

**Instructions:**

**Fee \$65**

1. Print these pages.
2. Circle the correct answers and transfer them to the [answer sheet](#).
3. Page down to the last page for the [verification forms](#) and mailing instructions.
4. Use the included analysis information as your reference materials.
5. All questions are listed in mini-sections throughout the complete course.

**Course: 17165 2014 NEC Analysis Part 4**

**This course is valid for these credentials:**

<b>Credential Description</b>	<b>Cred Code</b>	<b>Credit Hours</b>
Registered/Beginner Electrician	BE	8.0
Commercial Electrical Inspector	CEI	8.0
Industrial Journeyman Electrician	IJE	8.0
Journeyman Electrician	JE	8.0
Master Electrician	ME	8.0
Residential Journeyman Electrician	RJE	8.0
Residential Master Electrician	RME	8.0
UDC-Electrical Inspector	UEI	8.0

**2014 NEC Analysis Part 4**

430.53(D) Revisions clarify that the 3 m (10 ft.) and the 7.5 m (25ft.) tap conductors measurements for a motor are intended to begin from the point of the tap.

**2011 NEC Requirement.** Two or more motors, or one or more motors and other loads, are permitted to be connected to the same branch circuit under specified conditions. For these group installations, the conductors of any lap supplying a single motor is permitted to omit individual branch-circuit short-circuit and ground-fault protection, provided they comply with one of the following;

- (1) Conductors to the motor shall have an ampacity equal to that of the branch-circuit conductors.
- (2) Conductors to the motor shall have an ampacity not less than one-third that of the branch-circuit conductors, with a minimum in accordance with 430.22 Single Motor. Under this condition, the conductors to the motor overload device cannot be more than 7.5 m (25 ft.) long and must be protected from physical damage by being enclosed in an approved raceway or other approved means.
- (3) Conductors are permitted to have an ampacity not less than one-tenth the rating or setting of the branch-circuit short-circuit and ground-fault protective device under specific conditions. Under this condition, conductors from the controller to the motor must have an ampacity in accordance with 430.22 Single Motor. Additionally, these conductors from the branch-circuit short-circuit and ground-fault protective device to the controller must be suitably protected from physical damage, enclosed either by an enclosed controller or by a raceway and be not more than 3 m (10 ft) long, or have an ampacity not less than that of the branch-circuit conductors.

**2014 NEC Change.** These same provisions exist for the 2014 NEC, with language added to clarify as to where the 3 m (10 ft.) and the 7.5 m (25 ft.) tap conductors measurements are intended to begin. The 3 m (10 ft.) and the 7.5 m (25 ft.) tap conductors measurements for a motor are intended to begin from the point of the tap.

430.233 The minimum voltage levels for live parts of motors or controllers requiring guarding against accidental contact by insulating mats or platforms were lowered from 150 volts to ground to 50 volts to ground.

**2011 NEC Requirement.** Provisions at 430.232 require exposed live parts of motors and controllers operating at 50 volts or more between terminals to be guarded against accidental contact by their enclosures or by their locations. These locations include (1) a room or enclosure that is accessible only to qualified persons, (2) a suitable balcony, gallery, or platform, elevated and arranged so as to exclude unqualified persons, or (3) by elevation 2.5 m (8 ft.) or more above the floor. In the 2011 NEC, where live parts of motors or controllers

operating at over 150 volts to ground were guarded against accidental contact only by the location described above, suitable insulating mats or platforms were required to be provided. Another requirement for the inclusion of these insulating mats or platforms is the necessity of adjustment or other attendance being necessary during the operation of the apparatus. These insulating mats or platforms were required at this over 150 volts to ground level so that electrical personnel cannot readily touch live exposed parts unless standing on the insulating mats or platforms.

**2014 NEC Change.** The same provisions for guarding against accidental contact from exposed live parts of motors and controllers and insulating mats or platforms exist as in the 2011 NEC, but the minimum voltage levels for inclusion of the insulating mats or platforms were lowered from 150 volts to ground to 50 volts to ground.

440.9 A wire type equipment grounding conductor is now required for outdoor HVAC equipment in the outdoor portion of the wiring method of LFMC or EMT.

**2011 NEC Requirement.** By their own respective articles, liquidtight flexible metal conduit (LFMC) and electrical metallic tubing (EMT) are both permitted as an acceptable wiring method for outdoor heating and air-conditioning equipment. For the 2011 NEC, these two wiring methods were also permitted as their own equipment grounding conductor (EGC) from the unit disconnecting means to the AC units themselves in accordance with 250.118. No wire type EGC was required in addition to these wiring methods.

**2014 NEC Change.** A new section 440.0 now requires a wire type equipment grounding conductor, as specified in 250.118(1), to be provided in the outdoor portion of the raceway at outdoor air-conditioning and refrigeration equipment when the wiring method consists of liquidtight flexible metal conduit (LFMC) or electrical metallic tubing (EMT).

445.11 Marking is required for generators to indicate when the neutral of a generator is bonded to the generator frame.

**2011 NEC Requirement.** Marking requirements for generators required each generator to be provided with a nameplate. This nameplate was to indicate the manufacturer's name, the rated frequency, power factor, number of phases if of alternating current, the subtransient and transient impedances, the rating in kilowatts or kilovolt amperes, the normal volts and amperes corresponding to the rating, rated revolutions per minute, insulation system class and rated ambient temperature or rated temperature rise, and time rating. This applied to all generators, with no distinction between sizes of the generator.

**2014 NEC Change.** These same marking provisions held true for the 2014 NEC, but the power factor, the subtransient and transient impedances, the insulation system class, and the time rating markings are now required only for stationary and portable generators rated more than 15 kW. A new manufacturer's marking provision was also added requiring indication as to whether or not the generator neutral is bonded to the generator frame. This new neutral bonding provision goes further to require additional marking to indicate whether the generator neutral is bonded to the generator frame, whenever the bonding of a generator is modified in the field.

445.18 Portable generators that employ a cord and plug connection have been added as an acceptable disconnecting means for a generator.

**2011 NEC Requirement.** Generators are required to be equipped with disconnect(s) that are lockable in the open position. This lockable disconnecting means must be able to disconnect the generator and all protective devices, and to control apparatus entirely from the circuits supplied by the generator. Two conditions existed in the 2011 NEC that overrode this generator disconnecting means rule: (1) if the driving means for the generator can be readily shut down; and (2) the generator is not arranged to operate in parallel with another generator or other source of voltage.

**2014 NEC Change.** A few more conditions were added to the circumstances that permit the disconnecting means requirements for generators to be omitted. For portable generators that supply power from a self-contained receptacle outlet which would accept a cord and plug connection, the cord and plug can serve as the disconnecting means. For generators where the driving means can be readily shut down, they must also be rendered incapable of restarting and be lockable in the off or "open" position in accordance with the new locking provisions of 110.25 in order to suspend the requirement for a disconnecting means.

445.20 New GFCI requirements were added for portable generators and associated 125-volt, single-phase, 15-or 20-amperes receptacles.

**2011 NEC Requirement.** The 2011 NEC added provisions for all 125-volt and 125/250-volt, singlephase, 15-, 20-, and 30-ampere receptacle outlets that are a part of a 15-kW or smaller portable generators to have listed ground-fault circuit-interrupter (GFCI) protection for personnel for temporary installations, at 90.6(A)(3). These GFCI provisions for portable generators did not exist in Article 445 in the 2011 NEC.

**2014 NEC Change.** A new section entitled, "Ground-Fault Circuit-Interrupter Protection for Receptacles on 15-kW or Smaller, Portable Generators" was added in Article 445. This new provision will require all 125-volt, single-phase, 15-and 20-ampere receptacle outlets that are a part of a 15 kW or smaller, portable generator to either be equipped with GFCI protection integral to the generator or receptacle, or the generator must be capable of rendering the 125-volt, single-phase, 15- and 20-ampere receptacle outlets unavailable for use when the 125/250-volt locking-type receptacle is in use. This new requirement also indicates that if the generator does not have a 125/250-volt locking-type receptacle, this GFCI requirement is not applicable.

1. 430.53(D) Revisions clarify that the 3 m (10 ft.) and the 7.5 m (25ft.) tap conductors measurements for a motor are intended to begin from the point of the \_\_\_\_\_.
  - a. busbar
  - b. connection
  - c. tap
  - d. all of the above
2. 430.233 The minimum voltage levels for live parts of \_\_\_\_\_ requiring guarding against accidental contact by insulating mats or platforms.
  - a. motors
  - b. controllers
  - c. both a & b
  - d. none of the above
3. 430.233 The minimum voltage levels for live parts were lowered from \_\_\_\_\_ to ground.
  - a. 50 volts to ground to 150 volts
  - b. 250 volts to ground to 150 volts
  - c. 150 volts to ground to 50 volts
  - d. none of the above
4. 440.9 A wire type equipment grounding conductor is now required for outdoor HVAC equipment in the outdoor portion of the wiring method of \_\_\_\_\_.
  - a. LFMC
  - b. EMT
  - c. both a & b
  - d. none of the above
5. 445.11 \_\_\_\_\_ is required for generators to indicate when the neutral of a generator is bonded to the generator frame.
  - a. Listing
  - b. Identifying
  - c. Marking
  - d. all of the above
6. 445.18 Portable generators that employ a cord and plug connection have been \_\_\_\_\_ as an acceptable disconnecting means for a generator.
  - a. removed
  - b. added
  - c. revised
  - d. relocated
7. 445.20 New GFCI requirements were added for portable generators and associated 125-volt, single-phase, \_\_\_\_\_ amperes receptacles.
  - a. 15
  - b. 20
  - c. 30

d. both a & b

8. 445.20 This new requirement also indicates that if the generator does not have a 125/250-volt locking-type receptacle, this GFCI requirement is \_\_\_\_\_.

a. not applicable

b. applicable

c. recommended

d. none of the above

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450.10 A grounding and bonding terminal bar in transformer enclosures is not permitted to be installed on or over the vent screen portion of the enclosure.

**2011 NEC Requirement.** Section 450.10 of the 2011 NEC addressed grounding and bonding of exposed non-current-carrying metal parts of transformer installations. This might include fences, guards, etc. A grounding and bonding terminal bar inside the transformer enclosure was not addressed in Article 450 in the 2011 NEC.

**2014 NEC Change.** New provisions were put in place for terminating grounding and bonding conductors inside a transformer enclosure. These conductors could include equipment grounding conductors, supply-side bonding jumpers, etc. A grounding and bonding terminal bar for the purpose of landing these grounding and bonding conductors must be bonded to the transformer enclosure, but cannot be mounted on or over any vented opening or vented screens provided by the manufacturer of the transformer enclosure. A new exception to this new grounding and bonding main rule addresses transformers equipped with wire-type connections (pig-tail leads). Under this wire-type connection condition, the grounding and bonding connections are permitted to be connected together using any of the methods in 250.8, Connection of Grounding and Bonding Equipment, and shall be bonded to the enclosure (If the enclosure is metal). The existing rule for grounding and bonding of other metal parts associated with the installation of a transformer has become 450.10(B).

450.11 Marking requirements for transformers were revised into a list format. Transformers can be supplied at the secondary voltage (reversed wired) only in accordance with manufacturer's instructions.

**2011 NEC Requirement.** In the 2011 NEC, the required information was provided in a paragraph format.

**2014 NEC Change.** The required nameplate information for transformers was formatted into a more user-friendly list format. A new subsection (B) was added to require transformers that are supplied at the secondary voltage (reversed wired) to be installed in accordance with manufacturer's instructions. Transformers supplied at their secondary voltage are only permitted if identified as such by the manufacturer.

Article 480 Several changes occurred in Article 480 that resulted in the article's being restructured. New 480.3 was added for "Battery and Cell Terminations." New 480.6 was added for "DC Disconnect Methods." Section 480.9 was revised from "Working Space" to "Battery Locations."

**2011 NEC Requirement.** The requirements for storage batteries are found in Article 480. Refer to the 2011 NEC for complete text and article structure.

**2014 NEC Change.** Article 480, Storage Batteries, was restructured. See the 2014 NEC for complete text and article structure.

490.48 Requirements for substations were removed from 225.70 in their entirety and relocated at new 490.48(B). New provisions for substations were added at 490.48(A) and (C).

**2011 NEC Requirement.** Requirements for substations were located at 225.70 in the 2011 NEC. Section 225.70 dealt with warning signs for substations only.

**2014 NEC Change.** Requirements for substations were removed from 225.70 in their entirety and relocated at new 490.48(B). New provisions documentation requirements for substations were added at 490.48(A). Also new for the 2014 NEC are provisions for a permanent, single-line diagram of the switchgear to be provided in a readily visible location within the same room or enclosed area with the switchgear. This diagram must also identify interlocks, isolation means, and all possible sources of voltage to the installation under normal or emergency conditions with companion markings on the switchgear itself. A new exception was added for 490.48(C) to allow this diagram to be omitted where the equipment consists of a single cubicle or metal-enclosed unit substation containing only one set of high-voltage switching devices.

501.40 and Exception Section 501.40 and the associated exception dealing with multiwire branch circuits in Class 1, Division 1 were deleted entirely.

**2011 NEC Requirement.** The main rule of this section of Article 501 prohibited a multiwire branch circuit from being installed in a Class I, Division 1 location. Then the exception, which followed the main rule, permitted a multiwire branch circuit in a Class I, Division I location if the disconnect means for the multiwire branch circuit opened all ungrounded conductors simultaneously.

**2014 NEC Change.** NEC 501.40 and the exception were deleted entirely. The requirements for simultaneous disconnection of all ungrounded conductors of multiwire branch circuits are already provided at 210.4(8).

Article 504 Article 504 was revised to align with intrinsically safe products standards.

**2011 NEC Requirement.** Article 504 covered intrinsically safe systems. An intrinsically safe system is defined as, "an assembly of interconnected intrinsically safe apparatus, associated apparatus, and interconnecting cables, in that those parts of the system that may be used in hazardous (classified) locations are intrinsically safe circuits."

**2014 NEC Change.** Article 504 was revised to align with intrinsically safe products standards. New subsections were added such as 504.10(0 for "Enclosures"; 504.10(D) for "Simple Apparatus"; and 504.30(C) for separation of intrinsically safe conductors "From Grounded Metal." Revision also resulted in deletion of some duplication within Article 504.

9. 450.10 A \_\_\_\_\_ terminal bar in transformer enclosures is not permitted to be installed on or over the vent screen portion of the enclosure.

- a. grounding
- b. bonding
- c. both a & b
- d. none of the above

10. The existing rule for grounding and bonding of other metal parts associated with the installation of a transformer has become \_\_\_\_\_.

- a. 450.10(A)
- b. 450.10(B)
- c. 450.10(C)
- d. none of the above

11. 450.11 A new subsection (B) was added to require transformers that are supplied at the \_\_\_\_\_ to be installed in accordance with manufacturer's instructions.

- a. secondary voltage
- b. reversed wired
- c. both a & b
- d. none of the above

12. 450.11 Transformers supplied at their secondary voltage are only permitted if \_\_\_\_\_ as such by the manufacturer.

- a. marked
- b. approved
- c. identified
- d. listed

13. Article 480 Several changes occurred in Article 480 that resulted in the article's being restructured. New 480.3 was added for "\_\_\_\_\_."

- a. Battery Terminations
- b. Cell Terminations
- c. both a & b
- d. none of the above

14. New 480.6 was added for "\_\_\_\_\_."

- a. Working Space
- b. DC Disconnect Methods
- c. both a & b
- d. none of the above

15. Section 480.9 was revised from " \_\_\_\_\_."
  - a. Battery Locations to Working Space
  - b. Working Space to Battery Locations
  - c. both a & b
  - d. none of the above
16. 490.48 Requirements for substations were removed from \_\_\_\_\_ in their entirety.
  - a. 225.70
  - b. 225.71
  - c. 225.72
  - d. none of the above
17. 490.48 Requirements for substations were relocated at new \_\_\_\_\_.
  - a. 490.48(A)
  - b. 490.48(B)
  - c. 490.48(C)
  - d. none of the above
18. New provisions for substations were added at \_\_\_\_\_.
  - a. 490.48(A)
  - b. 490.48(B)
  - c. 490.48(C)
  - d. both a & c
19. Section 501.40 and the associated exception dealing with multiwire branch circuits in Class 1, Division 1 were \_\_\_\_\_ entirely.
  - a. added
  - b. relocated
  - c. deleted
  - d. revised
20. Article 504 was \_\_\_\_\_ to align with intrinsically safe products standards.
  - a. added
  - b. relocated
  - c. deleted
  - d. revised

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Table 514.3(B)(1), Footnote 2 and Figures 514.3(a) and 514.3(b) Footnote 2 following Table 514.3(B)(1) now references Figure 514.3(a) and new Figure 514.3 (b).

**2011 NEC Requirement.** Table 514.3(B)(1) gives a list of areas where Class 1 liquids are stored, handled, or dispensed and is used to delineate and classify motor fuel dispensing facilities, commercial garages, and aboveground tanks. Footnote 2 to this table referred to Figure 514.3 for an illustration of classified locations around dispensing devices.

**2014 NEC Change.** Footnote 2 to Table 514.3(B)(1) refers to the existing and renamed Figure 514.3(a) for illustrations of classified areas adjacent to dispensers, in addition to referencing the new Figure 514.3(13) for illustrations of classified areas adjacent to dispensers mounted on aboveground storage tanks.

Article 516 Article 516 was revised and reorganized for the 2014 NEC, including a new title of "Spray Application, Dipping, and Coating, and Printing Processes Using Flammable or Combustible Materials."

**2011 NEC Requirement.** Article 516 covers the regular or frequent application of flammable liquids, combustible liquids, and combustible powders by spray operations and the application of flammable liquids, or combustible liquids at temperatures above their flashpoint, by dipping, coating, or other means.

**2014 NEC Change.** Article 516 was revised and rewritten to correlate with the 2011 editions of NFPA 33 Standard for Spray Application Using Flammable and Combustible Materials and NFPA 34 Standard for Dipping, Coating, and Printing Processes Using Flammable or Combustible Liquids.

517.2 Definitions Several definitions in Article 517 were revised, deleted, or added.

**2011 NEC Requirement.** Definitions related to health care facilities are located at 514.2.

**2014 NFC Change.** Several definitions in Article 517 were revised, deleted or added. This was the result of the re-organization of the make-up of the "Essential Electrical System" of a hospital. (See NEC and 517.2 for complete text)

517.16 Isolated grounding type receptacles are not permitted within patient care vicinity (rather than the entire health care facility).

**2011 NEC Requirement.** Receptacles with insulated grounding terminals, as described in 250.146(D), were not permitted within a health care facility.

**2014 NEC Change.** The requirement to prohibit isolated ground receptacles in health care facilities was condensed to prohibit these receptacles from only the patient care vicinity of a health care facility.

517.18(A) All receptacles or the cover plate supplied from the critical branch are required to have a distinctive color or marking so as to be readily identifiable. Marking is also to indicate the panelboard and branch circuit number supplying them.

**2011 NEC Requirement.** Each patient bed location shall be supplied by at least two branch circuits; one of these branch circuits is required to be supplied from the normal system. In the 2011 NEC, one of these branch circuits was required to be supplied from the emergency system. These branch circuits serving patient bed locations cannot be part of a multiwire branch circuit. All branch circuits from the normal system must originate from the same panelboard. Three exceptions exist for these requirements.

**2014 NEC Change.** The term emergency system was removed from Article 517. Therefore, one of the two branch circuits to supply patient bed locations is now required to be supplied from the critical branch rather than from the emergency system. The branch circuit serving patient bed locations still cannot be part of a multiwire branch circuit and the normal system branch circuits must continue to originate from the same panelboard. A new requirement for all receptacles or the cover plate supplied from the critical branch is to have a distinctive color or marking so as to be readily identifiable. These markings are also required to indicate the panelboard and branch circuit number supplying these receptacles. The three existing exceptions for these requirements remain in place.

517.18(B) The minimum number of receptacles required for general care area patient bed locations of health care facilities was increased from four to eight.

**2011 NFC Requirement.** Each general care area patient bed location was required to be provided with a minimum of four receptacles. These receptacles are permitted to be supplied from a configuration of single, duplex, or quadruplex type, or any combination of the three. All of these patient bed location receptacles are required to be listed hospital grade-type receptacles and so identified. The grounding terminal of each receptacle is also required to be connected to an insulated copper equipment grounding conductor sized in accordance with Table 250.122. Two exceptions to these requirements deal with psychiatric, substance abuse, and rehabilitation hospitals.

**2014 NEC Change.** These same provisions for receptacles in general care area patient bed locations still apply, with the provision for the number of required receptacles being expanded from four to eight.

21. Figure \_\_\_\_\_ for illustrations of classified areas adjacent to dispensers.

- a. 514.3(a)
- b. 514.3(b)
- c. 514.3(13)
- d. 514.3(3)

22. New Figure \_\_\_\_\_ for illustrations of classified areas adjacent to dispensers mounted on aboveground storage tanks.

- a. 514.3(a)
- b. 514.3(b)
- c. 514.3(13)
- d. 514.3(3)

23. Article 516 Article 516 was revised and reorganized for the 2014 NEC, including a new title of "Spray Application, Dipping, and Coating, and Printing Processes Using \_\_\_\_\_ Materials."

- a. Flammable

- b. Combustible
  - c. both a & b
  - d. none of the above
24. Several definitions in Article 517 were revised, deleted or added. This was the result of the re-organization of the make-up of the "\_\_\_\_\_ " of a hospital.
- a. selective coordination
  - b. Essential Electrical System
  - c. Non-Essential Electrical System
  - d. none of the above
25. 517.16 Isolated grounding type receptacles are not permitted within \_\_\_\_\_.
- a. patient care vicinity
  - b. entire health care facility
  - c. both a & b
  - d. none of the above
26. 517.18(A) All receptacles or the cover plate supplied from the critical branch are required to have a distinctive \_\_\_\_\_ so as to be readily identifiable.
- a. color
  - b. marking
  - c. both a & b
  - d. none of the above
27. 517.18(A) Marking is also to indicate the \_\_\_\_\_ supplying them.
- a. panelboard
  - b. branch circuit number
  - c. both a & b
  - d. none of the above
28. 517.18(B) The minimum number of receptacles required for general care area patient bed locations of health care facilities was increased from four to \_\_\_\_\_.
- a. five
  - b. six
  - c. seven
  - d. eight

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517.19(B) The minimum number of receptacles required for critical care area patient bed locations of health care facilities was increased from six to fourteen.

**2011 NEC Requirement.** Each critical care area patient bed location was required to be provided with a minimum of six receptacles. At least one of these six receptacles must be supplied by either the normal system or by the emergency system supplied by a different transfer switch than the other receptacles at the same patient bed location. These receptacles are permitted to be supplied from a configuration of single, duplex, or quadruplex type, or any combination of the three. All of these patient bed location receptacles are required to be listed hospital grade-type and be so identified. The grounding terminal of each receptacle is also required to be connected to the reference grounding point by means of an insulated copper equipment grounding conductor.

**2014 NEC Change.** These same provisions for receptacles in critical care area patient bed locations still apply, with the provision for the number of required receptacles being expanded from six to fourteen. The systems required to supply at least one of these receptacles was changed from the emergency system to the critical branch, as the term emergency system has been removed from Article 517 in the 2014 NEC.

517.19(C) New 517.19(C) was added requiring a minimum number of 36 receptacles in an operating room of health care facilities.

2011 NEC Requirement. The minimum number of receptacles required in an operating room of a health care facility was not addressed.

**2014 NEC Change.** New subdivision (C) of 517.19 was added to address the minimum number of receptacles required in an operating room of a health care facility. A minimum number of thirty-six receptacles is now required in an operating room, with at least twelve of the thirty-six receptacles required to be connected to either the normal system branch or the critical branch circuit supplied by a different transfer switch than the other



receptacles at the same location. Being consistent with 517.18(B) and 517.19(B), all of these receptacles are permitted to be supplied from a configuration of single, duplex, or quadruple\* type, or any combination of the three. All of these operating room receptacles are required to be listed hospital grade-type receptacles and so identified. The grounding terminal of each receptacle is also required to be connected to the reference grounding point by means of an insulated copper equipment grounding conductor.

517.30(B) The use of, and term, emergency systems has been eliminated from Article 517, leaving only the essential system with the three separate branches: critical, life safety and equipment. The diagram in Figure 517.30, No. 1 has been re-worked to reflect these changes as well.

**2011 NEC Requirement.** The general applications of an essential electrical system for hospitals are described at 517.30(B). There were six list items addressed at this subsection. (1) Separate Systems demanded that the essential electrical systems for hospitals be comprised of two separate systems capable of supplying a limited amount of lighting and power considered essential for life safety and effective hospital operation during the time the normal electrical service is interrupted for any reason. These two systems were to be considered the emergency system and the equipment system. (2) Emergency System was to be limited to circuits essential to life safety and critical patient care and was designated as the life safety branch and the critical branch. (3) Equipment Systems supplied major electrical equipment necessary for patient care and basic hospital operation. (4) Transfer Switches described the number of transfer switches to be used, based on reliability, design, and load considerations. (5) Optional Loads were not covered in Article 517. These loads required their own transfer switch(es); and there had to be provisions so the transfer wouldn't take place if the generator would be overloaded, or the loads had to be shed if the generator became overloaded. (6) Contiguous Facilities required hospital power sources and alternate power sources to be permitted to serve the essential electrical systems of contiguous or same site facilities.

**2014 NEC Change.** The requirements for the "Essential Electrical Systems for Hospitals" were revised by removing references to the emergency system. Section 517.30(B) (3) Equipment System was also removed. This action leaves only the essential system with the three separate branches: critical, life safety and equipment branch.

517.30(E) Cover plates or the receptacles supplied from the essential electrical system are required to have a distinctive color or marking, and must also be supplied with an illuminated face or an indicator light to indicate that there is power to the receptacle.

**2011 NEC Requirement.** The cover plates or the electrical receptacles themselves that are supplied from the emergency system were required to have a distinctive color or marking so as to be readily identifiable.

**2014 NEC Change.** All references to the emergency system were removed from Article 517. These receptacles are now required to be supplied from the essential electrical system. The cover plates or the electrical receptacles themselves are still required to have a distinctive color or marking so as to be readily identifiable, but they now must also be supplied with an illuminated face or an indicator light to indicate that there is power to the receptacle.

517.30(G) Overcurrent devices for the essential electrical system do not need to be fully selectively coordinated but only required "coordination" for fault events that exceed 0.1 seconds.

**2011 NEC Requirement.** Selective coordination provisions for a health care facility exist at 517.17(C) in the 2011 NEC. No requirements existed in Article 517 for simply "coordination" for the essential electrical system in the 2011 NEC.

**2014 NEC Change.** Overcurrent protective devices serving the essential electrical system of a health care facility are now required to be coordinated for the period of time that a fault's duration extends beyond 0.1 second. An exception exists for this now rule for transformer primary and secondary overcurrent protective devices, where only one overcurrent protective device exists on the transformer secondary. Another exception was added for overcurrent protective devices of the same ampere rating installed in series.

520.2 Definitions. Three new definitions were added to Article 520 to meet demands of new theatre stage lighting technology.

**2011 NEC Requirement.** These new definitions were not part of the 2011 NEC.

**2014 NEC Change.** Three new definitions were added to Article 520. New definitions were added for stage equipment, stage lighting hoist, and stage switchboard.

29. 517.19(B) The minimum number of receptacles required for critical care area patient bed locations of health care facilities was increased from six to \_\_\_\_\_.

- a. 8
- b. 10
- c. 12
- d. 14

30. 517.19(C) New 517.19(C) was added requiring a minimum number of \_\_\_\_\_ receptacles in an operating room of health care facilities.

- a. 12
- b. 24
- c. 36
- d. 48

31. 517.30(B) The use of, and term, emergency systems has been eliminated from Article 517, leaving only the essential system with the three separate branches:

- a. critical
- b. life safety
- c. equipment
- d. all of the above

32. 517.30(E) \_\_\_\_\_ supplied from the essential electrical system are required to have a distinctive color or marking,

- a. Cover plates
- b. Receptacles
- c. both a or b
- d. none of the above

33. 517.30(E) and must also be supplied with an \_\_\_\_\_ to indicate that there is power to the receptacle.

- a. illuminated face
- b. indicator light
- c. both a or b
- d. none of the above

34. 517.30(G) Overcurrent devices for the essential electrical system do not need to be fully selectively coordinated but only required "coordination" for fault events that exceed \_\_\_\_\_ seconds.

- a. 0.1
- b. 1.0
- c. 0.01
- d. none of the above

35. 520.2 Definitions. \_\_\_\_\_ new definitions were added to Article 520 to meet demands of new theatre stage lighting technology.

- a. 1
- b. 2
- c. 3
- d. 4

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547.2 Definition. Equipotential plane for agriculture buildings is to minimize (not prevent) voltage potentials within the plane and between the plane, grounded equipment, and the earth.

**2011 NEC Requirement.** The definition of an equipotential plane for agriculture buildings was defined at 547.2 as a plane to "prevent" a difference in voltage from developing within the plane for livestock.

**2014 NEC Change.** The definition of an equipotential plane for agriculture buildings was revised to indicate that this plane is intended to "minimize" voltage potentials within the plane and between the plane, the grounded equipment, and the earth.

547.5(F) An insulated or covered aluminum or copper equipment grounding conductor is now permitted for underground agricultural building installations.

**2011 NFC Requirement.** Where an equipment grounding conductor was installed underground at an agricultural building location, it had to be an insulated or covered copper conductor.

**2014 NEC Change.** Revisions were made to 547.5(F) to now permit an equipment grounding conductor installed underground at an agricultural building location to be an insulated or covered aluminum or copper conductor.

550.15(H) "Under-Chassis Wiring (Exposed to Weather)" has been revised to allow any raceway or conduit "approved" for a wet location or where subject to physical damage.

**2011 NFC Requirement.** Where mobile home line-voltage wiring (120 volts, nominal, or higher) was installed outdoors or under the chassis of the mobile home, exposed to moisture or physical damage, this wiring had to be protected by rigid metal conduit or intermediate metal conduit, and the conductors must be "suitable" for wet locations. Two conditions existed that precluded the use of rigid metal conduit or intermediate metal conduit. Reinforced thermosetting resin conduit (RTRC) listed for aboveground use, Type MI cable, electrical metallic tubing, or rigid polyvinyl chloride conduit (PVC) was permitted as a wiring method where "closely routed against frames and equipment enclosures." The second condition allowed Schedule 80 PVC or RTRC listed for exposure to physical damage as a wiring method where this wiring method extended vertically from a direct-burial depth of at least 457 mm [18 in.] below grade and terminated to a factory-installed conduit or enclosure. These two conditions were added to the 2011 NEC.

**2014 NEC Change.** Revisions to 550.15(H) now permit mobile home line-voltage wiring (120 volts, nominal, or higher) installed outdoors or under the chassis of the mobile home, exposed to moisture or physical damage, to be protected by a conduit or raceway "approved" for use in wet locations or where subject to physical damage. Rather than the conductors having to be "suitable" for use in a wet location, the conductors must now be "listed" for use in wet locations.

551.4(C) New subsection was added to standardize label requirements in Article 551 at one location.

**2011 NEC Requirement.** There are four label requirements within Article 551: 551.46(D); 551.46(Q); 551.46(R)(4); and 551.46(5){3}, In the 2011 NEC, 551.4f>(D) was identified as the "label criteria" for Article 551. The other three Article 551 label requirements referred back to 551.46(D) for specifics of the label.

**2014 NEC Change.** A new subsection for "Labels" for recreational vehicles and recreational vehicle parks was added to the general requirements of 551.4. This new provision will require labels required by Article 551 to be made of etched, metal-stamped, or embossed brass, stainless steel, or plastic laminates 0.005 in. (0.13 mm) minimum thick, or anodized or alclad aluminum not less than 0.020 in. (0.5 mm) thick or equal.

551.71 Every recreational vehicle site equipped with a 50-ampere receptacle is now required to also be equipped with a 30-ampere, 125-volt receptacle.

**2011 NEC Requirement.** In accordance with the requirements of 551.71, every recreational vehicle site (with electrical power provided) must be equipped with a certain number and type of receptacles. Every recreational vehicle site must be provided with at least one 20-ampere, 125-volt receptacle. At least 20 percent of all recreational vehicle sites are required to be supplied with a 50-ampere, 125/250-volt receptacle. A minimum of 70 percent of all recreational vehicle sites must be equipped with a 30-ampere, 125-volt receptacle. All of the RV sites mentioned above are also permitted to include additional receptacles that have configurations such as 50-ampere, 125/250-volt, 3-pole, 4-wire receptacle or other configurations conforming to 551.81.

The remainder of the RV sites (with electrical power supplied) are required to be equipped with one or more of the receptacle configurations conforming to 551.81. Dedicated tent sites with a 15- or 20-ampere electrical supply are permitted to be excluded when determining the percentage of recreational vehicle sites with 30- or 50-ampere receptacles.

**2014 NEC Change.** In addition to all of the numbers and types of receptacle provisions required by the 2011 NEC, every recreational vehicle site equipped with a 50-ampere receptacle must also be equipped with a 30-ampere, 125-volt receptacle.

555.15(B) and (C) An insulated aluminum or copper equipment grounding conductor is now permitted at marinas and boatyards.

**2011 NEC Requirement.** For wiring and equipment at marinas and boatyards, equipment grounding conductors were required to consist of an insulated copper conductor with a continuous outer finish that is either green or green with one or more yellow stripes. The insulated copper equipment grounding conductor is to be sized in accordance with 250.122 but not smaller than 12 AWG. Where the wiring method is Typo MI cable, the equipment grounding conductor is permitted to be identified at terminations. For conductors larger than 6 AWG, or where multiconductor cables are used, re-identification of conductors is allowed.

**2014 NEC Change.** The 2011 NEC provisions at 555.15(B) and (C) hold true in the 2014 NEC, only the insulated equipment grounding conductor can be either copper or aluminum.

36. 547.2 Definition. Equipotential plane for agriculture buildings is to \_\_\_\_\_ voltage potentials within the plane and between the plane, grounded equipment, and the earth.

- a. minimize
- b. prevent
- c. both a & b
- d. none of the above

37. 547.5(F) \_\_\_\_\_ equipment grounding conductor is now permitted for underground agricultural building installations.

- a. Insulated aluminum
- b. Covered aluminum
- c. Copper
- d. all of the above

38. 550.15(H) "Under-Chassis Wiring (Exposed to Weather)" has been revised to allow any raceway or conduit " \_\_\_\_\_ " for a wet location or where subject to physical damage.

- a. marked
- b. listed
- c. identified
- d. approved

39. 550.15(H) "Under-Chassis Wiring (Exposed to Weather)" has been revised and the conductors must now be " \_\_\_\_\_ " for use in wet locations.

- a. marked
- b. listed
- c. identified
- d. approved

40. A new subsection for "Labels" for \_\_\_\_\_ was added to the general requirements of 551.4.

- a. recreational vehicles
- b. recreational vehicle parks
- c. both a & b
- d. none of the above

41. This new provision will require labels required by Article 551 to be made of \_\_\_\_\_ brass.

- a. etched
- b. metal-stamped
- c. embossed
- d. all of the above

42. This new provision will require labels required by Article 551 to be made of \_\_\_\_\_.

- a. stainless steel
- b. plastic laminates 0.010 in. (0.3 mm) minimum thick
- c. anodized or clad aluminum not less than 0.010 in. (0.2 mm) thick or thinner
- d. all of the above

43. 551.71 Every recreational vehicle site equipped with a 50-ampere receptacle is now required to also be equipped with \_\_\_\_\_ 30-ampere, 125-volt receptacle.

- a. one
- b. two
- c. three
- d. four

44. 555.15(B) and (C) An insulated aluminum or copper equipment grounding conductor is now permitted at \_\_\_\_\_.

- a. marinas
- b. boatyards
- c. both a & b
- d. none of the above

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590.4(D)(2) "Extra duty" covers are now required for all 15- and 20-ampere, 125- and 250-volt receptacles installed at temporary installations in a wet location (not just those supported from grade). This requirement now also includes dwelling unit temporary installation wet location receptacles as well.

**2011 NEC Requirement.** All 15- and 20-ampere, 125- and 250-volt receptacles installed in a temporary installation wet location are required to comply with 406.9(B)(1). This Article 406 requirement called for these receptacles to have an enclosure and cover that are weatherproof whether a cord cap is inserted or not. An outlet box hood cover installed for this purpose must be listed; and where installed on an enclosure supported from grade, this outlet box hood cover has to be identified as an "extra-duty" type cover. This extra duty hood cover did not apply to dwelling unit receptacles in the 2011 NEC. All 15- and 20-ampere, 125- and 250-volt nonlocking-type receptacles installed in wet locations must also be of the listed weather-resistant type.

**2014 NEC Change.** The language and text at 590.4(D){2} remains the same from the 2011 NEC to the 2014 NEC. What has changed is the referenced text and requirements at 406.9(B){1}. For the 2014 NEC, a revision at 406.9(B)(1) now requires all enclosures and covers installed in wet locations for 15- and 20-ampere 125- and 250-volt receptacles to be listed and of the "extra duty" type, not just boxes supported from grade. This requirement is now also required at dwelling units as well. All 15- and 20-ampere, 125- and 250-volt receptacles installed in a wet location must still have an enclosure and covers that are weather proof whether an attachment plug cap is inserted or not. The requirement for weather-resistant type receptacles in wet locations is still applicable in the 2014 NBC as well.

590.4(1) Flexible cords and cables must be secured to boxes with fittings "listed for connecting flexible cords and cables to boxes."

**2011 NEC Requirement.** Flexible cords and cables entering enclosures containing devices requiring termination were required to be secured to the box with fittings "designed for the purpose."

**2014 NEC Change.** Flexible cords and cables entering enclosures containing devices requiring termination are now required to be secured to the box with fittings "listed for connecting flexible cords and cables to boxes."

590.4(J) Cable assemblies and flexible cords installed as branch circuits or feeders are now prohibited from being installed or laid on the floor or the ground for temporary installations such as construction sites. (This does not include extension cords.)

**2011 NEC Requirement.** When installed for temporary lighting, branch circuits, etc., at construction sites, cable assemblies and flexible cords and cables are required to be supported by staples, cable ties, straps, or similar type fillings at intervals that ensure that they will be protected from physical damage. Vegetation is also not permitted to be used for support of overhead spans of branch circuits or feeders, with an exception for temporary holiday lighting.

**2014 NEC Change.** The same requirements for the 2011 NEC still apply, with a new provision for cable wiring methods. Cable assemblies and flexible cords and cables installed as branch circuits or feeders cannot be installed on the floor or on the ground. This new rule does not apply to extension cords.

600.4(E) All signs, outline lighting, skeleton tubing systems and retrofit kits are required to be marked to indicate that field-wiring and installation instructions are required (not just section signs).

**2011 NEC Requirement.** Section signs were required to be marked to indicate that field-wiring and installation instructions are required.

**2014 NEC Change.** Revisions to 600.4(E) changed the title of this subsection from "Section Signs" to "Installation Instructions." This subsection now requires all signs, outline lighting, skeleton tubing systems and retrofit kits to be marked to indicate that field-wiring and installation instructions are required (not just section signs). An exception was added to exclude portable, cord-connected signs from this requirement.

600.6(A)(1) Disconnect is required to be located at the point feeder(s) or branch circuit(s) supplying a sign or outline lighting system enters a sign enclosure or pole. This new language requires disconnection of all wiring where it enters the enclosure of the sign or pole.

**2011 NEC Requirement.** Section 600.6 requires each sign and outline lighting system, feeder circuit or branch circuit supplying a sign, outline lighting system, or skeleton tubing to be controlled by an externally operable switch or circuit breaker that opens all ungrounded conductors. Section 600.6(A)(1) and (A)(2) require the disconnecting means to be within sight of the sign and the controller. No provisions existed in the 2011 NEC as to the disconnecting means being required to be located ahead of the point of entry of electrical circuits before these circuits enter the sign enclosure.

**2014 NEC Change.** A new 600.6(A)(1) entitled, "At Point of Entry to a Sign Enclosure" has been added to this subsection. This addition will require the sign disconnect to be located at the point the feeder(s) or branch circuit(s) supplying a sign or outline lighting system enters a sign enclosure or pole and will require disconnection of all wiring where it enters the enclosure of the sign or pole. The existing provisions for the disconnecting means to be within sight of the sign and the controller have been pushed to 600.6(A)(2 and (A)(3) respectively.

600.7(A)(1) Metal parts of skeleton tubing as well as signs and outline lighting systems are required to be grounded by connection to the equipment grounding conductor of the supply branch circuit(s) or feeder.

**2011 NEC Requirement.** Signs and metal equipment of outline lighting systems were required to be grounded by connection to the equipment grounding conductor of the supply branch circuit(s) or feeder using any of the types of equipment grounding conductors specified in 250.118. Metal parts of skeleton tubing were not included in this grounding provision.

**2014 NEC Change.** Revisions occurred at 600.7(A)(1) to include metal parts of skeleton tubing as well as metal parts of signs and outline lighting systems requiring grounding by connection to the equipment grounding conductor of the supply branch circuit(s) or feeder.

45. 590.4(D)(2) " \_\_\_\_\_ " covers are now required for all 15-and 20-ampere, 125- and 250-volt receptacles installed at temporary installations in a wet location (not just those supported from grade).

- a. Medium duty
- b. Light duty
- c. Extra duty
- d. Heavy duty

46. 590.4(D)(2) This requirement \_\_\_\_\_ dwelling unit temporary installation wet location receptacles as well.

- a. does not included
- b. now also includes
- c. sometimes includes
- d. none of the above

47. 590.4(1) Flexible cords and cables must be secured to boxes with fittings " \_\_\_\_\_ for connecting flexible cords and cables to boxes."

- a. marked
- b. listed
- c. identified
- d. approved

48. 590.4(J) Cable assemblies and flexible cords installed as \_\_\_\_\_ are now prohibited from being installed or laid on the floor or the ground for temporary installations such as construction sites.

- a. branch circuits
- b. feeders
- c. both a & b
- d. none of the above

49. 590.4(J) This code section \_\_\_\_\_ include extension cords.

- a. does not
- b. does

- c. sometimes
  - d. none of the above
50. 600.4(E) All signs, outline lighting, skeleton tubing systems and retrofit kits are required to be marked to indicate that \_\_\_\_\_ are required (not just section signs).
- a. field-wiring
  - b. installation instructions
  - c. both a & b
  - d. none of the above
51. 600.4(E) An exception was added to \_\_\_\_\_ portable, cord-connected signs from this requirement.
- a. include
  - b. exclude
  - c. contain
  - d. none of the above
52. 600.6(A)(1) Disconnect is required to be located at the point feeder(s) or branch circuit(s) supplying a sign or outline lighting system enters a \_\_\_\_\_.
- a. sign enclosure
  - b. pole
  - c. both a & b
  - d. none of the above
53. 600.6(A)(1) This new language requires disconnection of all wiring where it \_\_\_\_\_ the enclosure of the sign or pole.
- a. leaves
  - b. enters
  - c. exits
  - d. none of the above
54. 600.7(A)(1) Metal parts of skeleton tubing as well as signs and outline lighting systems are required to be \_\_\_\_\_.
- a. earthed
  - b. bonded
  - c. grounded
  - d. all of the above
55. 600.7(A)(1) The above requirement includes a connection to the equipment grounding conductor of the supply \_\_\_\_\_.
- a. branch circuit(s)
  - b. feeder
  - c. both a or b
  - d. none of the above

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610.31 New reference to 430.109, Types of Disconnecting Means, replaces the previous laundry list of types of disconnecting means which was incomplete.

**2011 NEC Requirement.** A disconnecting means for a crane or hoist must be provided somewhere between the runway contact conductors and the power supply. This disconnecting means was required to consist of a motor circuit switch, circuit breaker, or molded-case switch. This disconnecting means had to comply with four specific conditions. (1) Installed in a readily accessible location and be operable from the ground or floor level. (2) Capable of being locked in the open position with specific conditions for the locking means. (3) Open all ungrounded conductors simultaneously, and (4) Placed within view of the runway contact conductors.

**2014 NEC Change.** This section was revised by removing the incomplete laundry list of types of disconnecting means permitted for cranes and hoists and replacing this previous list with a new reference to 430.109, Types of Disconnecting Means. The lockable provisions for the disconnecting means were replaced with a reference to the new lockable provisions at 110.25. A new exception was added for the "within view of the runway contact conductors" provision to allow the disconnecting means to be placed out of view of the runway contact conductors under specific conditions.

620.21, EX The cords and cables of listed cord- and plug connected equipment are not required to be installed in a raceway in hoistways, escalators, moving walkways, etc.

**2011 NEC Requirement.** All conductors and optical fiber cables located in and for hoistways, elevators, escalators, etc., were generally required to be installed in rigid metal conduit, intermediate metal conduit, electrical metallic tubing, rigid nonmetallic conduit, or wireways, or to be Type MC, MI, or AC cable. This does not include the traveling cables connecting the car or counterweight and hoistway wiring,

**2014 NEC Change.** An exception was added to this existing raceway rule for cords and cables of listed cord- and plug-connected equipment.

620.51(0)(1) Both fused and non-fused motor circuit switches are allowed when motor controllers are installed within the elevator hoistway and are not supplied with a means for protection from internal short circuits.

**2011 NEC Requirement.** On elevators without generator field control, the disconnecting means is required to be located within sight of the motor controller. Where the motor controller is located in the elevator hoistway, the disconnecting means is also required to be located in a machinery space, machine room, control space or control room outside the hoistway. In addition to these requirements, a non-fused, enclosed externally, operable motor-circuit switch, capable of being locked in the open position, to disconnect all ungrounded main power-supply conductors was required to be located within sight of the motor controller.

**2014 NEC Change.** In conjunction with the above provisions that were carried forward from the 2011 NEC, the enclosed externally operable motor-circuit switch for disconnection of all ungrounded main power-supply conductors is now permitted to be either a fused or non-fused motor-circuit switch.

Article 625 was renumbered and reorganized to provide a logical sequence and arrangement.

**2011 NEC Requirement.** Article 625, Electric Vehicle Charging Systems, was arranged with five parts; Part I. General; Part II. Wiring Methods; Part III. Equipment Construction; Part IV. Control and Protection; and Part V. Electric Vehicle Supply Equipment Locations.

**2014 NEC Change.** Article 625 was renumbered and reorganized into three parts; Part II. Equipment Construction; and Part III. Installation.

630.13 Revision requires the arc welder disconnect be marked to "identify" what the disconnect actually disconnects rather than requiring the disconnect be "identified."

**2011 NEC Requirement.** At 630.13 in the 2011 NEC, the Code called for an "identified" disconnecting means in the supply circuit for each arc welder that is not equipped with a disconnect mounted as an integral part of the welder. "Identified" for what?

**2014 NEC Change.** A disconnecting means is still required in the supply circuit for each arc welder that is not equipped with a disconnect mounted as an integral part of the welder, but language was added to specify that this disconnecting means is required to be marked to "indicate its purpose" or "identify" what it supplies.

645.14 and 645.15 This revision divides the grounding requirements for information technology equipment into two separate sections: one for equipment grounding and bonding, and new provisions for systems grounding.

**2011 NEC Requirement.** Section 645.15 entitled, "Grounding" required all exposed non-current-carrying metal parts of an information technology system to be bonded to the equipment grounding conductor in accordance with the entire Article 250, unless it was a double insulated system. Power systems derived within listed information technology equipment that supply information technology systems through receptacles or cable assemblies supplied as part of this equipment are not to be considered separately derived for the purpose of applying 250.30 (requirements for grounding a separately derived system). Where signal reference structures are installed, they are required to be bonded to the equipment grounding conductor provided for the information technology equipment.

**2014 NEC Change.** New 645.14 entitled, "System Grounding" was added, and existing 645.15 was retitled, "Equipment Grounding and Bonding" and revised. This revision divides the grounding requirements into two different sections: one for equipment grounding and bonding (645.15), and one for systems grounding (645.14). The provisions for separately derived power systems were moved to new 645.14. A new reference to 250.54 for auxiliary grounding electrode(s) was added to 645.15 as well.



56. 610.31 A new exception was \_\_\_\_for the "within view of the runway contact conductors" provision to allow the disconnecting means to be placed out of view of the runway contact conductors under specific conditions.
- deleted
  - moved
  - added
  - relocated
57. 610.31 The lockable provisions for the disconnecting means were replaced with a reference to the new lockable provisions at \_\_\_\_\_.
- 110.24
  - 110.25
  - 110.26
  - all of the above
58. 620.21, EX The cords and cables of listed cord- and plug connected equipment are not required to be installed in a raceway in \_\_\_\_\_.
- hoistways
  - escalators
  - moving walkways
  - all of the above
59. 620.51(0)(1) \_\_\_\_\_ motor circuit switches are allowed when motor controllers are installed within the elevator hoistway and are not supplied with a means for protection from internal short circuits.
- Fused
  - Non-fused
  - both a & b
  - none of the above
60. Article 625 was \_\_\_\_\_ to provide a logical sequence and arrangement.
- renumbered
  - reorganized
  - both a & b
  - none of the above
61. 630.13 Revision requires the arc welder disconnect be marked to " \_\_\_\_\_ " what the disconnect actually disconnects.
- identify
  - classify
  - recognize
  - all of the above
62. 630.13 rather than requiring the disconnect be " \_\_\_\_\_ " at stated in the 2011 NEC.
- identified
  - classified
  - recognized
  - all of the above
63. 645.14 and 645.15 This revision divides the grounding requirements for information technology equipment into two separate sections:
- equipment grounding and bonding
  - new provisions for systems grounding
  - both a & b
  - none of the above

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645.27 All overcurrent devices in critical operations data systems are required be selectively coordinated with all supply-side overcurrent devices.

**2011 NEC Requirement.** There were no selective coordination requirements in Article 645 for information technology equipment in the 2011 NEC.

**2014 NEC Change.** A new 645.27 was added that will now require all critical operations data system(s) overcurrent protective devices to be selectively coordinated with all supply-side overcurrent protective devices.

Article 646 A new article was added entitled, "Modular Data Centers."

**2011 NEC Requirement.** Information technology equipment is addressed at Article 645. Modular data centers were not specifically addressed in the 2011 NEC.

**2014 NEC Change.** A new Article 646 entitled, "Modular Data Centers" was added to the 2014 NEC.

680.2 Definition for storable swimming, wading, or immersion pools has been revised to include storable/portable spas and hot tubs.

**2011 NEC Requirement.** For the 2011 NEC, the definition for storable or portable spas or hot tubs was not included in the definition for a storable swimming, wading, or immersion pool. This definition did include pools that are constructed on or above the ground and are capable of holding water to a maximum depth of 1.0 m (42 in.). This definition also included any pool with nonmetallic, molded polymeric walls or inflatable fabric walls regardless of dimension.

**2014 NEC Change.** The definition remained the same with the inclusion of storable or portable spas and hot tubs in the definition.

680.12 Fountains were added to requirements for "Maintenance Disconnecting Means,"

**2011 NEC Requirement.** A disconnecting mean(s) is required to simultaneously disconnect all ungrounded conductors for all utilization equipment (other than lighting) for a pool, spa, or hot tub. This disconnecting mean(s) must be readily accessible and within sight from its equipment. This disconnecting mean(s) must also generally be located at least 1.5 m (5 ft.) horizontally from the inside walls of a pool, spa, or hot tub (unless separated by a permanently installed barrier).

**2014 NEC Change.** The same 2011 NEC maintenance disconnecting means rules at 680.12 were extended to fountains as well as to pools, spas, or hot tubs.

680.21(C) All single-phase, 120-volt through 240-volt outlets supplying pool pump motors now require GFCI protection (regardless of ampacity).

**2011 NEC Requirement.** The outlet(s) supplying pool pump motors for permanently installed pools, connected to single-phase, 120-volt through 240-volt branch circuits, rated 15 or 20 amperes required ground-fault circuit interrupter (GFCI) protection for personnel. This GFCI protection rule applies whether the pool pump motor is supplied by receptacle or by direct connection.

**2014 NEC Change.** These GFCI protection rules at 680.21 (Q) still apply to permanently installed pool pump motors, but for the 2014 NEC, the applicable limitation of motors "rated 15 or 20 amperes" has been removed.

680.22(A)(1) At least one 125-volt, 15- or 20-ampere receptacle on a general-purpose branch circuit must be located not less than 1.83 m (6 ft.) from, and not more than 6.0 m (20 ft.) from, the inside wall of all permanently installed pools (not just dwelling unit pools).

**2011 NEC Requirement.** At least one 125-volt, 15- or 20-ampere receptacle on a general-purpose branch circuit was required to be located not less than 1.83 m (6 ft.) from, and not more than 6.0 m (20 ft.) from, the inside wall of all permanently installed pools at dwelling units. This receptacle(s) could not be located more than 2.0 m (6 ft. 6 in.) above the floor, platform, or grade level serving the pool. This convenience receptacle was only applicable to dwelling unit and did not apply to "other than dwelling unit" permanently installed pools. This provision was also located at 680.22(A)(3) in the 2011 NEC.

**2014 NEC Change.** This provision for a required 125-volt, 15- or 20-ampere receptacle on a general purpose branch circuit was moved to 680.22(A)(1). The requirement was expanded to all permanently installed pools, not just dwelling unit permanently installed pools. The title was revised from, "Dwelling Unit(s)" to "Required Receptacle, Location."

64. 645.27 All overcurrent devices in critical operations data systems are required be selectively coordinated with all \_\_\_\_\_-side overcurrent devices.

- a. load
- b. supply
- c. both a & b
- d. none of the above

65. Article 646 A new article was added entitled, "\_\_\_\_\_."

- a. Modular Data Centers
  - b. Sectional Data Centers
  - c. Flexible Data Centers
  - d. all of the above
66. 680.2 Definition for storable swimming, wading, or immersion pools has been revised to include storable/portable \_\_\_\_\_.
- a. spas
  - b. hot tubs
  - c. both a & b
  - d. none of the above
67. 680.12 \_\_\_\_\_ were added to requirements for "Maintenance Disconnecting Means,"
- a. Spas
  - b. Hot tubs
  - c. Fountains
  - d. all of the above
68. 680.21(C) All single-phase, 120-volt through 240-volt outlets supplying pool pump motors now require \_\_\_\_\_ protection (regardless of ampacity).
- a. GFCI
  - b. combination GFCI/AFCI
  - c. AFCI
  - d. none of the above
69. 680.22(A)(1) At least one 125-volt, 15- or 20-ampere receptacle on a general-purpose branch circuit must to be located not less than 1.83 m (6 ft.) from, and not more than 6.0 m (20 ft.) from, the inside wall of all \_\_\_\_\_ pools.
- a. storable
  - b. permanently installed
  - c. shallow
  - d. none of the above
70. 680.22(A)(1) only includes dwelling unit pools.
- a. true
  - b. false

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680.22 (A) (2) Receptacles that provide power for pool pump motors located between 3.0 m (10 ft.) and 1.83 m (6 ft.) from the pool no longer are required to "employ a locking configuration."

**2011 NEC Requirement.** Receptacles that supply power for pool pump motors or other loads directly related to the circulation and sanitation system were addressed at 680.22(A)(1) in the 2011 NEC. This provision required the receptacle® to be located at least 3.0 m (10 ft.) from the inside walls of the pool. Permission was granted at 680.22(A)(1) to allow the circulation and sanitation receptacle(s) to be located not less than 1.83 m (6 ft.) from the inside walls of the pool, if the receptacle(s) complied with all of the following conditions: (1) consist of single receptacles, (2) employ a locking configuration, (3) are of the grounding type, and (4) be provided with GFCI protection.

**2014 NEC Change.** The requirements for receptacles that supply power for pool pump motors or other loads directly related to the circulation and sanitation system were moved to 680.22(A)(2). The same provisions in the 2011 NEC at 680.22(A)(1) were brought forward to 680.22(A)(2), with the exception of the requirement for "employ a locking configuration" being deleted.

680.22(B)(6) Specific low-voltage luminaires are now permitted to be installed within 1.5 m (5ft.) of the inside walls of permanently installed pools.

**2011 NEC Requirement.** Requirements at 680.22(B)(1) through (B)(5) generally prohibited luminaires from being installed within 1.5 m (5 ft.) horizontally of the inside of a pool. These provisions did not quantify the voltage type of these luminaires. No provisions existed at 680.22(B) for low-voltage luminaires in the 2011 NEC. Section 411.4(B) stated that "Lighting systems shall be installed not less than 3 m (10 ft.) horizontally from the nearest edge of the water, unless permitted by Article 680."

**2014 NEC Change.** A new list item was added at 680.22(B)(6) to address low-voltage luminaires around permanently installed pools. Specific low-voltage luminaires will now be permitted to be located less than 1.5 m (5 ft.) from the inside walls of the pool under certain conditions. These luminaires must be of the type that does not require connection to an equipment grounding conductor. These luminaires cannot exceed the voltage limitations defined in the definition of low voltage contact limit at 680.2. These luminaires must also be supplied by listed transformers or power supplies that comply with 680.23(A)(2) for transformers or power supplies listed for swimming pool and spa use.

680.25(A)(1), EX The exception allowing an "existing" feeder between an "existing" remote swimming pool panelboard and service equipment to be run in flexible metal conduit or an approved cable assembly has been revised to allow this exception for any feeder and remote swimming pool panelboard. Cable assembly is required to have an "insulated" EGC.

**2011 NEC Requirement.** The wiring methods for feeders on the supply side of panelboards supplying branch circuits for pool equipment are required to be installed in rigid metal conduit or intermediate metal conduit. Where not subject to physical damage, six specific wiring methods with conditions are permitted for this feeder installation, including EMT and PVC. An exception to this feeder wiring method rule permitted an existing feeder between an existing remote panelboard and service equipment to be run in flexible metal conduit or an approved cable assembly that includes an equipment grounding conductor within its outer sheath.

**2014 NEC Change.** The requirements for wiring methods for swimming pool panelboard feeders did not change at the main text of 680.25(A)(1), but the exception for an existing feeder between an existing remote panelboard and service equipment was deleted.

680.26(C) The requirement for "bonding" of pool water has been revised.

**2011 NEC Requirement.** The 2011 NEC text called for an "intentional bond" to the pool water from some conductive surface with a minimum surface area of 5800 mm<sup>2</sup> (9 in.<sup>2</sup>) in contact with the pool water. This bond to the conductive surface from the pool water was permitted to consist of parts that are required to be bonded in 680.26(13), such as metal ladders, metal railings, metal underwater luminaire housings, etc.

**2014 NEC Change.** The same provisions that were found in the 2011 NEC are still in place, but are worded differently to avoid the terms intentional bond or bond.

680.42(6) Equipotential bonding of perimeter surfaces is not required for outdoor spas and hot tubs with (4) specific conditions that must be met.

**2011 NEC Requirement.** A spa or hot tub installed outdoors is required to comply with the provisions of Parts I and II of Article 680. Section 680.42(A) and (B) gives some specific conditions that would supersede the provisions of Parts I and II of Article 680; but, otherwise, an outdoor spa or hot tub is to be treated like a permanently installed pool installed outdoors. Section 680.42(B) states that bonding by metal-to-metal mounting on a common frame or base is permitted, and the metal bands or hoops used to secure wooden staves are not required to be bonded as required in 680.26 for equipotential bonding.

There was no text at 680.42(B) in the 2011 NEC to supplant the provisions of 680.26 and equipotential bonding for outdoor spas or hot tubs, since outdoor spas or hot tubs were required to comply with the provisions of Parts I and II of Article 680. However, it should be noted that a Tentative Interim Amendment 70-1 1-1 (Log #1005) was issued by the Standards Council on March 1, 2011, for 680.42(13). This TIA introduced language that would exempt self-contained listed spas and hot tubs from the provisions of equipotential bonding in Part II of Article 680. A Tentative Interim Amendment (TIA) is tentative because it has not been processed through the entire Code-making procedures. It is interim because it is effective only between editions of the Code. A TIA automatically becomes a proposal of the proponent for the next edition of the Code;

**2014 NEC Change.** The concepts of TIA 70-11-1 were incorporated and added to 680.42(B) for the 2014 NEC. These new provisions eliminate equipotential bonding requirements for listed self-contained spas or hot tubs for aboveground use. In order for these listed self-contained spas or hot tubs to avoid 680.26 equipotential bonding requirements, four specific conditions must be satisfied (see actual NEC text provided on this page for specific conditions).

680.57(B) GFCI protection is required for either the branch circuit or feeder supplying electric signs installed within a fountain, but not both.

**2011 NEC Requirement.** All circuits supplying electric signs within a fountain or within 3.0 m (10 ft.) of the fountain's edge were required to provide ground-fault circuit-interrupter (GFCI) protection for personnel.

**2014 NEC Change.** This subsection was revised to clarify that (he required GFCI protection for fountain signs had to be provided in either the branch circuit or feeder supplying the sign, but not both.

71. 680.22 (A) (2) Receptacles that provide power for pool pump motors located between 3.0 m (10 ft.) and 1.83 m (6 ft.) from the pool \_\_\_\_\_ to "employ a locking configuration."

- a. required
- b. no longer are required
- c. could be required
- d. none of the above

72. The requirements for receptacles that supply power for pool pump motors or other loads directly related to the circulation and sanitation system were moved to \_\_\_\_\_.

- a. 680.22(A)(1)
- b. 680.22(A)(2)
- c. 680.22(A)(3)
- d. 680.22(A)(4)

73. 680.22(B)(6) Specific low-voltage luminaires are now permitted to be installed within \_\_\_\_\_ of the inside walls of permanently installed pools.

- a. 1.5 m
- b. 5ft.
- c. both a & b
- d. none of the above

74. These luminaires must also be supplied by listed transformers or power supplies that comply with 680.23(A)(2) for transformers or power supplies listed for \_\_\_\_\_ use.

- a. swimming pool
- b. spa
- c. both a & b
- d. none of the above

75. 680.22(B)(6) These luminaires cannot exceed the voltage limitations defined in the definition of low voltage contact limit at \_\_\_\_\_.

- a. 680.1
- b. 680.2
- c. 680.3
- d. 680.4

76. 680.25(A)(1), EX The exception allowing an "existing" feeder between an "existing" remote swimming pool panelboard and service equipment to be run in flexible metal conduit or an approved cable assembly has been revised to allow this exception for any \_\_\_\_\_.

- a. feeder
- b. remote swimming pool panelboard
- c. both a & b
- d. none of the above

77. 680.25(A)(1) EX Cable assembly is required to have an " \_\_\_\_\_ " EGC.

- a. bare
- b. covered
- c. insulated
- d. all of the above

78. 680.26(C) The requirement for "bonding" of pool water has been \_\_\_\_\_.

- a. added
- b. moved
- c. revised
- d. deleted

79. 680.42(6) Equipotential bonding of perimeter surfaces is not required for outdoor spas and hot tubs with \_\_\_\_\_ specific conditions that must be met.

- a. 1
- b. 2
- c. 3
- d. 4

80. 680.57(B) GFCI protection is required for either the branch circuit or feeder supplying electric signs installed within a \_\_\_\_\_, but not both.

- a. pools
- b. spas
- c. fountain
- d. hot tub

### 2014 NEC Analysis Part 4-Quiz Answer Sheet

<u>1</u>	a b c d	<u>27</u>	a b c d	<u>54</u>	a b c d
<u>2</u>	a b c d	<u>28</u>	a b c d	<u>55</u>	a b c d
<u>3</u>	a b c d	<u>29</u>	a b c d	<u>56</u>	a b c d
<u>4</u>	a b c d	<u>30</u>	a b c d	<u>57</u>	a b c d
<u>5</u>	a b c d	<u>31</u>	a b c d	<u>58</u>	a b c d
<u>6</u>	a b c d	<u>32</u>	a b c d	<u>59</u>	a b c d
<u>7</u>	a b c d	<u>33</u>	a b c d	<u>60</u>	a b c d
<u>8</u>	a b c d	<u>34</u>	a b c d	<u>61</u>	a b c d
<u>9</u>	a b c d	<u>35</u>	a b c d	<u>62</u>	a b c d
<u>10</u>	a b c d	<u>36</u>	a b c d	<u>63</u>	a b c d
<u>11</u>	a b c d	<u>37</u>	a b c d	<u>64</u>	a b c d
<u>12</u>	a b c d	<u>38</u>	a b c d	<u>65</u>	a b c d
<u>13</u>	a b c d	<u>39</u>	a b c d	<u>66</u>	a b c d
<u>14</u>	a b c d	<u>40</u>	a b c d	<u>67</u>	a b c d
<u>15</u>	a b c d	<u>41</u>	a b c d	<u>68</u>	a b c d
<u>16</u>	a b c d	<u>42</u>	a b c d	<u>69</u>	a b c d
<u>17</u>	a b c d	<u>43</u>	a b c d	<u>70</u>	a b c d
<u>18</u>	a b c d	<u>44</u>	a b c d	<u>71</u>	a b c d
<u>19</u>	a b c d	<u>45</u>	a b c d	<u>72</u>	a b c d
<u>20</u>	a b c d	<u>46</u>	a b c d	<u>73</u>	a b c d
<u>21</u>	a b c d	<u>47</u>	a b c d	<u>74</u>	a b c d
<u>22</u>	a b c d	<u>48</u>	a b c d	<u>75</u>	a b c d
<u>23</u>	a b c d	<u>49</u>	a b c d	<u>76</u>	a b c d
<u>24</u>	a b c d	<u>50</u>	a b c d	<u>77</u>	a b c d
<u>25</u>	a b c d	<u>51</u>	a b c d	<u>78</u>	a b c d
<u>26</u>	a b c d	<u>52</u>	a b c d	<u>79</u>	a b c d
		<u>53</u>	a b c d	<u>80</u>	a b c d

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