60 amps or 100 amps. Ground-faults onboard vessels and boats connected to these receptacles or cuts and breaks in the shore power cords can be a serious shock hazard. Ground-fault protection for branch circuits supplying the docks can help prevent electrical shock injuries.

However, because the "let-go" current level for adults is approximately 10 mA, a ground-fault device at the marina service set for 100 mA does not provide the same level of protection as a GFCI circuit breaker or receptacle with a trip setting of 4 mA-6 mA. Also, the leakage current from a large marina may exceed the 100 mA setting at the main overcurrent device without leakage current at an individual branch circuit in the marina being greater than 6 mA. If this was the case, power to the entire marina would be cut off.

Question 30: Which of the following is a requirement for ground-fault protection at a marina?

A: Ground-fault protection provided at the main disconnect can not be greater than 100 mA.
B: All the 15- and 20-ampere receptacles are required to be the ground-fault circuit- interrupter type.
C: Branch circuits supplying boat slips must be GFCI protected. Other branch circuits in the marina are not required to be GFCI protected.
D: Each feeder in the marina must have ground-fault circuit-interrupter protection not greater than 6 mA.

Question 31: 590.4(D) Temporary Installations. General. Receptacles.

Question ID#: 184.0

Extra duty weather-resistant covers and weather-resistant receptacles are now required for pole/post mounted receptacles on construction sites.

Receptacle outlets installed as temporary power in wet locations are often subject to abuse. Temporary power receptacles on construction sites are often exposed to damage from people and equipment. A new section has been added which requires that 15- and 20-ampere, 125- and 250-volt receptacles installed for temporary power in wet locations in an enclosure mounted on a post, similar structure, or that are supported by conduit as described in 314.23(B or F), have a cover or ***outlet box hood*** which is identified for ***extra duty***, per 406.9(B)(1).

The standard bubble cover used at dwelling units is not built to withstand the rough treatment of construction sites or other temporary wiring locations. The ***extra duty*** outlet box hood or cover is much stronger and more durable than plastic in-use, bubble covers. If a 15- and 20-ampere, 125- and 250-volt receptacle is used for temporary power in a wet location, and is mounted on a pole, or mounted directly on grade and supported by raceways with threaded conduit entries, the cover or hood must be identified as ***extra duty.*** The receptacle must be listed weather- resistant type.

Question 31: Which of the following statements about receptacles installed at temporary installations is true?

A: In a wet location, enclosures for 30-ampere receptacles must have a cover identified as extra duty.
B: All receptacles used for temporary installations must be listed weather resistant.
C: In a wet location, in an enclosure supported from grade, the outlet box hood or cover for an enclosure for a 20-ampere, 250-volt, twist-lock receptacle must be identified as extra duty.
D: In a wet location, enclosures for 15- and 20-ampere, 125- and 250-volt receptacles must be metal.

Question 32: 590.6 Ground-Fault Protection for Personnel.

Question ID#: 185.0

GFCI protection is required for 15-30 amp, 125/250-volt receptacle outlets on generators rated 15 kW or less used for temporary power.

The 2011 NEC requires portable generators used for temporary power that were manufactured after January 1, 2011 to include GFCI protection for all 125-volt and 125/250 volt, single-phase, 15-, 20-and 30-ampere receptacle outlets that are a part of the generator. If the generator will be used in wet or damp locations they are required to have in-use covers as required by 406.9(A & B).

Generators manufactured prior to January 1, 2011, were not required to include GFCI protection. Listed cord-sets that incorporate ground-fault protection for personnel are permitted to provide the required GFCI protection on 15 kW or less portable generators manufactured before January 1, 2011.

Requiring GFCI protected receptacles to be installed when the generator is manufactured will protect homeowners who buy portable generators and are unaware of the need for GFCI protection in temporary installations. GFCI protection at the portable generator will also protect workers on construction sites by protecting the branch circuit or feeder wiring from the generator to temporary receptacle outlets.

This entire section in the 2011 NEC on ground-fault protection for personnel at temporary installations has been rewritten to make it clear that GFCI protection for personnel is required for receptacle outlets that are not part of permanent wiring, and it is required for receptacle outlets that are existing or installed as permanent wiring.

Question 32: If a 15 kW single-phase portable generator that will be used for temporary power was manufactured on March 20th, 2011 which of the following statements is correct?

A: A listed cord-set with built-in GFCI protection is acceptable instead of GFCI protected receptacles on the generator.
B: Receptacles rated 125-volt and 125/250 volt, single-phase, 15-, 20- and 30-ampere must have GFCI protection.
C: In-use covers for 15- and 20- ampere, 125-volt receptacles are not required regardless of where the generator is used.
D: A receptacle rated 50 amperes, 250 volts must have GFCI protection.

Question 33: 600.4(C)&(D) Visibility and Durability.

Question ID#: 188.0

Electric sign markings are no longer required to be visible after installation.

Electric signs and outline lighting systems must be marked with the manufacturer's name, trademark, input voltage and current rating.

The 2008 NEC required these markings to be visible after installation. The 2011 NEC no longer requires them to be visible after installation. Now they can be applied in a location visible during servicing. Not having the input voltage and current rating of a sign visible after the installation is complete will make it harder for inspectors to determine if the sign has been installed according to Code. It may make it easier for service personnel working on the sign.

Marking labels for signs must be permanent, durable, and weatherproof when installed in a wet location. If the label is not readable because it has been exposed to the weather, the information on the label cannot be used to aid an inspector, installer or service personnel.

Question 33: Which one of the following electric signs is required to have a weatherproof marking label?

A: An outdoor drive-thru menu sign at a fast food restaurant.
B: A sign inside a barbershop window.
C: A menu sign inside a cafeteria.
D: A directory sign inside a shopping mall.

Question 34: 625.2 & 625.21 Electrical Vehicle Charging System. Definitions. Rechargeable Energy Storage System.

Question ID#: 196.0

A readily accessible disconnect is required for electric vehicle charging equipment rated more than 60 amperes.

A rechargeable energy storage system is ***any power source that has the capability to be charged and discharged.*** Informational Note: ***Batteries, capacitors, and electromechanical flywheels are examples of rechargeable energy storage systems.***

Rechargeable plug-in electric vehicles for on-road use are here now. Charging stations are being installed across the country to provide a way to extend the driving range of these vehicles. Charging stations for electric vehicles provide the biggest opportunity for the electrical industry since air conditioning.

Most charging stations for plug-in hybrid electric vehicles will operate at 240 volts, single phase. A standardized connector from the charging station plugs into the vehicle and can recharge the battery in a matter of hours. The electric vehicle connector on the charging station transfers power to the battery and sets up an information link between the charger and vehicle battery. Section 625.21 requires overcurrent protection for the feeder or branch circuit supplying the charging station to be sized at 125% of the maximum load of the electric vehicle supply equipment. A disconnecting means for vehicle supply equipment rated more than 60 amperes or more than 150 volts to ground is required in a readily accessible location.

Question 34: An electric vehicle charging station is rated for 30 amps. What is the maximum rating of the overcurrent device for the branch circuit supplying the charging station?

A: 40 amps.
B: 50 amps.
C: 60 amps.
D: 100 amps.

Question 35: 645.4 Special Requirements for Information Technology Equipment Room.

Question ID#: 200.0

To be classified as an information technology room specific criteria must be met.

Wiring in Information Technology (IT) equipment rooms can be done according to Article 645 if the room meets all the requirements of 645.4. Some of the wiring practices in Article 645 are not as strict as in Chapters 1-4. For example, liquidtight flexible non-metallic conduit is permitted under raised floors in an IT equipment room, but it is not permitted as plenum wiring in 300.22. Because of the less strict requirements in Article 645 for IT equipment rooms, all the requirements of 645.4 must be met for the room to be classified as an IT equipment room.

Except where supplied by an Integrated Electrical System covered by Article 685, an IT equipment room must have all of the following:

- A remote disconnect to remove power from all electronic equipment in the room or in zones in the room and a separate disconnecting means to disconnect dedicated HVAC equipment serving the IT areas. The two disconnecting means are permitted to be controlled by one device like a switch or pushbutton.
- A separate heating/ventilating system dedicated to the IT equipment room or zones.
- An access control system limits entry to the room to only authorized persons.
- Fire-resistant-rated walls, floors , and ceilings that separate the IT equipment room from other rooms.
- Only electrical equipment associated with the operation of IT equipment is permitted in IT rooms or zones.

Question 35: Which of the following is not a requirement for an information technology room?

A: A room with IT equipment and HVAC equipment that serves only the IT equipment room.
B: A room with IT equipment and two exits.
C: A room with IT equipment and fire resistant walls, floors and ceilings.
D: A room with IT equipment and locked doors that limit who can enter the IT room.

Question 36: 645.10 Disconnecting Means.

Question ID#: 202.0

The disconnect for IT equipment power is no longer required to be located beside an exit door.

An approved means to disconnect power to all electronic equipment and the HVAC system in the IT equipment room must be provided. The 2008 NEC required the controls for the disconnects to be located at a readily accessible location at the principal exit doors. The disconnect control could be a pushbutton or selector switch. Being located at the exit doors meant it could be easily operated by accident or by sabotage.

To solve this problem, the 2011 NEC permits the disconnect control to be mounted remotely in a manager's office or a similar location. The remote disconnect control must be in a location that is readily accessible to authorized persons and emergency responders. It must be identified as a disconnect, and it can be guarded with a cover or other means. Remote disconnect controls for the electronic equipment power and the HVAC systems shall be grouped and identified. A single control such as a pushbutton can operate the disconnecting means for both the IT equipment and HVAC system.

Critical Operations Data Systems are information technology systems that support public safety, emergency management, national security, or business continuity. A remotely controlled disconnecting means for the IT equipment for Critical Operations Data Systems is not required, provided the IT room or zone has smoke detectors, fire suppression systems, qualified people available to meet emergency personnel, an

established procedure to remove power and air movement from the IT area, and approved cable and raceways installed under raised flooring.

Question 36: Which of the following is a true statement about disconnecting means for information technology equipment?

A: The controls for disconnecting power to IT equipment must be located at the exits of the information technology room.
B: Remote disconnects for IT room equipment and the IT room HVAC system shall be grouped and identified.
C: Disconnects for IT equipment must be located inside the information technology room.
D: Separate controls to operate disconnects for the information technology equipment and HVAC systems are required.

Question 37: Table 680.10 Swimming Pools, Fountains, and Similar Installations. Minimum Cover Depths.

Question ID#: 205.0

Use Table 680.10 for the minimum cover depths of underground raceways for pools and hot tubs.

Wiring can never be installed underneath a swimming pool or within 5 ft. horizontally from the inside wall of a pool, spa or hot tub unless it is required to supply pool equipment permitted in Article 680. However, where required by space limitations, underground wiring not associated with a pool is permitted within 5 ft. of the pool wall when installed as a complete raceway system using RMC, IMC, or a non-metallic raceway. The burial depth of conduit within 5 ft. of the pool is shown in Table 680.10. A revision to the Table permits a reduction of the burial depth to 6 inches for non-metallic raceways listed for direct burial under a minimum of 4 inches of concrete which extends not less than 6 inches beyond the underground installation.

The 2008 NEC required non-metallic conduit to be buried 18 inches; the burial depth was the same whether it was buried below concrete or not.
Table 300.5 permits a reduced burial depth of 4 inches whenever a non-metallic raceway is installed under a minimum of 4 inches of concrete. However, in the 2011 NEC, if the non-metallic conduit is installed within 5 ft. of a swimming pool, spa or hot tub, Table 680.10 requires the non-metallic conduit to be installed a minimum of 6 inches deep if covered by at least 4 inches of concrete.

Question 37: What is the minimum burial depth for a run of Rigid PVC conduit installed within 2 feet of the edge of a swimming pool under a 4 inch concrete slab?

A: 4 inches.
B: 5 inches.
C: 6 inches.
D: 18 inches.

Question 38: 680.21(C) GFCI Protection.

Question ID#: 207.0

A single-phase, 120 volt - 240 volt, 15 or 20 amp pool pump motor is required to be GFCI protected whether it is hard-wired or cord-and-plug connected.

Pool pump motors are required to be GFCI protected if the pump is connected to a single-phase, 120 volt through 240 volt branch circuit rated 15 or 20 amps. GFCI protection is required whether the pool pump motor is hard-wired or cord-and-plug connected to a receptacle.

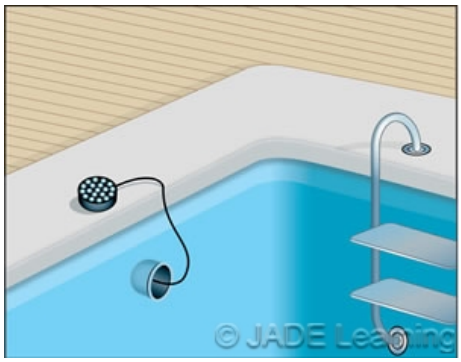
The requirement for GFCI protection for pool pump motors was moved from a section on area lighting, receptacles and equipment in the 2008 NEC to the section on motors in the 2011 NEC. In addition to relocating the requirement, the voltage range was changed from ***125 volts or 240 volts*** in the 2008 Code to ***120 volts through 240 volts*** in the 2011 NEC. With the change, 208 volt and 230 volt rated motors are covered.

Question 38: Which hotel swimming pool pump motor listed below requires GFCI protection?

A: Single-phase, 120 volt, 20 amp rated.
B: Three-phase, 208 volt, 20 amp rated.
C: Single-phase, 240 volt, 30 amp rated.
D: Single-phase, 277 volt, 15 amp rated.

Question 39: 680.23(A)(3) Underwater Luminaires. GFCI Protection. Relamping.

Question ID#: 208.0



GFCI protection is not required for underwater luminaires that operate at or below the low voltage contact limit.

GFCI protection of underwater luminaires that operate at or below ***the low voltage contact limit*** no longer require GFCI protection. The change was made because LED lighting for underwater luminaires is very popular and is connected to power supplies that operate below the low voltage contact limit.

The low voltage contact limit is defined in 680.2 as:

- 15 volts (RMS) sinusoidal AC
- 21.2 volts peak nonsinusoidal AC
- 30 volts continuous DC
- 12.4 volts peak DC that is interrupted at a rate of 10 to 200Hz

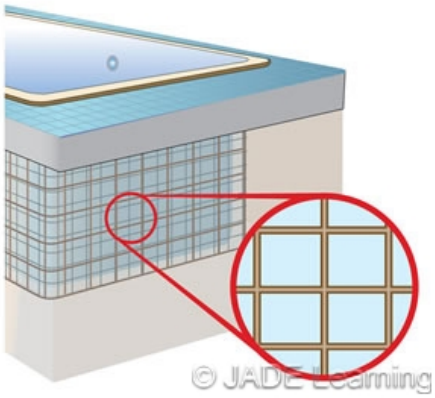
Underwater LED luminaires that operate below these voltage thresholds do not pose a shock hazard during relamping or at other times and do not require GFCI protection.

Question 39: Luminaires listed for which of the following voltages are required to be installed on GFCI protected branch circuits?

A: 15 volt RMS sinusoidal AC.
B: 21.2 volt peak nonsinusoidal AC.
C: 30 volt continuous DC.
D: 120 volt RMS sinusoidal rated AC.

Question 40: 680.26(B)(1)(b) Equipotential Bonding. Bonded Parts. Conductive Pool Shells.

Question ID#: 209.0



Concrete swimming pool shells are considered to be conductive and required to be bonded to the equipotential grid.

Concrete pools are considered to be electrically conductive shells regardless of their construction. Section 680.26(B)(1) requires conductive shells to be bonded to the equipotential grid to reduce voltage gradients in the pool area by one of two methods:

- Bonding uncoated structural rebar in the concrete together with steel tie wires.
- If the rebar is coated with a nonconductive covering, a grid of copper conductors is required to be installed within 6 inches of the pool shell.

Regardless of which method is used, the copper grid or rebar is connected by a No. 8 AWG, or larger, solid copper conductor to the equipotential bonding grid.

When a copper conductor grid is used to create an equipotential bonding grid for an in-ground pool, the No. 8 AWG bare solid copper conductors that make up the grid must be bonded at all points of crossing. The 2008 NEC did not specify how to make the connections at the crossing points. The 2011 NEC requires the connections to be made according to 250.8 or by other approved means.

Section 250.8 includes the following devices or methods as a way to make the connection: Listed pressure connectors, terminal bars, other connectors listed for grounding and bonding equipment, or by exothermic welding processes or other means listed for grounding and bonding equipment.

The copper conductor grid is only required to conform to the contour of the pool. The 2008 NEC required the copper conductor grid to conform to the contour of the pool and the pool deck. Equipotential bonding for the deck is different than for the pool shell. The NEC calls the pool deck a perimeter surface. Its bonding requirements are covered in 680.26(B)(2)(b). Bonding is done by one of two methods:

- Bonding uncoated structural rebar in the concrete together with steel tie wires.
- Bonding rebar with a single solid bare copper No. 8 AWG conductor connected to the reinforcing steel or copper conductor grid at four points.

Question 40: Which of the following statements about the copper conductor grid for a swimming pool shell is true?

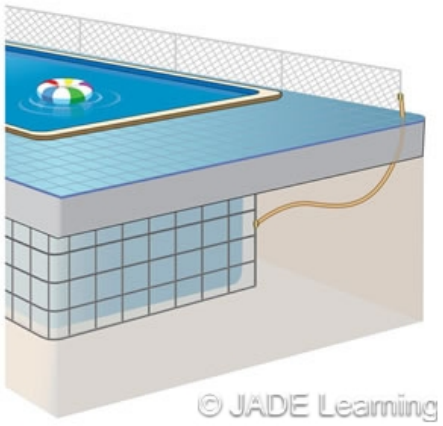
A: Steel tie wires are permitted to connect the copper conductor grid together.
B: The copper conductor grid is required for both the pool shell and the perimeter surface.
C: The copper conductor grid is permitted to be connected together with listed pressure connectors.
D: The copper conductor grid is constructed using a minimum No. 10 AWG bare copper conductor.

Question 41: 680.26(B)(7) Equipotential Bonding. Bonded Parts. Fixed Metal Parts.

Question ID#: 210.0

All metal parts that are part of the pool or located within 5 ft. horizontally ***and*** 12 ft. vertically from the pool must be bonded together and connected to the equipotential bonding grid. This includes, but is not limited to, metal-sheathed cables and raceways, metal piping, metal awnings, metal fences, metal ladders, and metal door and window frames.

It does not seem likely that metal door and window frames will become energized. However, the purpose of the equipotential bonding grid is not to provide a path for fault current if a metal object becomes energized. The purpose of the bonding grid is to reduce voltage differences in the pool area. If there is no difference in voltage potential between any two objects in the pool area, then the risk of electric shock is reduced.
Exception No. 1 was revised to make it clear that only those metal parts that were separated from the pool by a permanent barrier that prevents contact by a person with any metal part are not required to be bonded.



All metal parts that are part of the pool or located close to the pool are required to be bonded to the equipotential bonding grid.

Question 41: Which of the following items listed below would not be required to be bonded to the equipotential bonding grid?

A: A metal fence located within 4.5 feet from the edge of the pool.
B: A metal pool house door located within 5 feet from the edge of the pool.
C: A metal awning located 15-feet high covers a pool. No part of the awning or its supports is within 5 feet from the edge of the pool.
D: A metal luminaire pole located within 4 feet from the edge of the pool.

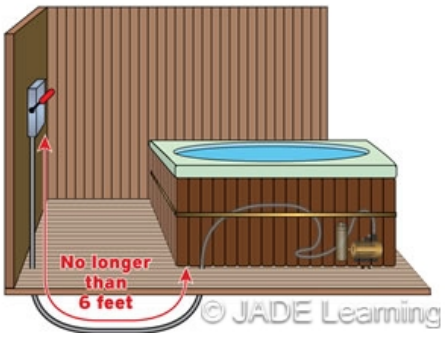
Question 42: 680.42(A)(1) Outdoor Installations. Flexible Conduit.

Question ID#: 211.0

An outdoor spa or hot tub with a factory-installed control panel or panelboard can use flexible wiring methods to connect the spa equipment to the control panel or panelboard. In the 2008 NEC, liquidtight flexible metal conduit or liquidtight flexible non-metallic conduit was permitted in lengths of not more than 6 ft.

The 2011 NEC permits 6 ft. of liquidtight flexible metal conduit or liquidtight flexible non-metallic conduit ***external to the spa or hot tub enclosure in addition to the length needed within the enclosure to make the electrical connection.***

The flexible conduit inside the hot tub or spa enclosure is protected from physical damage and is not counted in the total run of flexible conduit. Outside the hot tub or spa enclosure, the length of the flexible conduit is still limited to 6 ft.
Under the 2008 NEC with only a total of 6 ft. of liquidtight flexible metal conduit or liquidtight flexible non-metallic conduit allowed, it was necessary to install a fitting on the flexible conduit to make the transition to a different wiring method. The fitting was a weak point in the installation and if it pulled apart it would create a hazard. A single run of liquidtight flexible metal conduit or liquidtight flexible non-metallic conduit, without a fitting to change wiring methods, is a safer installation.



LFMC and FMC is limited to 6 ft. outside the hot tub enclosure, but any length is permitted inside the enclosure.

Question 42: Which of the following installations for outdoor spas or hot tubs is permitted by the 2011 NEC?

A: A 16 ft. run of flexible non-metallic conduit with 10 ft. of the flexible conduit outside of the hot tub or spa enclosure.
B: A 12 ft. run of flexible non-metallic conduit with 6 ft. of the flexible non-metallic conduit inside the hot tub or spa enclosure.
C: A 10 ft. run of flexible non-metallic conduit with 3 ft. of flexible conduit inside the hot tub or spa enclosure.
D: A 14 ft. run of flexible non-metallic conduit with 8 ft. of flexible conduit outside of the hot tub or spa enclosure.

Question 43: 680.43 Exception No.2 Spas and Hot Tubs. Indoor Installations.

Question ID#: 212.0

An indoor listed self-contained spa or hot tub that is installed above a finished floor is no longer required to have an equipotential bonding plane around the perimeter surface of the spa or hot tub. If the spa or hot tub is sitting on the floor, but not installed in the floor, it is considered above the floor.

Some jurisdictions were requiring the floor around a new hot tub to be cut out to allow for the installation of an equipotential bonding conductor to be installed around the perimeter of the hot tub. This added considerable expense to the installation and caused problems between inspectors, installers and homeowners, without making the installation safer.
The exception was added because there were no known reported shock or electrocution incidents where people making contact with the spa or hot tub and the surrounding perimeter surface were injured by a failure to bond the perimeter surface around an indoor spa or hot tub. However, spas and hot tubs installed outdoors still require equipotential bonding around the perimeter of the spa or hot tub.

An equipotential bonding plane is not required around an indoor listed self-contained spa or hot tub that is installed above a finished floor.

Question 43: Which of the following installations would not require an equipotential bonding grid?

A: A hot tub located on an existing concrete patio in the backyard.
B: A spa located in a bonus room on a ceramic tile floor.
C: A spa located outside on a new concrete patio.
D: A hot tub located on the back porch on new brick pavers.

Question 44: 680.73 Hydromassage Bathtub - Accessibility.

Question ID#: 214.0

A hydromassage bathtub is a permanently installed bathtub with a recirculating piping system that is designed to accept, circulate, and discharge water with each use.

Hydromassage bathtubs are required to be supplied by an individual branch circuit and be protected by a readily accessible ground-fault circuit-interrupter. If it is considered as not being readily accessible, a GFCI receptacle mounted behind service access doors underneath the tub cannot provide the GFCI protection required by 680.71. Whether a GFCI receptacle behind an access door is considered readily accessible will be an AHJ call; it may depend on how the door is secured to the tub enclosure. However, in all cases, the GFCI protection is required to be provided by a readily accessible GFCI circuit breaker, GFCI receptacle, or a blank GFCI device installed in a readily accessible location.

When the supply receptacle for a cord-and-plug connected hydromassage tub is mounted behind a service access door, the receptacle must be installed so that its face is within direct view and not more than 1 ft. from the opening. This will permit easier access to the receptacle under the tub whenever the access door is open and will mean the hydromassage tub motor can be easily observed and disconnected for servicing.

A GFCI protected receptacle for a cord and plug connected hydromassage tub must be accessible.

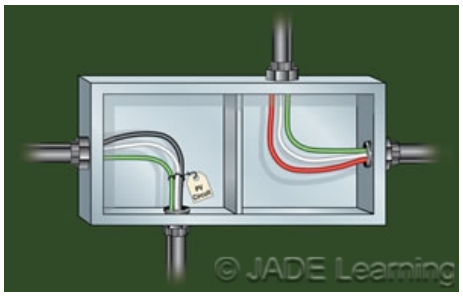
Question 44: If the receptacle provides the GFCI protection required by 680.71, which of the installations below is in compliance with the 2011 NEC?

A: A GFCI type receptacle located 12 inches behind a hydromassage bathtub access cover which is held in place by screws.
B: A GFCI protected receptacle located 10 inches behind a hydromassage bathtub access cover with the receptacle face positioned away from the access door.
C: A GFCI protected receptacle located 24 inches behind a hydromassage bathtub access cover with the face of the receptacle in direct view.
D: A GFCI protected receptacle for a hydromassage bathtub is located 8 inches behind a hinged access cover beside the

tub. No tools are needed to open the cover and the face of the receptacle is in direct view when the cover is opened.

Question 45: 690.4(B) Installation. Identification and Grouping.

Question ID#: 216.0



A partition is required to separate PV source and output circuits installed in a junction box from conductors of other systems.

PV source and output circuits cannot be installed in the same raceway, cable tray, cable, outlet box, or junction box with conductors from other systems, unless there is a partition between the PV conductors and the conductors of the different systems. The wiring between the common connection point of a DC power system and PV modules and the wiring between PV modules themselves is a PV ***source*** circuit. The wiring between an inverter, or DC utilization equipment, and a PV source circuit is a PV ***output*** circuit.

The following PV system conductors must be identified and grouped as indicated. The means of identification shall be by separate color coding, marking tape, tagging, or other approved means.

- PV Source Circuits at all terminations, connections, and splices.
- PV Output and Inverter Circuits at all terminations, connections, and splices.
- Multiple Systems -Where conductors of more than one system are involved, identify the system at all terminations, connections, and splices. If the identification of the conductors is obvious by spacing or arrangement, identification of each system is not required.
- Grouping - If more than one system is installed in the same junction box or raceway that has removable covers, group AC conductors and DC conductors of each system separately with wire ties, spaced not more than 6 ft. apart. Grouping is not required if the circuit enters from a cable or raceway that makes the grouping obvious.

Question 45: Where conductor identification and grouping is not made obvious by termination and wiring methods, if PV-source circuits and output circuits are terminated in a combiner or junction box that also contains non-PV system circuit conductors, which of the following statements is true?

A: The PV source and output circuits should be grouped together as one bundle with tie wraps.
B: PV source and output circuits can never be installed in the same junction box.
C: The PV source and output circuits are not required to be identified at terminations or splices.
D: The PV source and inverter output circuits must each be identified differently and separated from non-PV system conductors by a partition.

Question 46: 690.4(E) Installation. Wiring and Connections.

Question ID#: 217.0

Only qualified persons should install photovoltaic circuits and systems.

PV circuits, wiring and equipment shall be installed only by qualified persons. Article 100 defines a qualified person as ***"one who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved."***

Installing photovoltaic circuits and systems is a job that should only be performed by qualified electricians. Some energized PV circuits are no less hazardous than circuits supplied by a service or generator. There is a potential for danger from shock and arc flash in a PV system, just like in normal wiring.

PV wiring has much in common with residential and commercial wiring, but there are some unique differences. DC wiring, batteries, inverters and working with interconnected grid electric power sources may be new to many installers. There clearly is a demand for qualified PV technicians. Upgrading skills to include PV installations can be an exciting and rewarding opportunity.

Question 46: Which of the following individuals would be considered qualified to install solar photovoltaic systems?

A: An apprentice electrician.
B: A roofer/handyman.
C: A qualified electrician experienced with PV installations.
D: A general contractor.

Question 47: 690.4(F) Installation. Circuit Routing.

Question ID#: 218.0

PV conductors should be installed next to structural members to reduce the possibility of physical damage.

PV wiring inside of a building must be routed along structural members such as beams, rafters, columns, and trusses. This is required even if the wiring is installed in conduit.

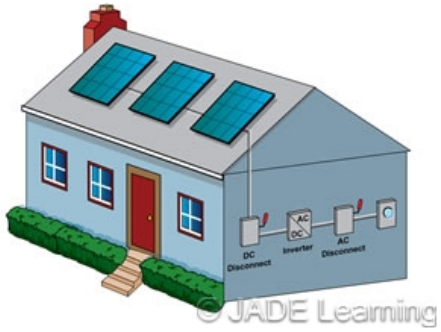
If there is a fire in the building, firefighters often break through the roof to allow for controlled air flow. If PV wiring is installed between the rafters or beams, it is likely a firefighter could cut into a live circuit and receive a shock. Since the PV disconnecting means is permitted inside the building, cuts in a circuit made by a fireman could be ahead of the disconnect or overcurrent protection. Installing PV conductors along structural members reduces the possibility of injury to firefighters. PV systems may be integrated into the roof of the structure. In those parts of the roof that are not covered by the PV modules themselves, or other PV equipment, the location of PV circuit wiring within a structural member must be clearly marked. The method of marking is not described. The reason for the marking is to prevent firefighters from cutting into energized PV wiring.

Question 47: Which of the following violates requirements for routing and installing PV circuit conductors that are not protected by being installed directly under a PV module?

A: PV source circuit conductors installed in EMT secured to a rafter 12-inches below the roof decking of a dwelling.
B: PV output circuit conductors installed in IMC under a truss in a commercial building.
C: PV source circuit conductors installed in MC-Cable that is run perpendicularly to rafters and is secured directly to the underside of 5/8 inch roof sheeting of a single family dwelling.
D: PV output circuit conductors in IMC that is imbedded within a built up roofing panel that is clearly and permanently marked to indicate the location of the conductors.

Question 48: 690.11 Arc-Fault Circuit Protection (Direct Current).

Question ID#: 220.0



A listed DC arc-fault circuit interrupter will protect PV systems from series faults occurring in wiring between PV modules.

PV systems that are mounted on a building or penetrate the building membrane and operate at a voltage of 80 volts or greater require a ***listed DC arc-fault circuit interrupter, PV type, or other system components listed to provide equivalent protection.*** The device must detect the fault and disable the components within the arcing circuit, such as battery charge controllers or inverters. The disconnected equipment must be manually restarted, and there must be a visual indication that the AFCI device has operated.

As of January 2011, there isn't currently a listed direct current AFCI device in existence. In fact, there is not even a UL standard for testing this device, although 1699B is expected in 2011. The device will most likely be located in the inverter or combiner box in a grid-tied system and in the charge controller of a battery based system. The protection will be for series faults that occur in the wiring between modules.

Question 48: Assuming that each PV DC module is rated 19 V, which of the following module arrays require arc-fault circuit protection? (Hint: a series string adds voltage but the current stays the same while a parallel connection adds current and the voltage stays the same.)

A: A single series string of 4 PV modules.
B: Two paralleled series strings of 4 PV modules.
C: A single series string of 5 PV modules.
D: Three paralleled series strings of 3 PV modules.

Question 49: 690.31(E) Methods Permitted. Direct-Current Photovoltaic Source and Output Circuits Inside a Building.

Question ID#: 223.0

Type MC metal-clad cable is now permitted as a wiring method when installing PV conductors in buildings.

There are new requirements for installing PV conductors inside of buildings. MC metal-clad cable is now permitted as a wiring method. There are also four new sections:

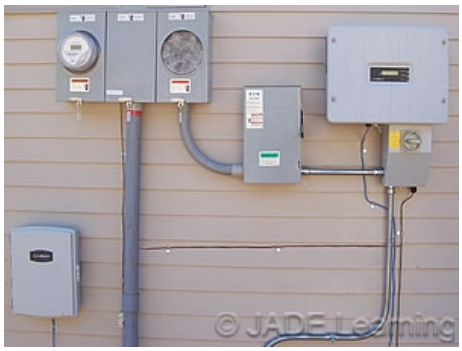
- Beneath Roofs. There are no specified distance requirements between roof decking or sheathing for any wiring methods installed beneath a roof as long as the wiring is directly under PV modules mounted on the roof. Wiring that is not installed directly under PV modules is permitted to be installed more than 10-inches below the roof decking or sheathing.
- Flexible Wiring Methods. FMC smaller than 3/4 in. and MC cable smaller than 1 in. shall have guard strips installed to protect the raceway or cable when run across ceilings or floor joists. The wiring methods shall closely follow the building surface.
- Marking or Labeling Required. Enclosures and wiring methods containing PV conductors shall be marked "Photovoltaic Power Source."
- Marking and Labeling Methods and Locations. Labels must be visible after installation. Labels must be installed no more than 10 ft. apart and are required to be suitable for the environment where they are installed.

Question 49: For PV source and output circuits ahead of the PV disconnecting means that are installed in an attic but NOT installed beneath a PV module, which of the following installations is permitted?

A: NM cable installed 8-inches from the roof decking.
B: AC-Cable installed at a right angle across the face of 6-inch roof rafters supporting the roof decking.
C: UF cable installed parallel to the ceiling joists 8-inches from the roof surface.
D: MC cable installed 11 inches from the roof decking.

Question 50: 690.47(C) Grounding Electrode System. Systems with AC and DC Grounding Requirements.

Question ID#: 225.0



PV systems can be connected to a grounding electrode in 3 different ways.

Section 690.47(D), which required a separate grounding electrode for the DC side of a PV system was deleted, and 690.47(C) was rewritten to clarify the requirements for installing grounding electrodes and grounding electrode conductors for PV systems.

Basically there are three ways to connect a PV system to a grounding electrode: (1) Install separate grounding electrodes at the AC side of the system and the DC side of the system, and bond them together. (2) Use a common grounding electrode; the DC grounding electrode conductor can be bonded to the AC grounding electrode. (3) Connect a DC grounding electrode conductor to the AC equipment grounding terminal in the inverter.
The rewrite makes it much clearer that the DC grounding electrode and the AC grounding electrode must be bonded together. Also, it clarifies that a common grounding electrode can serve both the DC and AC side of a PV system.

Question 50: Which of the following statements about connecting a grounding electrode to a PV system is true?

A: If a system has a DC grounding electrode, it must be bonded to the AC grounding electrode.
B: The DC grounding electrode is bonded to the PV modules but not to the AC side of the system.
C: A DC grounding electrode conductor is always required to connect to a DC grounding electrode.
D: The AC grounding electrode is isolated from the DC PV modules.

Question 51: Article 694 Small Wind Electric Systems.

Question ID#: 226.0

Small wind (turbine) electric systems are rated up to 100 kW.

Article 694 is new to the 2011 NEC. The scope of the article in section 694.1 says:

The provisions of this article apply to small wind (turbine) electric systems that consist of one or more wind electric generators with individual generators having a rated power up to and including 100kW. These systems can include generators, alternators, inverters, and controllers.

Each tower-mounted wind turbine has an individual generator. The output of the single generator cannot be more than 100kW if it is to be regulated by Article 694. The separate wind turbine generators can be connected together to deliver large blocks of power to the utility grid.

A wind turbine uses a generator to create electricity. A windmill uses mechanical energy to perform work such as pump water.

An Informational Note at 694.1 explains:

Small wind electric systems can be interactive with other electrical power production sources or might be stand-alone systems. Small wind electric systems can have ac or dc output, with or without electrical energy storage, such as batteries.

Like solar photovoltaic systems, most small wind electric systems are connected to the utility grid and sell the power back to the utility operator.

Many of the requirements in Article 694, Small Wind Electric Systems are similar to the requirements in Article 690, Solar Photovoltaic (PV) Systems.

Question 51: Which of the following statements about small wind electric systems is true?

A: The output is always DC current.
B: The maximum rated output current cannot be more than 10 kW.
C: They can be installed as stand-alone or utility-interactive systems.
D: They cannot be connected to other sources of power.

Question 52: 695.3 Power Source(s) for Electric Motor-Driven Fire Pumps.

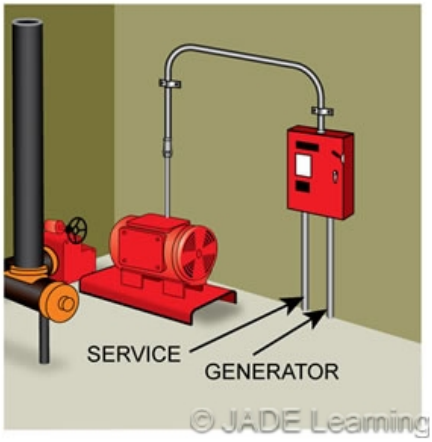
Question ID#: 227.0

Fire pumps are mission critical for the fire protection of buildings. The fire pump supplies water to the building sprinkler system, and it must continue to run under all conditions. The power source(s) for the fire pump must be as reliable as possible and supply power to the fire pump even if the building is disconnected from the utility. Section 695.3 has been rewritten to help clarify the requirements for how power is supplied to a fire pump.

A fire pump can be supplied by (1) a separate utility connection or a utility connection ahead of the service disconnecting means, (2) an onsite power production facility, such as a customer owned power plant, or (3) a dedicated feeder downstream of the service disconnect.

Fire pumps are permitted to have more than a single source of power. The most common arrangement is to have a connection to the utility (usually ahead of the service disconnecting means) and a connection to a standby generator. If a standby generator is used as an alternate source of power for the fire pump, it must have enough capacity to start the fire pump motor. Because the starting current for typical AC squirrel cage induction motors is approximately 6 times the motor's running current, a generator that is able to start the pump can easily supply its running current. Motors do not simultaneously pull both starting and running current. After the pump is started, the generator must be rated to carry its running current and any other loads that are operated simultaneously with the fire pump.

For example: If a fire pump's full load current was 30 amps, the generator would have to be able to provide approximately 6 times its running current or 180 amps in order to start the pump motor. Motors do not draw starting and running current simultaneously; once the fire-pump is started its current drops to 30-A. If the stand-by generator can supply a starting current of 180-A, it can also supply any load less than 180-Amps. Because the pump's starting current is higher than its running current, if the generator is sized to carry the pump's starting current, it will easily carry its running current.



Fire pumps are permitted to have multiple sources of power.

Question 52: A fire pump is supplied by a standby generator. The fire pump has a full-load current of 18 amps, and a starting current of 108 amps. What is the required capacity of the standby generator in amps?

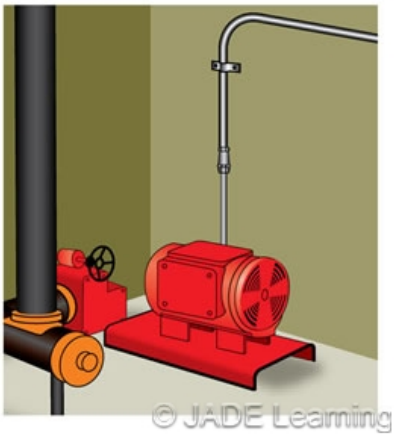
A: 27 amps.
B: 108 amps.
C: 135 amps.
D: 169 amps.

Question 53: 695.6 Power Wiring.

Question ID#: 229.0

This section has been rewritten and several new requirements have been added. For feeders on the load side of the final disconnecting means, and for conductors connected to an on-site generator, the conductors must be kept independent of all other wiring. The conductors shall supply only loads directly associated with the fire pump system. The conductors shall be protected from physical damage. Where routed through a building the conductors must be either encased in a minimum of 2 inches of concrete, be protected by a fire-rated assembly with a minimum 2 hour rating, or be a listed electrical circuit protective system with a minimum 2 hour rating.

Electrical metallic tubing is now an acceptable wiring method for wiring from the fire pump controller to the fire pump motor.
A number of requirements have been extracted from NFPA 20-2010 Standard for the Installation of Stationary Pumps for Fire Protection. These include sections on Listed Electrical Circuit Protective System to Controller Wiring, Junction Boxes, and Raceway Terminations. Where raceways are terminated at fire pump controllers, listed conduit hubs are required.



EMT is now a permitted wiring method between the fire pump controller and the fire pump motor.

Question 53: Which of the following is true for feeder conductors on the load side of the final disconnecting means?

A: Conductors cannot be installed inside of buildings.
B: Conductors can supply the fire pump system and other loads.
C: Conductors installed inside of buildings shall be encased in 2 inches of concrete or be protected by listed protective system with a 2-hour fire rating.
D: Conductors installed outside of buildings shall be encased in 2 inches of concrete.

Question 54: 700.10(D)(1) Wiring, Emergency System. Fire Protection. Feeder-circuit Wiring.

Question ID#: 231.0

Requirements for emergency system feeder wiring for places of assembly have been clarified.

Section 700.10(D)(1) describes the requirements for installing emergency wiring systems in occupancies used for ***"assembly, educational, residential, detention and correctional, business, or mercantile purposes."*** It applies to these occupancies only if they are designed for 1,000 people or more or are in buildings over 75 feet high. The 2011 NEC increased the fire rating for feeder-circuit wiring for emergency systems in these occupancies from 1 to 2 hours.

Feeder-circuit wiring for emergency systems in facilities affected by this change are required to comply with one of the following:

- To be protected by an approved automatic fire suppression system.
- To have a circuit protective system with a minimum 2 hour fire rating.
- To be provided with a listed thermal protective barrier having at least a 2 hour rating.
- To be installed in a fire rated assembly containing only emergency wiring having at least a 2 hour rating.
- To be encased in a minimum of 2 inches of concrete.

This change is designed to ensure that fire pumps, fire-service elevators, and emergency lighting will have emergency power for at least 2 hours. This additional time provides an increased margin of safety for firefighters and for those who are trying to escape large burning buildings.

Question 54: If it is not provided with a listed electrical circuit protective system with a 2 hour fire rating, which of the following is permitted to provide the required protection for a feeder-circuit for emergency lighting in a prison?

A: RMC in a 2 hour fire rated assembly containing emergency wiring and normal wiring.
B: RMC embedded in 4 inches of concrete.
C: RMC protected by an listed thermal protective barrier with a 1 hour rating.

D: RMC installed in an area which is not protected by an approved automatic fire suppression system or other means.

Question 55: 700.12(F) Emergency Systems. General Requirements. Unit Equipment. Exception 2.

Question ID#: 232.0

Emergency lighting outside an exit door can be supplied from the emergency lighting circuit inside the same exit door.

A new exception permits emergency lighting on the outside of an exit door to be supplied from the emergency lighting circuit immediately inside the same exit door. The 2008 NEC required the lighting for the exterior of the exit door to be supplied by an outdoor lighting circuit.

The exception will allow the exit/emergency lights inside the door to supply remote lighting heads outside the exit door. It will make for a more efficient installation and still not compromise safety. When the normal power fails and the emergency lighting inside the exit door is energized, the outside emergency lighting will also be energized, providing illumination for people evacuating the building.

Unit equipment for emergency lighting is required to include the following:

- A battery that is rechargeable.
- A means of recharging the battery.
- One or more lights mounted on the unit or terminals for remote lights. Units are also permitted to include mounted lights as well as terminals for remote heads.
- To be fixed (not portable).
- To automatically turn on if the normal power supply is interrupted.
- To be supplied by a branch circuit supplying normal lighting in the area where the unit is installed or to be supplied by a separate circuit from the same panel that supplies normal lighting circuits and to be equipped with a ***lock-on*** device.

Question 55: Which of the following violates requirements for unit equipment providing emergency illumination?

A: Interior unit equipment supplying lighting for the exterior side of an exit door.
B: Unit equipment including mounted lights but without terminals to supply remote lights.
C: Unit equipment illuminating the interior area adjacent to an exit door on the 3rd floor and supplying remote lights outside an exit door on the 1st floor.
D: Unit equipment illuminating the interior area adjacent to an exit door and also illuminating the area immediately outside that exit door with a remote light.

Question 56: 708.10(A)(2)(Ex.) COPS. Feeder and Branch Circuit Wiring. Receptacle Identification.

Question ID#: 236.0

Article 708 specifies the requirements for Critical Operations Power Systems (COPS). COPS are defined as power systems for facilities or parts of facilities that require continuous operation for the reasons of public safety, emergency management, national security or business continuity. Designated Critical Operations Areas (DCOA) are areas within a facility or site designated as requiring critical operations power.

Critical Operations Power Systems are designed to supply electrical power to Designated Critical Operations Areas for HVAC, fire alarm, security, communications, and signaling systems as well as for general power distribution within the facility.

In buildings where Critical Operations Power Systems are present with other types of wiring, the receptacles or the receptacle plates for the COPS systems must have a distinctive marking or color to make them readily identifiable.
A new exception has been added which says that if the COPS supplies power to a DCOA that is a stand-alone building, receptacle cover plates or the receptacles themselves are not required to have the distinctive marking or color.

COPS supplied receptacles must be distinguished from receptacles of other systems.

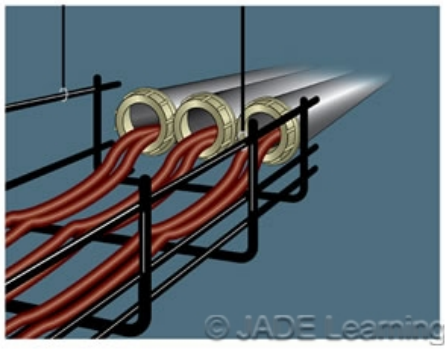
Question 56: Which of the following installations supplied by COPS is required to have the receptacles or receptacles covers identified by a distinctive marking or color?

A: A DCOA located in a stand-alone building where all power is supplied by COPS.
B: A building designated exclusively as a DCOA where all power is supplied by COPS.
C: A building with several power systems that has one floor assigned as a DCOA and the rest of the building used for other purposes.
D: A DCOA where all power is supplied by COPS located in a stand-alone building on a military base.

Question 57: 725.3(J) Class 1, Class 2, and Class 3 Remote-Control, Signaling, and Power-Limited Circuits. Bushing.

Question ID#: 239.0

When cables and conductors are installed in raceways for physical support and/or protection, section 725.3(J) requires that a bushing be installed on the raceway to protect the cable from abrasion as required by 300.15(C). However, 300.15(C) only requires that a fitting be used to provide protection from abrasion. ***The fitting could be either a bushing or other listed fitting that provides the required protection***.
Section 760.3(K) requires that cable systems used for fire alarm systems be protected in the same manner.
Raceways used as sleeves to provide physical protection for cables and conductors are not required to be terminated in a box or conduit body. However, if a raceway used as a sleeve does not terminate in an enclosure, a bushing or other listed fitting is still required to be installed on the end of the raceway to protect cables and conductors from abrasion. A bushing or other fitting is also required when raceways containing cables or conductors are terminated on boxes or enclosures. For example, in vertical raceways where cables are supported in an enclosure by ***off-set*** cleats, a bushing or other fitting is required on the ends of the raceway where the cable enters and exits the enclosure.



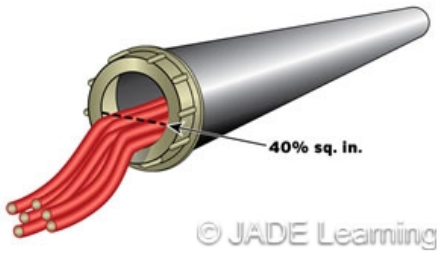
Cables and conductors used in Class 1, 2, and 3 circuits are required to be protected by bushings when exiting raceways.

Question 57: Which of the following does not require a bushing to be installed on the end of a raceway to prevent a cable from being damaged by abrasion?

A: A vertical installation of a fire-rated CI-cable installed in RMC secured to a junction box where an off-set arrangement of cleats provides mechanical support for the cable.
B: A horizontal installation of a fire-rated CI-cable installed in RMC secured to an enclosure with a listed fitting that already has an integral insulated bushing.
C: A horizontal run of IMC used as a sleeve to protect a fire-rated CI-cable.
D: A horizontal installation of a fire-rated CI-cable installed in RMC secured to a junction box.

Question 58: 760.3(J) Fire Alarm Systems. Number and Size of Cables and Conductors in Raceway.

Question ID#: 240.0



The conductors installed in raceways for fire alarm systems are not permitted to exceed the percentage fill permitted in Table 1, Ch. 9.

Section 760.3(J) limits the number and size of conductors and cables permitted in raceways for fire alarm systems and requires installations to comply with 300.17. Raceways permitted for fire alarm systems all require that the size and number of conductors in a raceway not exceed the percentage fill permitted in Table 1, Chapter 9.

The area of a multiconductor cable is used when determining the allowable percentage of raceway fill in accordance with Table 1 in Chapter 9. However, because Chapter 9 does not include information on fire alarm cables, this information has to be obtained from product listing data or from the manufacturer. If you know the area of a fire alarm cable, you can use Table 1 (page 711) and Table 4 (page 714 for RMC) in Chapter 9 to determine the minimum size raceway required for the cable.

For example, on page 714, using RMC and one cable with an area of .375 sq. inches:

- Find the column for 1 wire (53% fill).
- In this column find the smallest fill area in sq. inches that equals or exceeds the .375 sq. inch area of the sample cable.
- The smallest fill area in the 53% column that exceeds the area of the cable is .470 sq. inches.
- In that row, the far left column indicates the minimum size RMC that can be used for the cable is 1 inch RMC.

If a raceway has more than one cable, add the area of all cables and then use the appropriate fill column (31% for 2 wires or 40% for over 2 wires). Select the smallest raceway that has an allowable fill area equaling or exceeding the total area of the cables.

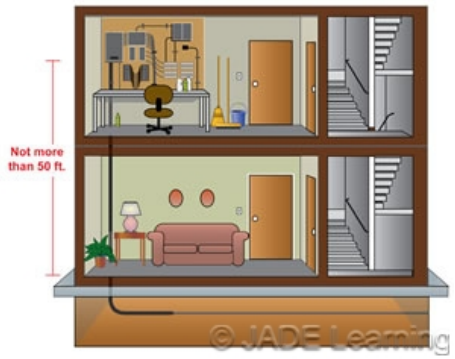
Question 58: If a single multiconductor cable for a fire alarm system has a cross-sectional area of .45 sq. inches, what is the minimum size raceway permitted if 3 cables are installed in RMC? (Hint: Use the over 2 wires, 40% column.)

A: 1 1/4 inch RMC.
B: 1 1/2 inch RMC.
C: 2 inch RMC.
D: 2 1/2 inch RMC.

Question 59: 800.113 Communications Systems. Installation of Communications Wires, Cables and Raceways.

Question ID#: 246.0

In general, section 800.113 requires communications cables, wires, and raceways installed in buildings to be listed. However, if not installed in risers, ducts, plenums, or spaces used for environmental air, an exception permits up to 50 feet of unlisted communication cable to be installed from the ***point of entrance*** to a listed primary protector or an enclosure. This exception permits unlisted underground cables used by communications utilities to enter buildings.



The requirements for installing communications cables inside of buildings and structures have been clarified.

Some types of cable are permitted to be installed in metal raceways in risers that are fire-stopped at each floor. Other types are listed for installation in cable tray. Cables and installation methods installed in risers, plenums, and spaces for handling environmental air are required to be listed for these locations and designed to resist spread of fire and toxic fumes. ***"Communications raceway"*** is a new term defined in section 800.2 as a closed non-metallic channel; different types are listed for installation in plenums, risers, or general applications.

Section 800.113 was revised providing more detailed information on the installation requirements for communication wires, cables, raceways, and cable routing assemblies. Sections B through L identify different locations in buildings and different types of buildings where communication cables are permitted to be installed. This same information is presented in an easy to understand table format in Table 800.154(a).

Question 59: Which of the following is permitted when installing an unlisted communications cable in a building from the point of entrance to a listed primary protector?

A: Installing 35 feet of the cable in a plenum.
B: Installing 60 feet of the cable in an area not used for handling air or a riser.
C: Installing 20 feet of the cable in a duct for environmental air.
D: Installing 50 feet of the cable in an area not used for handling air or a riser.

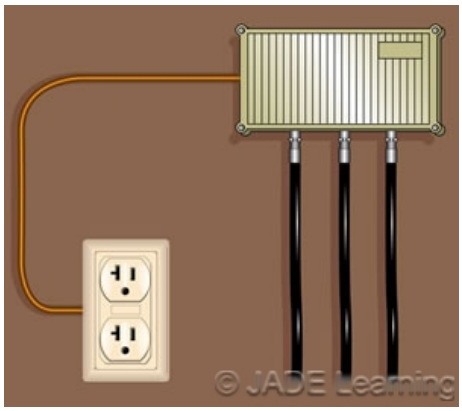
Question 60: Article 820.100 Exception. Community Antenna Television and Radio Distribution Systems. Cable Bonding and Grounding.

Question ID#: 248.0

The general rule in section 820.100 requires the shield of coaxial cable to be bonded and grounded. These requirements are similar to the requirements in Article 800 for bonding and grounding communications cables. However, an exception in the 2011 NEC permits the cable shield to be connected to any of the equipment grounding conductors permitted in 250.118 where the cable is electrically isolated from the outside cable plant:

Exception: For communications systems using coaxial cable confined within the premises and isolated from outside cable plant, the shield shall be permitted to be grounded by a connection to an equipment grounding conductor as described in 250.118. ***Connecting to an equipment grounding conductor through a grounded receptacle using a dedicated grounding conductor and permanently connected listed device shall be permitted. Use of a cord and plug for the connection to an equipment grounding conductor shall not be permitted.***

Grounding through a cord and plug connection is not permitted because unplugging the cord would break the grounding connection. The exception applies only to coaxial cable that is entirely confined inside a building and that is electrically isolated from all outside cable. Because the coaxial shields of isolated cables are not connected to cables outside the premises, they do not need to be protected against lightning and power crossover like cables that enter a building from an outside cable network.



When CATV cable is isolated from outside cable it can be connected to an equipment grounding conductor from the interior wiring.

Question 60: Which of the following statements about bonding and grounding the sheath of coaxial cable that is entirely within a building and is electrically isolated from outside coaxial cables is correct?

A: It is permitted to be cord and plug connected to an equipment grounding conductor.
B: It is required to be cord and plug connected to an equipment grounding conductor.
C: It is not required to be grounded.
D: It is permitted to be grounded by connection to any equipment grounding conductor permitted in 250.118 to an intersystem bonding terminal.

Question 61: Article 840 Premises-Powered Broadband Communications Systems.

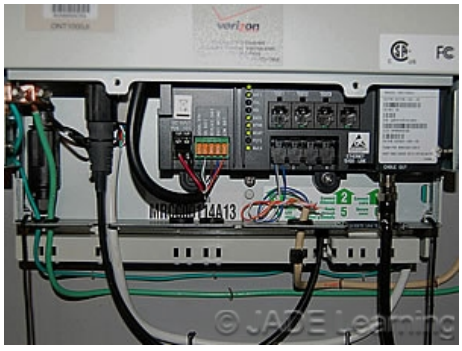
Question ID#: 249.0

Article 840 is a new article for premises-powered optical fiber-based broadband communications systems which are used to provide voice, video, data, and/or interactive services through an Optical Network Terminal (ONT).

An Informational Note in 840.1 describes a typical premises-powered broadband system as one that is supplied by an optical fiber cable with premises based equipment that converts optical input to electrical signals that can provide electrical input to internet connected PCs, telephones, and/or video equipment.

The incoming optical cable is not a source of power. The power for the equipment that converts the optical input to an electrical output signal is supplied by the premises electrical system or by a battery powered back-up. Some coaxial cables are non-conductive; others have conductive metallic shields and/or wire used to provide physical support.

Conductive cable shields supplying an optical network terminal are required to be grounded. However, the communication circuits themselves are not required to be grounded. An optical network terminal itself is only required to be grounded if its listing requires it.



Article 840, Premises-Powered Broadband Communications Systems, is a new Article.

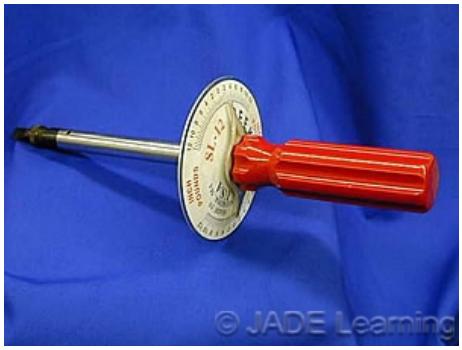
Question 61: Which of the following statements about premises-powered optical fiber-based broadband communications system optical network terminals is correct?

A: An ONT is never required to be grounded.
B: An ONT is always required to be grounded.
C: When an ONT is required to be grounded, the size of the equipment grounding conductor is based on Table 250.66.
D: The metal shield of a coaxial cable connected to an ONT is required to be grounded.

Question 62: Informative Annex I Recommended Tightening Torque Tables from UL Standard 486A-B.

Question ID#: 250.0

Informative Annex I, like the other Annexes in the 2011 NEC, is not part of the requirements of the Code. It is included for informational purposes only. The torque tables are to be used in the absence of manufacturer's instructions on the equipment.



Annex I provides torque specifications for screws and recessed Allen or square drives.

There are three tables in Annex I. Table I.1, Tightening Torque for Screws. Table I.2, Tightening Torque for Slotted Head Screws Smaller Than No. 10 Intended for Use with 8 AWG or Smaller Conductors. Table I.3, Tightening Torque for Screws with Recessed Allen or Square Drives.

Each Table has the metric measurement and the standard measurement (inside parenthesis). The standard measurements are read as inch-pounds. The Tables are taken from UL Standard 486 A-B. The values from both the A and B Standard are given, with separate A and B columns. The B column lists tighter torque values. Table I.1 and I.2 are divided by the slot width or slot length of the screw. A separate section of Table I.1 is for connectors with hexagonal heads. Use the left hand column in Table I.1 to select a connector based on the size of the wire in the connector. Read across the table to find the correct torque. For example, the suggested torque for a split-bolt connector used with 2/0 conductors is 385 inch-pounds, from the B column.

Question 62: What is the required torque for a split-bolt connector with a hexagonal head that is used for No. 1 AWG conductors? Use the B column.

A: 165 inch-pounds.
B: 275 inch-pounds.
C: 300 inch-pounds.
D: 375 inch-pounds.

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

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

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