2017 NEC CODE CHANGE
Part 2 • 8 Hours

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DISCLAIMER NOTE: This course is APPROVED by the Wisconsin Department of safety and professional services for continuing education to renew your electrical license and is not intended to replace or supersede any state or local adopted codes.
(Revised) 408.3 (A) (2) Service Panelboards, Switchboards, and Switchgear. Barriers shall be placed in all service panelboards, switchboards, and switchgear such that no uninsulated, ungrounded service busbar or service terminal is exposed to inadvertent contact by persons or maintenance equipment while servicing load terminations.

(Revised) 408.4 (B) Source of Supply. All switchboards, switchgear, and panelboards supplied by a feeder(s) in other than one- or two-family dwellings shall be permanently marked to indicate each device or equipment where the power originates. The label shall be permanently affixed, of sufficient durability to withstand the environment involved, and not handwritten.

(Revised) 409.110 Marking. An industrial control panel shall be marked with the following information that is plainly visible after installation:

1. Manufacturer’s name, trademark, or other descriptive marking by which the organization responsible for the product can be identified.

2. Supply voltage, number of phases, frequency, and full load current for each incoming supply circuit.

3. Industrial control panels supplied by more than one electrical source where more than one disconnecting means is required to disconnect all circuits 50-volts or more within the control panel shall be marked to indicate that more than one disconnecting means is required to deenergize the equipment. The location of the means necessary to disconnect all circuits 50-volts or more shall be documented and available.

4. Short-circuit current rating of the industrial control panel based on one of the following:
   a. Short-circuit current rating of a listed and labeled assembly
   b. Short-circuit current rating established utilizing an approved method

(Revised) 410.62 (C) Electric-Discharge and LED Luminaires. Electric discharge and LED luminaires shall comply with (1), (2), and (3) as applicable.

1. Cord-Connected Installation. A luminaire or a listed assembly in compliance with any of the conditions in (a) through (c) shall be permitted to be cord connected provided the luminaire is located directly below the outlet or busway, the cord is not subject to strain or physical damage, and the cord is visible over its entire length except at terminations.
   a. A luminaire shall be permitted to be connected with a cord terminating in a grounding-type attachment plug or busway plug.
   b. A luminaire assembly equipped with a strain relief and canopy shall be permitted to use a cord connection between the luminaire assembly and the canopy. The canopy shall be permitted to include a section of raceway not over 150 mm (6 in.) in length and intended to facilitate the connection to an outlet box mounted above a suspended ceiling.
   c. Listed luminaires connected using listed assemblies that incorporate manufactured wiring system connectors in accordance with 604.100(C) shall be permitted to be cord connected.

(Revised) 410.136(B) Informational Note: Combustible low-density cellulose fiberboard includes sheets, panels, and tiles that have a density of 320 kg/m3 (20 lb/ft3) or less and that are formed of bonded plant fiber material but
1. What article should be referenced to determine the applications regarding the immersion of low voltage lighting?
   A. 300
   B. 700
   C. 310
   D. 680

2. How are you NOT allowed to label a panelboard installed in a warehouse that indicates where each device or equipment power originates?
   A. Placard label
   B. Typed label
   C. Hand written label
   D. Phenolic label

3. What is the maximum length of raceway permitted in a luminaire assembly equipped with a canopy intended to facilitate the connection to an outlet box mounted above a suspended ceiling?
   A. 6 inches
   B. 12 inches
   C. 8 inches
   D. Only the minimum length is listed

4. What is the maximum current a low voltage power supply can output under all load conditions?
   A. 20 amps
   B. 25 amps
   C. 30 amps
   D. 2 amps

5. What ANSI is listed to determine the standard test method for surface burning characteristics of building materials?
   A. ANSI/ASM E84–2015o
   B. ANSI/ATM E85–2015a
   C. ANSI/ASTM E84–2015a
   D. ANSI/ASTM E84–2013b

6. When can an LED Luminaire be cord connected?
   A. The cord is visible over the entire length
   B. The cord is not subject to strain
   C. The cord is not subject to physical damage
   D. All listed answers

7. What type of power supply is required to be used with low voltage lighting systems?
   A. Control transformers
   B. Oscillating power supply
   C. Isolating power supply
   D. Air core transformers
8. What is required to be installed to prevent inadvertent contact with uninsulated parts inside switchgear while servicing load terminations?
   A. Guards
   B. Barriers
   C. Mesh dividers
   D. Service lighting

9. What is the maximum DC voltage for a light to be considered low voltage?
   A. 60
   B. 30
   C. 15
   D. 24

10. What article covers the installation and marking of industrial control panels?
    A. 408
    B. 409
    C. 406
    D. 410

(Revised) 411.4 Listing Required. Low-voltage lighting systems shall comply with 411.4(A) or 411.4(B).

(A) Listed System. The luminaires, power supply, and luminaire fittings (including the exposed bare conductors) of an exposed bare conductor lighting system shall be listed for the use as part of the same identified lighting system.

(B) Assembly of Listed Parts. A lighting system assembled from the following listed parts shall be permitted:
    (1) Low-voltage luminaires
    (2) Power supply
    (3) Low-voltage luminaire fittings
    (4) Suitably rated cord, cable, conductors in conduit, or other fixed Chapter 3 wiring method for the secondary circuit

(NEW) 422.5 (A) General. Appliances identified in 422.5(A)(1) through (5) rated 250 volts or less and 60 amperes or less, single- or 3-phase, shall be provided with GFCI protection for personnel. Multiple GFCI protective devices shall be permitted but shall not be required.
    (1) Automotive vacuum machines provided for public use
    (2) Drinking water coolers
    (3) High-pressure spray washing machines — cord-and-plug-connected
    (4) Tire inflation machines provided for public use
    (5) Vending machines

(NEW) 422.5 (B) Type. The GFCI shall be readily accessible, listed, and located in one or more of the following locations:
    (1) Within the branch circuit overcurrent device
    (2) A device or outlet within the supply circuit
    (3) An integral part of the attachment plug
    (4) Within the supply cord not more than 300 mm (12 in.) from the attachment plug
    (5) Factory installed within the appliance
(NEW) 422.6 Listing Required. All appliances operating at 50 volts or more shall be listed.

(Revised) 422.16(B)(2) Built-in Dishwashers and Trash Compactors. Built-in dishwashers and trash compactors shall be permitted to be cord-and-plug-connected with a flexible cord identified as suitable for the purpose in the installation instructions of the appliance manufacturer where all of the following conditions are met:

1. The flexible cord shall be terminated with a grounding-type attachment plug.
   Exception: A listed dishwasher or trash compactor distinctly marked to identify it as protected by a system of double insulation shall not be required to be terminated with a grounding-type attachment plug.

2. For a trash compactor, the length of the cord shall be 0.9 m to 1.2 m (3 ft to 4 ft) measured from the face of the attachment plug to the plane of the rear of the appliance.

3. For a built-in dishwasher, the length of the cord shall be 0.9 m to 2.0 m (3 ft to 6.5 ft) measured from the face of the attachment plug to the plane of the rear of the appliance.

4. Receptacles shall be located to protect against physical damage to the flexible cord.

5. The receptacle for a trash compactor shall be located in the space occupied by the appliance or adjacent thereto.

6. The receptacle for a built-in dishwasher shall be located in the space adjacent to the space occupied by the dishwasher.

7. The receptacle shall be accessible.

(Revised) 422.16 (4) Range Hoods. Range hoods shall be permitted to be cord-and-plug-connected with a flexible cord identified as suitable for use on range hoods in the installation instructions of the appliance manufacturer, where all of the following conditions are met:

1. The flexible cord is terminated with a grounding-type attachment plug.
   Exception: A listed range hood distinctly marked to identify it as protected by a system of double insulation shall not be required to be terminated with a grounding-type attachment plug.

2. The length of the cord is not less than 450 mm (18 in.) and not over 1.2 m (4 ft).

3. Receptacles are located to protect against physical damage to the flexible cord.

4. The receptacle is accessible.

5. The receptacle is supplied by an individual branch circuit.

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**PART 2 EXAM QUESTIONS**

11. At what voltage do all appliances have to be listed?
   - A. 35 volts
   - B. 150 volts or less
   - C. 50 volts or more
   - D. 25 volts

12. What is the current range that an automotive vacuum machine provided for public use is required to be GFCI protected?
   - A. 60 to 70 amps
   - B. .1 to 60 amps
   - C. 20 to 80 amps
   - D. .1 to 100 amps
13. What is the minimum listed length that a hood range cord can be?
   A. 18 inches
   B. 24 inches
   C. 12 inches
   D. 8 inches

14. What is the listed length for a built-in dishwasher cord measured from the face of the attachment plug to the plane of the rear of the appliance?
   A. There are no length requirements for a built-in dishwasher cord
   B. 3 to 4 feet
   C. 1 to 2 feet
   D. 3 to 6 ft. 6 inches

15. What is the maximum distance a drinking water cooler GFCI inside the supply cord that protects personnel required to be installed from the attachment plug?
   A. 24 inches
   B. 12 inches
   C. 18 inches
   D. 8 inches

16. What is not considered part of a low voltage lighting system assembly?
   A. Wall switch
   B. Low-voltage luminaire fittings
   C. Power supply
   D. Low-voltage luminaires

17. What is the listed length for a trash compactor cord measured from the face of the attachment plug to the plane of the rear of the appliance?
   A. 3 to 6 ft. 6 inches
   B. 3 to 4 feet
   C. 1 to 2 feet
   D. There are no length requirements for a trash compactor cord

(Revised) 422.18 Support of Ceiling-Suspended (Paddle) Fans. Ceiling suspended (paddle) fans shall be supported independently of an outlet box or by one of the following:
   (1) A listed outlet box or listed outlet box system identified for the use and installed in accordance with 314.27(C)
   (2) A listed outlet box system, a listed locking support and mounting receptacle, and a compatible factory installed attachment fitting designed for support, identified for the use and installed in accordance with 314.27(E)

(Revised) 422.21 Covering of Combustible Material at Outlet Boxes. Any combustible ceiling finish that is exposed between the edge of a ceiling-suspended (paddle) fan canopy or pan and an outlet box and that has a surface area of 1160 mm² (180 in.²) or more shall be covered with noncombustible material.

(Revised) 422.30 General. A means shall be provided to simultaneously disconnect each appliance from all ungrounded conductors in accordance with the following sections of Part III. If an appliance is supplied by more than one branch circuit or feeder, these disconnecting means shall be grouped and identified as being the multiple disconnecting means for the appliance. Each disconnecting means shall simultaneously disconnect all ungrounded conductors that it controls.

(Revised) 422.31 (A) Rated at Not over 300 Volt-Amperes or 1/8 Horsepower. For permanently connected appliances rated at not over 300 volt-amperes or 1/8 hp, the branch-circuit overcurrent device shall be permitted
to serve as the disconnecting means where the switch or circuit breaker is within sight from the appliance or is lockable in accordance with 110.25.

(Revised) 422.31 (C) Motor-Operated Appliances Rated over 1/8 Horsepower. The disconnecting means shall comply with 430.109 and 430.110. For permanently connected motor-operated appliances with motors rated over 1/8 hp, the disconnecting means shall be within sight from the appliance or be capable of being locked in the open position in compliance with 110.25.

(Revised) 424.19 Disconnecting Means. Means shall be provided to simultaneously disconnect the heater, motor controller(s), and supplementary overcurrent protective device(s) of all fixed electric space-heating equipment from all ungrounded conductors. Where heating equipment is supplied by more than one source, feeder, or branch circuit, the disconnecting means shall be grouped and identified as having multiple disconnecting means. Each disconnecting means shall simultaneously disconnect all ungrounded conductors that it controls. The disconnecting means specified in 424.19(A) and (B) shall have an ampere rating not less than 125 percent of the total load of the motors and the heaters and shall be lockable in accordance with 110.25.

(Revised) 424.36 Clearances of Wiring in Ceilings. Wiring located above heated ceilings shall be spaced not less than 50 mm (2 in.) above the heated ceiling. The ampacity of conductors shall be calculated on the basis of an assumed ambient temperature of 50°C (122°F), applying the correction factors shown in the 0–2000-volt ampacity tables of Article 310. If this wiring is located above thermal insulation having a minimum thickness of 50 mm (2 in.), the wiring shall not require correction for temperature.

(Revised) 424.34 Heating Cable Construction. Factory-assembled non-heating leads of heating cables, if any, shall be at least 2.1 m (7 ft) in length.

(Revised) 424.38 (B) Uses Not Permitted. Heating cables shall not be installed as follows:
1. In closets, other than as noted in 424.38(C)
2. Over the top of walls where the wall intersects the ceiling
3. Over partitions that extend to the ceiling, unless they are isolated single runs of embedded cable
4. Under or through walls
5. Over cabinets whose clearance from the ceiling is less than the minimum horizontal dimension of the cabinet to the nearest cabinet edge that is open to the room or area
6. In tub and shower walls
7. Under cabinets or similar built-ins having no clearance to the floor

18. What is the maximum horsepower that a permanently connected appliance can use its circuit breaker within sight of the appliance as its disconnect?
   A. 1/8 hp
   B. 1/16 hp
   C. 1/4 hp
   D. 3/4 hp

19. Where can heating cables be installed?
   A. As per the manufacturer’s instructions
   B. In tub and shower walls
   C. Over the top of walls where the wall intersects the ceiling
   D. Under or through walls
20. What part of Article 422 should be referenced to determine the disconnecting means and requirements for appliances?
   A. VI  
   B. II  
   C. IV  
   D. III

21. What type of material is a ceiling-suspended (paddle) fan with an outlet box that has a minimum surface area of 180 in.² required to be covered with?
   A. Insulation material  
   B. Noncombustible material  
   C. Noncondensing material  
   D. Minimum weight inscriptions

22. How many sections does the disconnect for permanently connected motor-operated appliances rated over 1∕8 hp required to comply with?
   A. 3  
   B. 1  
   C. 2  
   D. 6

23. What is the minimum length factory-assembled non-heating leads of heating cables can be?
   A. 6 ft  
   B. 7 ft  
   C. 5 ft  
   D. 3 ft

24. The disconnecting means specified in 424.19(A) and (B) is required to have a minimum ampere rating of not less than what percent of the total load of the motors and the heaters?
   A. 135  
   B. 100  
   C. 125  
   D. 150

25. How is a ceiling suspended (paddle) fan required to be supported at the outlet box?
   A. Tight to the box  
   B. Securely  
   C. Rigidly  
   D. Independently

26. What is the minimum height above a heated ceiling that wiring above the heated ceiling can be installed?
   A. 3 inches  
   B. 2 inches  
   C. 1 inch  
   D. 4 inches

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(Revised) 424.39 Clearance from Other Objects and Openings. Heating elements of cables installed in ceilings shall be separated at least 200 mm (8 in.) from the edge of outlet boxes and junction boxes that are to be used for mounting surface luminaires. A clearance of not less than 50 mm (2 in.) shall be provided from recessed luminaires and their trims, ventilating openings, and other such openings in room surfaces. No heating cable shall be covered by any surface-mounted equipment.

(Revised) 424.40 Splices. The length of heating cable shall only be altered using splices identified in the manufacturer’s instructions.

(NEW) 424.45 Installation of Cables Under Floor Coverings.
   (A) Identification. Heating cables for installation under floor covering shall be identified as suitable for installation under floor covering.
(B) Expansion Joints. Heating cables shall not be installed where they bridge expansion joints unless provided with expansion and contraction fittings applicable to the manufacture of the cable.

(C) Connection to Conductors. Heating cables shall be connected to branch-circuit and supply wiring by wiring methods described in the installation instructions or as recognized in Chapter 3.

(D) Anchoring. Heating cables shall be positioned or secured in place under the floor covering, per the manufacturer’s instructions.

(E) Ground-Fault Circuit-Interrupter Protection. Groundfault circuit-interrupter protection for personnel shall be provided.

(F) Grounding Braid or Sheath. Grounding means, such as copper braid, metal sheath, or other approved means, shall be provided as part of the heated length.

(Revised) 424.70 Scope. The provisions in Part VII of this article shall apply to boilers employing resistance-type heating elements. See Part VIII of this article for electrode-type boilers.

(Revised) 424.95 (B) Interior Walls. The ampacity of any wiring behind heating panels or heating panel sets located in interior walls or partitions shall be calculated on the basis of an assumed ambient temperature of 40°C (104°F), applying correction factors given in the 0–2000 volt ampacity tables of Article 310.

(Revised) 424.97 Nonheating Leads. Excess nonheating leads of heating panels or heating panel sets shall be permitted to be cut to the required length as indicated in the manufacturer's installation instructions. Nonheating leads that are an integral part of a heating panel and a heating panel set, either attached or provided by the manufacturer as part of a terminal junction assembly, shall not be subjected to the ampacity requirements of 424.3(B) for branch circuits.

(NEW) 424.100 Scope. Low-voltage fixed electric space-heating equipment shall consist of an isolating power supply, low voltage heaters, and associated equipment that are all identified for use in dry locations.

(NEW) 424.101 (A) Power Unit. The power unit shall be an isolating type with a rated output not exceeding 25 amperes, 30 volts (42.4 volts peak) ac, or 60 volts dc under all load conditions.

(NEW) 424.101 (B) Alternate Energy Sources. Listed low-voltage fixed electric space-heating equipment shall be permitted to be supplied directly from an alternate energy source such as solar photovoltaic (PV) or wind power. When supplied from such a source, the source and any power conversion equipment between the source and the heating equipment and its supply shall be listed and comply with the applicable section of the NEC for the source used. The output of the source shall meet the limits of 424.101(A).

(NEW) 424.104 (A) Equipment shall be permitted to be supplied from branch circuits rated not over 30 amperes.

(B) The equipment shall be considered a continuous duty load.
(NEW) 425.1 Scope. This article covers fixed industrial process heating employing electric resistance or electrode heating technology. For the purpose of this article, heating equipment shall include boilers, electrode boilers, duct heaters, strip heaters, immersion heaters, process air heaters, or other approved fixed electric equipment used for industrial process heating. This article shall not apply to heating and room air conditioning for personnel spaces covered by Article 424, fixed heating equipment for pipelines and vessels covered by Article 427, induction and dielectric heating equipment covered by Article 665, and industrial furnaces incorporating silicon carbide, molybdenum, or graphite process heating elements.
(NEW) 425.2 Other Articles. Fixed industrial process heating equipment incorporating a hermetic refrigerant motor-compressor shall also comply with Article 440.

(NEW) 425.8 (C) Above Grade Level, Floor, or Work Platform. Where the enclosure is located above grade, the floor, or a work platform, all of the following shall apply:

1. The enclosure shall be accessible.
2. The width of the working space shall be the width of the enclosure or a minimum of 762 mm (30 in.), whichever is greater.
3. The depth of the workspace shall comply with 110.26(A) or 110.34 based upon the voltage to ground.
4. All doors or hinged panels shall open to at least 90 degrees.

(NEW) 425.19 Disconnecting Means. Means shall be provided to simultaneously disconnect the heater, motor controller(s), and supplementary overcurrent protective device(s) of all fixed industrial process heating equipment from all ungrounded conductors. Where heating equipment is supplied by more than one source, feeder, or branch circuit, the disconnecting means shall be grouped and identified as having multiple disconnecting means. Each disconnecting means shall simultaneously disconnect all ungrounded conductors that it controls. The disconnecting means specified in 425.19(A) and (B) shall have an ampere rating not less than 125 percent of the total load of the motors and the heaters and shall be lockable in accordance with 110.25.

(NEW) 425.19 (A) Heating Equipment with Supplementary Overcurrent Protection. The disconnecting means for fixed industrial process heating equipment with supplementary overcurrent protection shall be within sight from the supplementary overcurrent protective device(s), on the supply side of these devices, if fuses, and, in addition, shall comply with either 425.19(A)(1) or (A)(2).

(NEW) 425.19 (A) (1) Heater Containing No Motor Rated over 1/8 Horsepower. The disconnecting means specified in 425.19 or unit switches complying with 425.19(C) shall be permitted to serve as the required disconnecting means for both the motor controller(s) and heater under either of the following conditions:

1. The disconnecting means provided is also within sight from the motor controller(s) and the heater.
2. The disconnecting means is lockable in accordance with 110.25.

(NEW) 425.21 Switch and Circuit Breaker to Be Indicating. Switches and circuit breakers used as disconnecting means shall be of the indicating type.

(NEW) 425.22 (A) Branch-Circuit Devices. Fixed industrial process heating equipment other than such motor-operated equipment as required by Articles 430 and 440 to have additional overcurrent protection shall be permitted to be protected against overcurrent where supplied by one of the branch circuits in Article 210.

(NEW) 425.22 (B) Resistance Elements. Resistance-type heating elements in fixed industrial process heating equipment shall be protected at not more than 60 amperes. Equipment rated more than 48 amperes and employing such elements shall have the heating elements subdivided, and each subdivided load shall not exceed 48 amperes. Where a subdivided load is less than 48 amperes, the rating of the supplementary overcurrent protective device shall comply with 425.3(B). A boiler employing resistance-type immersion heating elements contained in an ASME-rated and stamped vessel shall be permitted to comply with 425.72(A).
37. Where is the disconnecting means for fixed industrial process heating equipment with supplementary overcurrent protection required to be installed?
   A. Within sight from the primary overcurrent protective device(s)
   B. Within 50 ft from the supplementary overcurrent protective device(s)
   C. Within sight from the supplementary overcurrent protective device(s)
   D. Within 50 ft from the primary overcurrent protective device(s)

38. What additional article is fixed industrial process heating equipment incorporating a hermetic refrigerant motor-compressor required to comply with?
   A. 424
   B. 426
   C. 450
   D. 440

39. What is the disconnect used for fixed industrial process heating employing electric resistance required to simultaneously disconnect?
   A. Heater
   B. Motor controller(s)
   C. Supplementary overcurrent protective device(s)
   D. All listed answers

40. What new article covers fixed industrial process heating employing electric resistance or electrode heating technology?
   A. 440
   B. 425
   C. 424
   D. 426

41. A 1/16th horsepower power motor used with industrial process heating equipment is required to have a lockable disconnect as required by what listed section?
   A. 110.27
   B. 110.18
   C. 110.25
   D. 425.3

42. How is a hinged door installed above grade used for fixed industrial process heating employing electric resistance required to open?
   A. 180 degrees
   B. Vertically
   C. Horizontally
   D. 90 degrees

43. If resistance-type heating elements in fixed industrial process heating equipment have a subdivided load of less than 48 amps, what section is the supplementary overcurrent protective device required to comply with?
   A. 425.72(A)
   B. 425.3(B)
   C. 425.21
   D. 110.25

44. What type of circuit breaker must be used if used as a disconnecting means for fixed industrial process heating equipment?
   A. Edison breaker
   B. Fused
   C. Indicating type
   D. Solder pot type breaker

45. What is the maximum current that resistance-type heating elements in fixed industrial process heating equipment are required to be protected?
   A. 100 amps
   B. 50 amps
   C. 40 amps
   D. 60 amps

46. Fixed industrial process heating equipment shall be permitted to be protected against overcurrent where supplied by one of the branch circuits as described in what listed article?
   A. 240
   B. 210
   C. 230
   D. 220
(NEW) 425.22 (C) Overcurrent Protective Devices. The supplementary overcurrent protective devices for the subdivided loads specified in 425.22(B) shall be
(1) factory installed within or on the heater enclosure or supplied for use with the heater as a separate assembly by the heater manufacturer; (2) accessible, but shall not be required to be readily accessible; and (3) suitable for branch-circuit protection.

(NEW) 425.22 (C) Informational Note No. 3: disconnecting means for cartridge fuses in circuits of any voltage, see 240.40.

(NEW) 425.22 (D) Branch-Circuit Conductors. The conductors supplying the supplementary overcurrent protective devices shall be considered branch-circuit conductors. Where the heaters are rated 50 kW or more, the conductors supplying the supplementary overcurrent protective devices specified in 425.22(C) shall be permitted to be sized at not less than 100 percent of the nameplate rating of the heater, provided all of the following conditions are met:

(1) The heater is marked with a minimum conductor size.
(2) The conductors are not smaller than the marked minimum size.
(3) A temperature-actuated device controls the cyclic operation of the equipment.

(NEW) 425.22 (E) Conductors for Subdivided Loads. Field-wired conductors between the heater and the supplementary overcurrent protective devices for fixed industrial process heating equipment shall be sized at not less than 125 percent of the load served. The supplementary overcurrent protective devices specified in 425.22(C) shall protect these conductors in accordance with 240.4. Where the heaters are rated 50 kW or more, the ampacity of field-wired conductors between the heater and the supplementary overcurrent protective devices shall be permitted to be not less than 100 percent of the load of their respective subdivided circuits, provided all of the following conditions are met:

(1) The heater is marked with a minimum conductor size.
(2) The conductors are not smaller than the marked minimum size.
(3) A temperature-activated device controls the cyclic operation of the equipment.

(NEW) 425.28 (B) Location. This nameplate shall be located so as to be visible or easily accessible after installation.

(NEW) 425.57 General. Part V shall apply to any heater mounted in the airstream of a forced-air system where the air-moving unit is not provided as an integral part of the equipment.

(NEW) 425.70 The provisions in part VI of this article shall apply to boilers employing resistance-type heating elements. Electrode-type boilers shall not be considered as employing resistance-type heating elements. See Part VII of this article.

(NEW) 425.72 (A) Boiler Employing Resistance-Type Immersion Heating Elements in an ASME-Rated and Stamped Vessel. A boiler employing resistance-type immersion heating elements contained in an ASME-rated and stamped vessel shall have the heating elements protected at not more than 150 amperes. Such a boiler rated more than 120 amperes shall have the heating elements subdivided into loads not exceeding 120 amperes. Where a subdivided load is less than 120 amperes, the rating of the overcurrent protective device shall comply with 425.3(B).

(NEW) 425.72 (B) Boiler Employing Resistance-Type Heating Elements Rated More Than 48 Amperes and Not Contained in an ASME-Rated and Stamped Vessel. A boiler employing resistance-type heating elements not contained in an ASME-rated and stamped vessel shall have the heating elements protected at not more
than 60 amperes. Such a boiler rated more than 48 amperes shall have the heating elements subdivided into loads not exceeding 48 amperes. Where a subdivided load is less than 48 amperes, the rating of the overcurrent protective device shall comply with 425.3(B).

(NEW) 425.72 (E) Conductors Supplying Supplementary Overcurrent Protective Devices. The conductors supplying these supplementary overcurrent protective devices shall be considered branch-circuit conductors. Where the heaters are rated 50 kW or more, the conductors supplying the overcurrent protective device specified in 424.72(C) shall be permitted to be sized at not less than 100 percent of the nameplate rating of the heater, provided all of the following conditions are met:

(1) The heater is marked with a minimum conductor size.
(2) The conductors are not smaller than the marked minimum size.
(3) A temperature- or pressure-actuated device controls the cyclic operation of the equipment.

**PART 2 EXAM QUESTIONS**

47. What is the maximum allowable current protection for a boiler employing resistance-type immersion heating elements contained in an ASME-rated and stamped vessel?
   A. 150 amps
   B. 60 amps
   C. 125 amps
   D. 100 amps

48. What are the conductors supplying the supplementary overcurrent protective devices with resistance-type heating elements in fixed industrial process heating equipment considered?
   A. Branch-circuit conductors
   B. Feeders
   C. Service Laterals
   D. Readily acceptable

49. What are the conductors supplying the supplementary overcurrent protective devices with a boiler employing resistance-type immersion heating elements considered?
   A. Service Laterals
   B. Feeders
   C. Branch-circuit conductors
   D. Readily acceptable

50. How are field-wired conductors between the heater and the supplementary overcurrent protective devices for fixed industrial process heating equipment required to be sized for the load served?
   A. 135%
   B. 100%
   C. 125%
   D. 80%

51. What section should be referenced when using cartridge fuses as the disconnect with resistance-type heating elements in fixed industrial process heating equipment?
   A. 425.3(B)
   B. 240.40
   C. 425.21
   D. 110.25

52. What part of Article 425 applies to boilers employing resistance-type heating elements?
   A. III
   B. V
   C. VII
   D. VI
53. Fixed industrial process heating equipment mounted in the airstream of a forced-air system where the air-moving unit is not provided as an integral part of the equipment is required to comply with what part of Article 425?
   A. VII
   B. VI
   C. V
   D. III

54. What is the maximum allowable current protection for a boiler employing resistance-type immersion heating elements not contained in an ASME-rated and stamped vessel?
   A. 150 amps
   B. 60 amps
   C. 125 amps
   D. 100 amps

55. What part of Article 425 applies to electrode-type boilers that are not considered as employing resistance-type heating elements?
   A. III
   B. V
   C. VI
   D. VII

56. How many provisions are the supplementary overcurrent protective devices for resistance-type heating elements in fixed industrial process heating equipment with subdivided loads specified in 425.22(B) required to meet?
   A. 2
   B. 3
   C. 1
   D. There are no special requirements

57. Where is the name plate for fixed industrial process heating equipment required to be installed?
   A. Readily accessible location
   B. Easily accessible location
   C. Visible location
   D. All listed answers

(NEW) 425.72 (F) Conductors for Subdivided Loads. Field-wired conductors between the heater and the supplementary overcurrent protective devices shall be sized at not less than 125 percent of the load served. The supplementary overcurrent protective devices specified in 425.72(C) shall protect these conductors in accordance with 240.4. Where the heaters are rated 50 kW or more, the ampacity of field-wired conductors between the heater and the supplementary overcurrent protective devices shall be permitted to be not less than 100 percent of the load of their respective subdivided circuits, provided all of the following conditions are met:
   (1) The heater is marked with a minimum conductor size.
   (2) The conductors are not smaller than the marked minimum size.
   (3) A temperature-activated device controls the cyclic operation of the equipment.

(NEW) 425.73 Over temperature Limit Control. Each boiler, designed so that in normal operation there is no change in state of the heat transfer medium, shall be equipped with a temperature sensitive limiting means. It shall be installed to limit maximum liquid temperature and shall directly or indirectly disconnect all ungrounded
conductors to the heating elements. Such means shall be in addition to a temperature-regulating system and other devices protecting the tank against excessive pressure.

**(NEW) 425.74 Overpressure Limit Control.** Each boiler, designed so that in normal operation there is a change in state of the heat transfer medium from liquid to vapor, shall be equipped with a pressure-sensitive limiting means. It shall be installed to limit maximum pressure and shall directly or indirectly disconnect all ungrounded conductors to the heating elements. Such means shall be in addition to a pressure-regulating system and other devices protecting the tank against excessive pressure.

**(NEW) 425.80 Scope.** The provisions in Part VII of this article shall apply to boilers for operation at 600 volts, nominal, or less, in which heat is generated by the passage of current between electrodes through the liquid being heated.

**(NEW) 425.82 Branch-Circuit Requirements.** The size of branch-circuit conductors and overcurrent protective devices shall be calculated on the basis of 125 percent of the total load (motors not included). A contactor, relay, or other device, approved for continuous operation at 100 percent of its rating, shall be permitted to supply its full-rated load. See 210.19(A).

**425.86 Markings.** All electrode-type boilers shall be marked to show the following:

1. The manufacturer’s name.
2. The normal rating in volts, amperes, and kilowatts.
3. The electrical supply required specifying frequency, number of phases, and number of wires.
4. The marking “Electrode-Type Process Heating Boiler.”
5. A warning marking, “All Power Supplies Shall Be Disconnected Before Servicing, Including Servicing the Pressure Vessel.” A field-applied warning marking or label shall comply with 110.21(B).

The nameplate shall be located so as to be visible after installation.

**(Revised) 426.4 Continuous Load.** Fixed outdoor electric deicing and snow-melting equipment shall be considered a continuous load.

**(Revised) 426.32** The secondary windings of the isolation transformer connected to the impedance heating elements shall not have an output voltage greater than 30 volts ac.

**(Revised) 427.20 Marking.** Each factory-assembled heating unit shall be legibly marked within 75 mm (3 in.) of an end of the non-heating leads with the permanent identification symbol, catalog number, and ratings in volts and watts or in volts and amperes.

**(Revised) 430.53 (D)(3)** Conductors from the point of the tap from the branch circuit to a listed manual motor controller additionally marked “Suitable for Tap Conductor Protection in Group Installations,” or to a branch-circuit protective device, shall be 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. The conductors from the controller to the motor shall have an ampacity in accordance with 430.22. The conductors from the point of the tap to the controller(s) shall (1) be suitably protected from physical damage and enclosed either by an enclosed controller or by a raceway and be not more than 3 m (10 ft) long or (2) have an ampacity not less than that of the branch-circuit conductors.
### Part 2 Exam Questions

58. What is the maximum length permitted for conductors from the point of the tap to a controller?
   - A. 12 ft
   - B. 10 ft
   - C. 16 ft
   - D. 25 ft

59. What is a boiler designed so that in normal operation there is no change in state of the heat transfer medium required to be equipped with?
   - A. Level transmitter
   - B. Pressure-sensitive limiting means
   - C. Flow transmitter
   - D. Temperature sensitive limiting means

60. What is a boiler required to be equipped with that is designed so that in normal operation there is a change in state of the heat transfer medium from liquid to vapor?
   - A. Pressure-sensitive limiting means
   - B. Temperature sensitive limiting means
   - C. Flow transmitter
   - D. Level transmitter

61. How are field-wired conductors between the heater and the supplementary overcurrent protective devices for a boiler employing resistance-type immersion heating elements required to be sized for the load served?
   - A. 135%
   - B. 100%
   - C. 125%
   - D. 80%

62. What is the maximum voltage for boilers covered in part VII of Article 425?
   - A. 480
   - B. 575
   - C. 600
   - D. 1000

63. What type of load is fixed outdoor electric deicing and snow-melting equipment considered?
   - A. Non-continuous load
   - B. Continuous load
   - C. Fixed load
   - D. Stationary load

64. What is the marking on an electrode-type boiler required to say?
   - A. “Electrode-Type Control Process Heating Boiler”
   - B. “Electrode-Type Process Control Heating Boiler”
   - C. “Electrode-Type Process Heating Boiler”
   - D. “Electrode Process Heating Type Boiler”

65. What is the maximum allowable output voltage when secondary windings of an isolation transformer are connected to impedance heating elements?
   - A. 24 volts AC
   - B. 30 volts AC
   - C. 60 volts DC
   - D. 30 volts DC

66. Non-heating leads that are used with factory-assembled heating units are required to be marked within how many inches of the end?
   - A. 2 inches
   - B. 3 inches
   - C. 6 inches
   - D. 4 inches

67. What percentage of the total load are branch-circuit conductors and overcurrent protective devices used with electrode-type boilers required to be calculated?
   - A. 80%
   - B. 100%
   - C. 135%
   - D. 125%

(NEW) **430.53 (D)(4)** Conductors from the point of the tap from the branch circuit to a listed manual motor controller additionally marked “Suitable for Tap Conductor Protection in Group Installations,” or to a branch-circuit protective device, shall be permitted to have an ampacity not less than one third that of the branch-circuit conductors. The conductors from the controller to the motor shall have an ampacity in accordance with 430.22. The conductors from the point of the tap to the controller(s) shall (1) be suitably protected from physical damage and enclosed either by an enclosed controller or by a raceway and be not more than 7.5 m (25 ft) long or (2) have an ampacity not less than that of the branch-circuit conductors.
(NEW) **430.99 Available Fault Current.** The available short circuit current at the motor control center and the date when the short circuit current calculation was performed shall be documented and made available to those authorized to inspect the installation.

(NEW) **430.130 (A)(4)** Where an instantaneous trip circuit breaker or semiconductor fuses are permitted in accordance with the drive manufacturer’s instructions for use as the branch-circuit short-circuit and ground-fault protective device for listed power conversion equipment, they shall be provided as an integral part of a single listed assembly incorporating both the protective device and power conversion equipment.

(Revised) **440.2 Rated-Load Current.** The current of a hermetic refrigerant motor-compressor resulting when it is operated at the rated load, rated voltage, and rated frequency of the equipment it serves.

(NEW) **440.9 Grounding and Bonding.** Where multi-motor and combination-load equipment is installed outdoors on a roof, an equipment grounding conductor of the wire type shall be installed in outdoor portions of metallic raceway systems that use non-threaded fittings.

(Revised) **440.65** Single-phase cord-and-plug-connected room air conditioners shall be provided with one of the following factory-installed devices:

1. Leakage-current detector-interruptor (LCDI)
2. Arc-fault circuit interrupter (AFCI)
3. Heat detecting circuit interrupter (HDCI)

The protection device shall be an integral part of the attachment plug or be located in the power supply cord within 300 mm (12 in.) of the attachment plug.

(NEW) **445.10 Informational Note:** See NFPA 37, Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines, for information on the location of generator exhaust.

(Revised) **445.11 Marking.** Each generator shall be provided with a nameplate giving the manufacturer’s name, the rated frequency, the number of phases if ac, the rating in kilowatts or kilovolt-amperes, the power factor, the normal volts and amperes corresponding to the rating, the rated ambient temperature, and the rated temperature rise.

Nameplates or manufacturer’s instructions shall provide the following information for all stationary generators and portable generators rated more than 15 kW:

1. Subtransient, transient, synchronous, and zero sequence reactances
2. Power rating category
3. Insulation system class
4. Indication if the generator is protected against overload by inherent design, an overcurrent protective relay, circuit breaker, or fuse
68. AC outdoor multi-motor and combination-load equipment is required to have an equipment grounding conductor of the wire type installed in the outdoor portions of the metallic raceway systems if what occurs?
   A. Use non-threaded fittings
   B. Use threaded fittings
   C. Use Meyers hubs
   D. Threaded compression fittings are used

69. Who is the date when short circuit current calculations were performed at a motor control center required to be made available to?
   A. The maintenance crew
   B. The AHJ
   C. The Start-up crew
   D. All listed answers

70. What best defines the current of a hermetic refrigerant motor-compressor resulting when it is operated at the rated load, rated voltage, and rated frequency of the equipment it serves?
   A. Full load-current
   B. Listed load-current
   C. Rated load-current
   D. Locked rotor-current

71. Where does the 2017 code direct one to find information regarding information on the location of generator exhaust?
   A. NFPA 73
   B. NFPA 37
   C. IEEE/NFPA 30
   D. 430.22

72. Where should the manufacturer of a 50 kW stationary generator indicate the neutral is bonded?
   A. At the grounding electrode conductor
   B. At the frame
   C. At the equipment grounding conductor
   D. At the transfer switch

73. What factory-installed device is a plug-connected room air conditioner required to have installed?
   A. Toggle switch
   B. GFCI
   C. HDCI
   D. All listed answers

74. How many items should be listed in a 20 kW portable generator manufacturer’s instructions?
   A. 3
   B. 4
   C. 7
   D. 5

75. Conductors “Suitable for Tap Conductor Protection in Group Installations,” or to a branch-circuit protective device, are permitted to have an ampacity not less than what of the branch-circuit conductors?
   A. One sixth
   B. One third
   C. One tenth
   D. One sixteenth

76. What section allows semiconductor fuses serving as a ground-fault protective device for listed power conversion equipment designed so it is an integral part of a single listed assembly incorporating both the protective device and power conversion equipment?
   A. 430.53 (D)(3)
   B. 430.99
   C. 430.130 (A)(4)
   D. 430.53 (D)(4)

77. What is the maximum distance that a plug-connected room air conditioner protection device is required to be installed from the end of an attachment plug?
   A. 18 inches
   B. 3 inches
   C. 6 inches
   D. 12 inches
(NEW) 445.13 (B) Overcurrent Protection Provided. Where the generator set is equipped with a listed overcurrent protective device or a combination of a current transformer and overcurrent relay, conductors shall be permitted to be tapped from the load side of the protected terminals in accordance with 240.21(B). Tapped conductors shall not be permitted for portable generators rated 15 kW or less where field wiring connection terminals are not accessible.

(Revised) 445.14 Protection of Live Parts. Live parts of generators operating at more than 50 volts ac or 60 volts dc to ground shall not be exposed to accidental contact where accessible to unqualified persons.

(NEW) 445.18 (A) Disconnecting Means. Generators other than cord-and-plug-connected portable shall have one or more disconnecting means. Each disconnecting means shall simultaneously open all associated ungrounded conductors. Each disconnecting means shall be lockable in the open position in accordance with 110.25.

(NEW) 445.18 (B) Shutdown of Prime Mover. Generators shall have provisions to shut down the prime mover. The means of shutdown shall comply with all of the following:

1. Be equipped with provisions to disable all prime mover start control circuits to render the prime mover incapable of starting
2. Initiate a shutdown mechanism that requires a mechanical reset

The provisions to shut down the prime mover shall be permitted to satisfy the requirements of 445.18(A) where it is capable of being locked in the open position in accordance with 110.25.

Generators with greater than 15 kW rating shall be provided with an additional requirement to shut down the prime mover. This additional shutdown means shall be located outside the equipment room or generator enclosure and shall also meet the requirements of 445.18(B)(1) and (B)(2).

(NEW) 445.18 (C) Generators Installed in Parallel. Where a generator is installed in parallel with other generators, the provisions of 445.18(A) shall be capable of isolating the generator output terminals from the paralleling equipment. The disconnecting means shall not be required to be located at the generator.

(Revised) 445.20 Ground-Fault Circuit-Interrupter Protection for Receptacles on 15-kW or Smaller Portable Generators. Receptacle outlets that are a part of a 15-kW or smaller portable generator shall have listed ground-fault circuit-interrupter protection (GFCI) for personnel integral to the generator or receptacle as indicated in either (A) or (B):

(NEW) (A) Unbonded (Floating Neutral) Generators. Unbonded generators with both 125-volt and 125/250-volt receptacle outlets shall have listed GFCI protection for personnel integral to the generator or receptacle on all 125-volt, 15- and 20-ampere receptacle outlets. Exception: GFCI protection shall not be required where the 125-volt receptacle outlet(s) is interlocked such that it is not available for use when any 125/250-volt receptacle outlet(s) is in use.

(NEW) (B) Bonded Neutral Generators. Bonded generators shall be provided with GFCI protection on all 125-volt, 15- and 20-ampere receptacle outlets.

(NEW) Exception: GFCI protection shall not be required where the 125-volt receptacle outlet(s) is interlocked such that it is not available for use when any 125/250-volt receptacle outlet(s) is in use.

(NEW) 445.20 (B) Bonded Neutral Generators. Bonded generators shall be provided with GFCI protection on all 125-volt, 15- and 20-ampere receptacle outlets.

(NEW) Informational Note: Refer to 590.6(A)(3) for GFCI requirements for 15-kW or smaller portable generators used for temporary electric power and lighting.
(NEW) 445.20 (A) Unbonded (Floating Neutral) Generators. Unbonded generators with both 125-volt and 125/250-volt receptacle outlets shall have listed GFCI protection for personnel integral to the generator or receptacle on all 125-volt, 15- and 20-ampere receptacle outlets.

(Revised) 450.43 (C) Locks. Doors shall be equipped with locks, and doors shall be kept locked, access being allowed only to qualified persons. Personnel doors shall open in the direction of egress and be equipped with listed panic hardware.

(NEW) 480.3 Equipment. Storage batteries and battery management equipment shall be listed. This requirement shall not apply to lead-acid batteries.

(Revised) 480.6 Overcurrent Protection for Prime Movers. Overcurrent protection shall not be required for conductors from a battery with a voltage of 60 volts dc or less if the battery provides power for starting, ignition, or control of prime movers. Section 300.3 shall not apply to these conductors.

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**PART 2 EXAM QUESTIONS**

78. A generator disconnect is required to be lockable in what position?
   - A. Tripped position
   - B. Closed position
   - C. Open position
   - D. Overload position

79. What are storage batteries and battery management equipment required to be?
   - A. Listed
   - B. Rated
   - C. Readily accessible
   - D. Guarded

80. What is not permitted for portable generators rated 15 kW or less where field wiring connection terminals are not accessible?
   - A. Operating under natural gas solely
   - B. Back feeding a branch circuit
   - C. Operating under gas solely
   - D. Using tapped conductors

81. What additional requirement is a 25 kW generator required to have?
   - A. A switched neutral
   - B. An eddy current meter
   - C. Current transformers
   - D. Additional means to shut down the prime mover

82. At how many dc volts to ground are the live parts of generators required to be protected against accidental contact where accessible to unqualified persons?
   - A. 50
   - B. 60
   - C. 32
   - D. 24

83. What section pertains directly to floating neutral generators?
   - A. 445.18(B)(1)
   - B. 445.18(A)
   - C. 445.20 (A)
   - D. 590.6(A)(3)

84. If a generator is installed in parallel with other generators, what section pertains to isolating the generator output terminal from the paralleling equipment?
   - A. 445.20 (A)
   - B. 445.18(B)(1)
   - C. 445.18(A)
   - D. 590.6(A)(3)

85. Where does the 2017 code direct you to look for the GFCI requirements for 15-kW or smaller portable generators used for temporary electric power and lighting?
   - A. 445.20 (A)
   - B. 445.18(A)
   - C. 445.20 (B)
   - D. 590.6(A)(3)
86. What is the receptacle on a 10 kW generator required to be listed as?
A. LCDI
B. GFCI
C. AFCI
D. HDCI

87. What is the personnel door in a transformer vault required to be equipped with?
A. Usage alarm
B. Listed panic hardware
C. Egress sign
D. Quick latch feature

88. What is the maximum dc voltage where overcurrent protection is not required for conductors from a battery to a generator starter?
A. 12
B. 100
C. 24
D. 60

(Revised) 480.7 (A) Disconnecting Means. A disconnecting means shall be provided for all ungrounded conductors derived from a stationary battery system with a voltage over 60 volts dc. A disconnecting means shall be readily accessible and located within sight of the battery system.

(Revised) 480.8 Insulation of Batteries. Batteries constructed of an electrically conductive container shall have insulating support if a voltage is present between the container and ground.

(NEW) 480.9 Battery Support Systems. For battery chemistries with corrosive electrolyte, the structure that supports the battery shall be resistant to deteriorating action by the electrolyte. Metallic structures shall be provided with nonconducting support members for the cells, or shall be constructed with a continuous insulating material. Paint alone shall not be considered as an insulating material.

(Revised) 480.11 (A) Vented Cells. Each vented cell shall be equipped with a flame arrester.

Informational Note: A flame arrester prevents destruction of the cell due to ignition of gases within the cell by an external spark or flame.

(Revised) 480.11 (B) Sealed Cells. Where the battery is constructed such that an excessive accumulation of pressure could occur within the cell during operation, a pressure-release vent shall be provided.

(Revised) 500.5(A) General. Locations shall be classified depending on the properties of the flammable gas, flammable liquid–produced vapor, combustible liquid–produced vapors, combustible dusts, or fibers/flyings that could be present, and the likelihood that a flammable or combustible concentration or quantity is present. Each room, section, or area shall be considered individually in determining its classification. Where pyrophoric materials are the only materials used or handled, these locations are outside the scope of this article. Refrigerant machinery rooms that contain ammonia refrigeration systems and are equipped with adequate mechanical ventilation that operates continuously or is initiated by a detection system at a concentration not exceeding 150 ppm shall be permitted to be classified as “unclassified” locations.

(NEW) 490.3 (B) Enclosures in Damp or Wet Locations. Enclosures in damp or wet locations shall meet the requirements of 312.2.
500.6 (4) Informational Note No. 2: For classification of areas involving ammonia atmospheres, see ANSI/ASHRAE 15-2013, Safety Standard for Refrigeration Systems.

(Revised) 500.8 (E)(2) Equipment Provided with Threaded Entries for Metric-Threaded Fittings. For equipment with metric-threaded entries, listed conduit fittings or listed cable fittings shall be used. Such entries shall be identified as being metric, or listed adapters to permit connection to conduit or NPT-threaded fittings shall be provided with the equipment and shall be used for connection to conduit or NPT-threaded fittings. Metric-threaded fittings installed into explosion-proof equipment shall have a class of fit of at least 6g/6H and shall be made up with at least five threads fully engaged.

(Revised) 501.15(A)(1)(2) The entry is metric designator 53 (trade size 2) or larger, and the enclosure contains terminals, splices, or taps. An enclosure, identified for the location, and marked “Leads Factory Sealed,” or “Factory Sealed,” or “Seal not Required,” or equivalent shall not be considered to serve as a seal for another adjacent enclosure that is required to have a conduit seal. Conduit seals shall be installed within 450 mm (18 in.) from the enclosure or as required by the enclosure marking. Only explosion-proof unions, couplings, reducers, elbows, and capped elbows that are not larger than the trade size of the conduit shall be permitted between the sealing fitting and the explosion-proof enclosure.

(Revised) 501.15 (D) (1) At Terminations. Cables shall be sealed with sealing fittings that comply with 501.15(C) at all terminations. Type MC-HL cables with a gas/vapor tight continuous corrugated metallic sheath and an overall jacket of suitable polymeric material shall be sealed with a listed fitting after the jacket and any other covering have been removed so that the sealing compound can surround each individual insulated conductor in such a manner as to minimize the passage of gases and vapors. Seals for cables entering enclosures shall be installed within 450 mm (18 in.) of the enclosure or as required by the enclosure marking. Only explosion-proof unions, couplings, reducers, elbows, and capped elbows that are not larger than the trade size of the enclosure entry shall be permitted between the sealing fitting and the enclosure.

**PART 2 EXAM QUESTIONS**

89. How close do cable seals need to be installed from an enclosure when required?
   A. 18 inches
   B. 24 inches
   C. 10 ft
   D. 36 inches

90. What alone is not an insulating material with regards to a support system for batteries?
   A. Paint
   B. Rubber
   C. Plastic
   D. Porcelain

91. What section should be referenced for enclosures in damp or wet locations operating at over 1000 volts?
   A. 314.2
   B. 312.2
   C. 310.4
   D. 315(B)(2)

92. What are vented cells required to be equipped with regarding battery systems?
   A. Restrictor plate
   B. Flame arrester
   C. Pressure-release vent
   D. Blow off valve
PART 2

501.105 (A) Class I, Division 1. In Class I, Division 1 locations, meters, instruments, and relays, including kilowatt-hour meters, instrument transformers, resistors, rectifiers, and thermionic tubes, shall be provided with enclosures identified for Class I, Division 1 locations. Enclosures for Class I, Division 1 locations include explosion-proof enclosures and purged and pressurized enclosures.

(Revised) 501.105 (B) Class I, Division 2. In Class I, Division 2 locations, meters, instruments, and relays shall comply with 501.105(B)(2) through (B)(6).

(1) General-Purpose Assemblies. Where an assembly is made up of components for which general-purpose enclosures are acceptable as provided in 501.105(B)(1), (B)(2), and (B)(3), a single general-purpose enclosure shall be acceptable for the assembly. Where such an assembly includes any of the equipment described in 501.105(B)(1), 501.105(B)(2),

93. How many threads must be fully engaged when using metric-threaded fittings installed into explosion-proof equipment?
   A. 3
   B. 4
   C. 6
   D. 5

94. What is required to be installed when a battery is constructed such that an excessive accumulation of pressure could occur within the cell during operation?
   A. Flame arrester
   B. Restrictor plate
   C. Pressure-release vent
   D. Blow off valve

95. Refrigerant machinery rooms that contain ammonia refrigeration systems are considered “unclassified” locations if the concentration does not exceed how many ppm?
   A. 150
   B. 200
   C. 100
   D. 75

96. How close do conduit seals need to be installed from an enclosure when required?
   A. 24 inches
   B. 18 inches
   C. 10 ft
   D. 36 inches

97. What are batteries constructed of an electrically conductive container required to have if a voltage is present between the container and ground?
   A. Terminal covers
   B. Bleed off conductors
   C. Insulating support
   D. Battery terminal insulators

98. At what voltage is a disconnecting means required for all ungrounded conductors derived from a stationary battery system?
   A. 50 volts dc
   B. 60 volts dc
   C. 60 volts ac
   D. 24 volts dc

99. What ANSI covers areas involving ammonia atmospheres?
   A. ANSI/ISA-60079-28 (12.21.02)-2013
   B. ANSI/IEEE 14-2013
   C. ANSI/ASHRAE 13-2015
   D. ANSI/ASHRAE 15-2013
and 501.105(B)(3), the maximum obtainable surface temperature of any component of the assembly that exceeds 100°C shall be clearly and permanently indicated on the outside of the enclosure. Alternatively, equipment shall be permitted to be marked to indicate the temperature class for which it is suitable, using the temperature class (T Code) of Table 500.8(C).

(Revised) 501.105(6) Connections. To facilitate replacements, process control instruments shall be permitted to be connected through flexible cord by means of attachment plug and receptacle, provided that all of the following conditions apply:

(1) The attachment plug and receptacle are listed for use in Class I, Division 2 locations and for use with flexible cords and shall be of the locking and grounding type.

Exception: A Class I, Division 2 listing shall not be required if the circuit is nonincendive field wiring.

(2) Unless the attachment plug and receptacle are interlocked mechanically or electrically, or otherwise designed so that they cannot be separated when the contacts are energized and the contacts cannot be energized when the plug and socket outlet are separated, a switch complying with 501.105(B)(2) is provided so that the attachment plug or receptacle is not depended on to interrupt current.

Exception: The switch shall not be required if the circuit is nonincendive field wiring.

(3) The flexible cord does not exceed 900 mm (3 ft) and is of a type listed for extra-hard usage or for hard usage if protected by location, if applicable.

(4) Only necessary receptacles are provided.

(5) The circuit has a maximum current of 3 amps.

(NEW) 501.125(B)(5) Informational Note No. 5: For details of the evaluation process to determine incendivity, refer to Annex A and Figure A1 of UL 1836–2014, Outline of Investigation for Electric Motors and Generators for Use in Class I, Division 2, Class I, Zone 2, Class II, Division 2 and Zone 22 Hazardous (Classified) Locations.

(NEW) 502.10(A)(1)(5) In industrial establishments with restricted public access, where the conditions of maintenance and supervision ensure that only qualified persons service the installation, listed Type ITC-HL cable with a gas/vapor tight continuous corrugated metallic sheath and an overall jacket of suitable polymeric material, and terminated with fittings listed for the application, and installed in accordance with the provisions of Article 727.

(Revised) 504.1 Scope. This article covers the installation of intrinsically safe (I.S.) apparatus, wiring, and systems for Articles 500 through 516.

(NEW) 505.4 (B) Informational Note No. 8: Portable or transportable equipment having self-contained power supplies, such as battery-operated equipment, could potentially become an ignition source in hazardous (classified) locations. See ANSI/ISA-12.12.03-2011, Standard for Portable Electronic Products Suitable for Use in Class I and II, Division 2, Class I Zone 2 and Class III, Division 1 and 2 Hazardous (Classified) Locations.

(NEW) 505.4 (B) Informational Note No. 9: For additional information concerning the installation of equipment utilizing optical emissions technology (such as laser equipment) that could potentially become an ignition source in hazardous (classified) locations, see ANSI/ISA-60079-28 (12.21.02)-2013, Explosive Atmospheres — Part 28: Protection of equipment and transmission systems using optical radiation.
100. What annex is listed for details regarding the evaluation process to determine incendivity?
   A. D
   B. B
   C. A
   D. F

101. What publication is listed for additional information concerning the installation of equipment utilizing optical emissions technology (such as laser equipment) that could potentially become an ignition source in hazardous (classified) locations?
   A. ANSI/ASHRAE 15-2013
   B. ANSI/ISA-60079-28 (12.21.02)-2013
   C. ANSI/ISA-12.12.03-2011
   D. IEEE/ASHRAE 15-2014

102. What is the maximum allowable current for a process control instrument to be connected by a flexible cord?
   A. 2.5 amps
   B. 2 amps
   C. .1 to 1 amp
   D. 3 amps

103. If an assembly is made up of components for which general-purpose enclosures are acceptable as provided in 501.105(B)(1), (B)(2), and (B)(3), what is the minimum allowable general-purpose enclosure(s) acceptable for this assembly?
   A. One
   B. Two
   C. Three
   D. There are no minimum requirements for this installation

104. What is the maximum flexible cord length that a process control instrument can have connected?
   A. 5 ft
   B. 4 ft
   C. 3 ft
   D. 2 ft

105. What publication is listed regarding the standard for portable electronic products suitable for use in Class I and II, Division 2, Class I Zone 2 and Class III, Division 1 and 2 Hazardous (Classified) Locations?
   A. ANSI/ASHRAE 15-2013
   B. ANSI/ISA-12.12.03-2011
   C. ANSI/ISA-60079-28 (12.21.02)-2013
   D. IEEE/ASHRAE 15-2014

106. What article must type ITC-HL cable comply with when installed in industrial establishments where the conditions of maintenance and supervision ensure that only qualified persons service the installation?
   A. 501.10
   B. 700
   C. 800
   D. 727

107. A kilowatt-hour meter is required to be installed in what type of enclosure?
   A. Class III, Division 1I
   B. Class I, Division 1
   C. Class I, Division 1I
   D. Class II, Division 1

108. What article covers the installation of intrinsically safe systems?
   A. 501
   B. 500
   C. 502
   D. 504
(Revised) 505.6 (A) Group IIC. Atmospheres containing acetylene, hydrogen, or flammable gas, flammable liquid–produced vapor, or combustible liquid–produced vapor mixed with air that may burn or explode, having either a maximum experimental safe gap (MESG) value less than or equal to 0.50 mm or minimum igniting current (MIC) ratio less than or equal to 0.45.

(Revised) 505.6 Group (C) IIA. Atmospheres containing acetone, ammonia, ethyl alcohol, gasoline, methane, propane, or flammable gas, flammable liquid–produced vapor, or combustible liquid–produced vapor mixed with air that may burn or explode, having either a maximum experimental safe gap (MESG) value greater than 0.90 mm or minimum igniting current (MIC) ratio greater than 0.80.

(Revised) 505.7(F) Available Short-Circuit Current for Type of Protection “e”. Unless listed and marked for connection to circuits with higher available short-circuit current, the available short-circuit current for electrical equipment using type of protection “e” for the field wiring connections in Zone 1 locations shall be limited to 10,000 rms symmetrical amperes to reduce the likelihood of ignition of a flammable atmosphere by an arc during a short-circuit event.

(Revised) 505.9(E)(1) Equipment Provided with Threaded Entries for NPT Threaded Conduit or Fittings. For equipment provided with threaded entries for NPT threaded conduit or fittings, listed conduit, listed conduit fittings, or listed cable fittings shall be used. All NPT threaded conduit and fittings shall be threaded with a National (American) Standard Pipe Taper (NPT) thread. NPT threaded entries into explosion proof or flameproof equipment shall be made up with at least five threads fully engaged.

(NEW) 505.17 (B) Instrumentation Connections for Zone 2. To facilitate replacements, process control instruments shall be permitted to be connected through flexible cords, attachment plugs, and receptacles, provided that all of the following conditions apply:

1. A switch listed for Zone 2 is provided so that the attachment plug is not depended on to interrupt current, unless the circuit is type “ia,” “ib,” or “ic” protection, in which case the switch is not required.
2. The current does not exceed 3 amperes at 120 volts, nominal.
3. The power-supply cord does not exceed 900 mm (3 ft), is of a type listed for extra-hard usage or for hard usage if protected by location, and is supplied through an attachment plug and receptacle of the locking and grounding type.
4. Only necessary receptacles are provided.
5. The receptacle carries a label warning against unplugging under load.

(Revised) 506.5 (1) Zone 20. A Zone 20 location is a location in which either of the following occur:
1. Ignitible concentrations of combustible dust or ignitable fibers/flyings are present continuously.
2. Ignitible concentrations of combustible dust or ignitable fibers/flyings are present for long periods of time.

(Revised) 506.5 (2) Zone 21. A Zone 21 location is a location where one of the following apply:
1. Ignitible concentrations of combustible dust or ignitable fibers/flyings are likely to exist occasionally under normal operating conditions.
2. Ignitible concentrations of combustible dust or ignitable fibers/flyings may exist frequently because of repair or maintenance operations or because of leakage.
3. Equipment is operated or processes are carried on, of such a nature that equipment breakdown or faulty operations could result in the release of ignitible concentrations of combustible dust or ignitable fibers/flyings.
and also cause simultaneous failure of electrical equipment in a mode to cause the electrical equipment to become a source of ignition.

(4) The location is adjacent to a Zone 20 location from which ignitable concentrations of dust or ignitable fibers/flyings could be communicated.

(Revised) 506.5 (3) Zone 22. A Zone 22 location is a location where one of the following apply:

(1) Ignitible concentrations of combustible dust or ignitable fibers/flyings are not likely to occur in normal operation and, if they do occur, will only persist for a short period.

(2) Combustible dust or fibers/flyings are handled, processed, or used but in which the dust or fibers/flyings are normally confined within closed containers of closed systems from which they can escape only as a result of the abnormal operation of the equipment with which the dust or fibers/flyings are handled, processed, or used.

(3) The location is adjacent to a Zone 21 location, from which ignitable concentrations of dust or fibers/flyings could be communicated.

### PART 2 EXAM QUESTIONS

109. What zone exhibits ignitible concentrations of combustible dust or ignitable fibers/flyings that may exist frequently because of repair or maintenance operations or because of leakage?

A. 2  
B. 20  
C. 22  
D. 21

110. What is the minimum igniting current ratio for combustible liquid-produced vapor mixed with air that may burn or explode having either a maximum experimental safe gap (MESG) value less than or equal to 0.50?

A. 0.50  
B. 0.45  
C. 0.40  
D. 0.54

111. What is the available short-circuit current for electrical equipment using type “e” protection for the field wiring connections in Zone 1 locations?

A. 15,000 rms symmetrical amperes  
B. 20,000 rms symmetrical amperes  
C. 10,000 rms symmetrical amperes  
D. 100,000 rms symmetrical amperes

112. A group IIA atmosphere should have a maximum experimental safe gap value greater than what?

A. 0.90 mm  
B. 0.60 mm  
C. 0.45 mm  
D. 0.50 mm

113. What type of taper is used for threaded conduit and fittings?

A. Pipe Taper thread (NPT)  
B. Standard Pipe Taper (NPT) thread  
C. National (American) Standard Pipe Taper (NPT) thread  
D. Iron pipe size (IPS)

114. What zone would best describe ignitible concentrations of combustible dust or ignitable fibers/flyings that are present continuously?

A. 2  
B. 21  
C. 22  
D. 20
115. What zone has combustible dust or fibers/flyings that are handled, processed, or used, but in which the dust or fibers/flyings are normally confined within closed containers of closed systems from which they can escape only as a result of the abnormal operation of the equipment with which the dust or fibers/flyings are handled, processed, or used?

A. 21  
B. 20  
C. 22  
D. 2

116. How many items must be met to use flexible cords to connect process control instruments in a Zone 2 location?

A. 2  
B. 4  
C. 6  
D. 5

**Revised 506.6 Material Groups.** For the purposes of testing, approval, and area classification, various air mixtures (not oxygen enriched) shall be grouped as required in 506.6(A), (B), and (C).

(A) Group IIIC. Combustible metal dust. Group IIIC shall be considered to be equivalent to Class II, Group E.

(B) Group IIIB. Combustible dust other than combustible metal dust. Group IIIB shall be considered to be equivalent to Class II, Groups F and G.

(C) Group IIIA. Solid particles, including fibers, greater than 500 μm in nominal size, which could be suspended in air and could settle out of the atmosphere under their own weight. Group IIIA shall be considered to be equivalent to Class III.

**Revised 511.3 (C) Repair Garages, Major and Minor.** Where vehicles using Class I liquids or heavier-than-air gaseous fuels (such as LPG) are repaired, hazardous area classification guidance is found in Table 511.3(C).

**Informational Note:** For additional information, see NFPA 30A-2015, Code for Motor Fuel Dispensing Facilities and Repair Garages, Table 8.3.2.

**Revised 511.3 (D) Repair Garages, Major.** Where vehicles using lighter-than-air gaseous fuels (such as hydrogen and natural gas) are repaired or stored, hazardous area classification guidance is found in Table 511.3(D).

**Informational Note:** For additional information see NFPA 30A-2015, Code for Motor Fuel Dispensing Facilities and Repair Garages, Table 8.3.2.

**NEW 511.8 Underground Wiring.** Underground wiring shall be installed in threaded rigid metal conduit or intermediate metal conduit.

**Revised 514.3(B) (2) Compressed Natural Gas, Liquefied Natural Gas, and Liquefied Petroleum Gas Areas.** Table 514.3(B)(2) shall be used to delineate and classify areas where CNG, LNG, compressed or liquefied hydrogen, LP-Gas, or combinations of these, are dispensed as motor vehicle fuels along with Class I or Class II liquids that are also dispensed as motor vehicle fuels.

Where CNG or LNG dispensers are installed beneath a canopy or enclosure, either the canopy or enclosure shall be designed to prevent accumulation or entrapment of ignitable vapors or all electrical equipment installed beneath the canopy or enclosure shall be suitable for Class I, Division 2 hazardous (classified) locations.
Dispensing devices for LP-Gas shall be located as follows:
(1) At least 3 m (10 ft) from any dispensing device for Class I liquids
(2) At least 1.5 m (5 ft) from any dispensing device for Class I liquids where the following conditions exist:
   a. The LP-Gas deliver nozzle and filler valve release no more than 4 cm³ (0.1 oz) of liquid upon disconnection.
   b. The fixed maximum liquid level gauge remains closed during the entire refueling process.

(NEW) 514.3(B)(3)(a) Aboveground tanks storing CNG or LNG shall be separated from any adjacent property line that is or can be built upon, any public way, and the nearest important building on the same property.

Informational Note: The relevant distances are given in Section 8.4 of NFPA 52-2013, Vehicular Gaseous Fuel Systems Code.

(NEW) 514.3(B)(b) Aboveground tanks storing hydrogen shall be separated from any adjacent property line that is or can be built upon, any public way, and the nearest important building on the same property.

Informational Note: The relevant distances given in NFPA-2011, Hydrogen Technologies Code.

(NEW) 514.3(B)(c) Aboveground tanks storing LP-Gas shall be separated from any adjacent property line that is or can be built upon, any public way, and the nearest important building on the same property.

Informational Note: The relevant distances are given in Section 6.3 of NFPA 58-2014, Liquefied Petroleum Gas Code.

**PART 2 EXAM QUESTIONS**

117. What is group IIIB now equivalent to?
   A. Class III
   B. Class II, Group E
   C. Class II, Group H
   D. Class II, Groups F and G

118. What section of the Liquefied Petroleum Gas Code would you find the relevant distances for the aboveground storage of LP-Gas?
   A. Section 5.5
   B. Section 4.3
   C. Section 6.7
   D. Section 6.3

119. What are above ground storage tanks that store LNG required to be separated from?
   A. Storage buildings
   B. Adjacent property line
   C. In-ground storage tanks
   D. All listed answers

120. What table should be used to determine hazardous area classification guidance where vehicles using heavier-than-air gaseous fuels are repaired?
   A. 506.6(A)
   B. 511.3(D)
   C. 511.3(C)
   D. 506.5 (3)

121. What is group IIIA now equivalent to?
   A. Class II, Groups F and G
   B. Class II, Group E
   C. Class II, Group H
   D. Class III

122. If you only have 22 inches of cover, what type of raceway is required to be used for underground wiring in a commercial garage?
   A. HDPE
   B. PVC
   C. Threaded rigid metal
   D. RTRC
123. What table should be used to determine hazardous area classification guidance where vehicles using lighter-than-air gaseous fuels are stored?
A. 511.3(C)
B. 511.3(D)
C. 506.6(A)
D. 506.5 (3)

124. What is the minimum distance from a Class I liquid being dispensed as motor vehicle fuel is a LP-Gas dispenser required to be?
A. 12 ft
B. 3 ft
C. 6 ft
D. 10 ft

125. Where would you find the relevant distances when storing hydrogen?
A. NFPA 58-2014
B. NFPA 52-2013
C. NFPA-2011
D. 514.3(B)(2)

126. What is group IIIIC now equivalent to?
A. Class III
B. Class II, Groups F and G
C. Class II, Group H
D. Class II, Group E

(NEW) 514.3(B)(d) Aboveground tanks storing CNG, LNG, or LP-Gas shall be separated from each other by at least 6 m (20 ft) and from dispensing devices that dispense liquid or gaseous motor vehicle fuels by at least 6 m (20 ft).

Exception No. 1: The required separation shall not apply to tanks or dispensers storing or handling fuels of the same chemical composition.

Exception No. 2: The required separation shall not apply when both the gaseous fuel storage and dispensing equipment are at least 15 m (50 ft) from any other aboveground motor fuel storage or dispensing equipment.

Informational Note: For further information, see NFPA 52-2013, Vehicular Gaseous Fuel Systems Code, or NFPA 58-2014, Liquefied Petroleum Gas Code, as applicable.

(NEW) 514.3(B)(e) Dispenser Installations Beneath Canopies. Where CNG or LNG dispensers are installed beneath a canopy or enclosure, either the canopy or enclosure shall be designed to prevent accumulation or entrapment of ignitible vapors or all electrical equipment installed beneath the canopy or enclosure shall be suitable for Class I, Division 2 hazardous (classified) locations.

(NEW) 514.3(B)(f) Specific Requirements for LP-Gas Dispensing Devices. Dispensing devices for LP-Gas shall be located as follows:

1. At least 3 m (10 ft) from any dispensing device for Class I liquids

2. At least 1.5 m (5 ft) from any dispensing device for Class I liquids where the following conditions exist:
   a. The LP-Gas deliver nozzle and filler valve release no more than 4 cm³ (0.1 oz) of liquid upon disconnection.
   b. The fixed maximum liquid level gauge remains closed during the entire refueling process.

Table 514.3(B)(2) shall be used to delineate and classify areas for the purpose of installation of electrical wiring and electrical utilization equipment.
(Revised) 514.11 (A) Emergency Electrical Disconnects. Fuel dispensing systems shall be provided with one or more clearly identified emergency shutoff devices or electrical disconnects. Such devices or disconnects shall be installed in approved locations but not less than 6 m (20 ft) or more than 30 m (100 ft) from the fuel dispensing devices that they serve. Emergency shutoff devices or electrical disconnects shall disconnect power to all dispensing devices; to all remote pumps serving the dispensing devices; to all associated power, control, and signal circuits; and to all other electrical equipment in the hazardous (classified) locations surrounding the fuel dispensing devices. When more than one emergency shutoff device or electrical disconnect is provided, all devices shall be interconnected. Resetting from an emergency shutoff condition shall require manual intervention and the manner of resetting shall be approved by the authority having jurisdiction.

(NEW) 517.2 Governing Body. The person or persons who have the overall legal responsibility for the operation of a health care facility.

(NEW) 517.2 Support (Category 4) Space. Space in which failure of equipment or a system is not likely to have a physical impact on patient care.

(Revised) 517.19 (1) Minimum Number and Supply. Each operating room shall be provided with a minimum of 36 receptacles divided between at least two branch circuits. At least 12 receptacles, but no more than 24, shall be connected to either of the following:

1. The normal system branch circuit required in 517.19(A)
2. A critical branch circuit supplied by a different transfer switch than the other receptacles at the same location

(Revised) 517.19 (F) Additional Protective Techniques in Critical Care (Category 1) Spaces (Optional). Isolated power systems shall be permitted to be used for critical care (Category 1) spaces, and, if used, the isolated power system equipment shall be listed as isolated power equipment. The isolated power system shall be designed and installed in accordance with 517.160.

### PART 2 EXAM QUESTIONS

127. What type of location is an LNG dispenser installed beneath a canopy required to be suitable for?
   A. Class III, Division
   B. Class II, Division 2
   C. Class I, Division 2
   D. Class II, Division 1

128. What is the minimum number of receptacles required for an operating room?
   A. 24
   B. 36
   C. 12
   D. 30

129. An aboveground storage tank that has LP-Gas must be separated by what distance from CNG aboveground motor fuel storage or dispensing equipment?
   A. 20ft
   B. 100 ft
   C. 50 ft
   D. 10 ft

130. Who has the overall legal responsibility for the operation of a health care facility?
   A. Governing Body
   B. Administrator
   C. Board of directors
   D. Quality of care committee
### 131. What is the minimum distance from fuel dispensing systems that an emergency shutoff device must be installed?

- A. 10 ft
- B. 100 ft
- C. 50 ft
- D. 20 ft

### 132. In general, how far from a Class I liquid are dispensing devices for LP-Gas required to be installed?

- A. 100 ft
- B. 10 ft
- C. 50 ft
- D. 20 ft

### 133. What type of category is a critical care space?

- A. Category 1
- B. Category 2
- C. Category 3
- D. Category 4

### 134. What is the maximum distance from fuel dispensing systems that an emergency shutoff device can be installed?

- A. 10 ft
- B. 20 ft
- C. 50 ft
- D. 100 ft

### 135. The type of space in which the failure of equipment or a system is not likely to have a physical impact on patient care is best defined as?

- A. Category 1
- B. Category 2
- C. Category 3
- D. Category 4

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(**NEW**) 517.29 (B) Critical care (Category 1) spaces shall be served only by a Type 1 essential electrical system.

**NEW** 517.40 Informational Note: Nursing homes and other limited care facilities can be classified as critical care (Category 1) or general care (Category 2) patient care space depending on the design and type of care administered in the facility. For small, less complex facilities, only minimal alternate lighting and alarm service may be required. At nursing homes and other limited care facilities where patients are not sustained by electrical life support equipment or inpatient hospital care the requirements of 517.40 through 517.41 apply. If the level of care is comparable to that provided in a hospital, see the essential electrical system requirements of 517.29 through 517.30.

(Revised) 517.43(E) Dining and Recreation Areas. Sufficient lighting in dining and recreation areas to provide illumination to exit ways at a minimum of 5 ft-candles.

**NEW** 520.2 Adapter. A device used to adapt a circuit from one configuration of an attachment plug or receptacle to another configuration with the same current rating.

**NEW** 520.2 Stage Switchboard, Portable. A portable rack or pack containing dimmers or relays with associated overcurrent protective devices, or overcurrent protective devices alone that are used to feed stage equipment.

(Revised) 520.53 Construction. Portable stage switchboards shall be listed and shall comply with 520.53(A) through (E). (A) Pilot Light. A pilot light shall be provided for each ungrounded conductor feeding the switchboard. The pilot light(s) shall be connected to the incoming feeder so that operation of the main overcurrent protective device or master switch shall not affect the operation of the pilot light(s).
(NEW) 520.54 (B) Conductor Sizing. The power supply conductors for portable stage switchboards utilizing solid-state phase control dimmers shall be sized considering the neutral conductor as a current-carrying conductor for ampacity adjustment purposes. The power supply conductors for portable stage switchboards utilizing only solid-state sine wave dimmers shall be sized considering the neutral conductor as a non–current carrying conductor for ampacity adjustment purposes.

(Revised) 520.54 (J) Supply Neutral Conductor. Supply neutral conductors shall comply with (1) and (2) below:

(1) Marking. Grounded neutral conductors shall be permitted to be identified by marking at least the first 150 mm (6 in.) from both ends of each length of conductor with white or gray.

(2) Conductor Sizing. Where single-conductor feeder cables not installed in raceways are used on multiphase circuits feeding portable stage switchboards containing solid-state phasecontrol dimmers, the grounded neutral conductor shall have an ampacity of at least 130 percent of the ungrounded circuit conductors feeding the portable stage switchboard. Where such feeders are supplying only solid-state sine wave dimmers, the grounded neutral conductor shall have an ampacity of at least 100 percent of the ungrounded circuit conductors feeding the portable stage switchboard.

(NEW) 520.62 (F) Single-Conductor Feeders. Portable power distribution equipment fed by single-conductor feeder systems shall comply with 520.53(C) and (D) and 520.54.

(Revised) 550.2 Manufactured Home. A structure, transportable in one or more sections, which in the traveling mode is 2.4 m (8 ft) or more in width or 12.2 m (40 ft) or more in length, or when erected on site is 29.77 m² (320 ft²) or more is built on a permanent chassis and is designed to be used as a dwelling with or without a permanent foundation, whether or not connected to the utilities, and includes plumbing, heating, air conditioning, and electrical systems contained therein. The term manufactured home includes any structure that meets all the requirements of this paragraph except the size requirements and with respect to which the manufacturer voluntarily files a certification required by the regulatory agency. Calculations used to determine the number of square meters (square feet) in a structure are based on the structure’s exterior dimensions and include all expandable rooms, cabinets, and other projections containing interior space, but do not include bay windows. For the purpose of this Code and unless otherwise indicated, the term mobile home includes manufactured homes and excludes park trailers defined in Article 552.4.

**PART 2 EXAM QUESTIONS**

136. What is a device used to adapt a circuit from one configuration of an attachment plug or receptacle to another configuration with the same current rating?
   - A. Adapter
   - B. Splitter
   - C. Spearman rank order correlation coefficient
   - D. Extension cord

137. What type of category is a general care space?
   - A. Category 1
   - B. Category 2
   - C. Category 3
   - D. Category 4
138. What is the minimum length when transported that a structure could be considered a manufactured home?
   A. 32 ft
   B. 30 ft
   C. 40 ft
   D. 8 ft

139. What is the minimum required illumination from dining rooms to exit ways with regards to health care facilities?
   A. 7 ft-candles
   B. 2 ft-candles
   C. 10 ft-candles
   D. 5 ft-candles

140. How many sections are single-conductor feeder systems that power portable power distribution equipment required to comply with?
   A. 3
   B. 4
   C. 2
   D. 5

141. What is a portable rack containing relays with their associated overcurrent protective devices used to feed stage equipment?
   A. Switchboard Stage, Portable
   B. Stage Switchboard, Portable
   C. Stage switch system, System portable
   D. Switchboard stage, Portable system

142. What type of electrical system is required for a critical care area?
   A. Type 3 Life safety electrical system
   B. Type 2 isolated electrical system
   C. Type 1 critical electrical system
   D. Type 1 essential electrical system

143. What is each ungrounded conductor feeding a portable stage switchboard required to be equipped with?
   A. A rheostat
   B. A pilot light
   C. A quick disconnect
   D. A current transformer

144. How should the supply neutral conductors for portable stage switchboards be identified?
   A. With 3 white or gray stripes at each end
   B. With a pilot light
   C. With 6 inches of white or gray phase tape at each end
   D. All listed answers

145. What conductor is required to be used for ampacity adjustment purposes regarding the branch circuit feeding a portable stage switchboard utilizing only solid-state sine wave dimmers?
   A. The power supply conductors and neutral
   B. The power supply conductors
   C. The neutral conductor only
   D. There are no ampacity adjustments required for portable stage switchboards

(Revised) 550.25 (B) Mobile Homes and Manufactured Homes. All 120-volt branch circuits that supply 15- and 20-ampere outlets shall comply with 210.12.

(Revised) 551.71 (C) 50-Ampere. A minimum of 20 percent of existing and 40 percent of all new recreational vehicle sites, with electrical supply, shall each be equipped with a 50-ampere, 125/250-volt receptacle conforming to the configuration as identified in Figure 551.46(C)(1). Every recreational vehicle site equipped with a 50-ampere receptacle shall also be equipped with a 30-ampere, 125-volt receptacle conforming to Figure 551.46(C)(1). These electrical supplies shall be permitted to include additional receptacles that have configurations in accordance with 551.81.

(NEW) 551.72 (A) Systems. Distribution systems shall provide the voltage and have a capacity for the receptacles provided in the recreational vehicle (RV) site supply equipment as calculated according to 551.73 and shall have an ampacity not less than 30 amperes. Systems permitted include 120 volts, 1-phase; 120/240 volts, 1-phase; and 120/208 volts, 1-phase.
(NEW) 552.5 Park trailer Labels. Labels required by Article 552 shall be made of etched, metal-stamped, or embossed brass or stainless steel; plastic laminates not less than 0.13 mm (0.005 in.) thick; or anodized or al clad aluminum not less than 0.5 mm (0.020 in.) thick or the equivalent.

(Revised) 552.44(D) Labeling at Electrical Entrance. Each park trailer shall have a safety label with the signal word WARNING in minimum 6 mm (1/4 in.) high letters and body text in minimum 3 mm (1/8 in.) high letters on a contrasting background. The safety label shall be affixed to the exterior skin, at or near the point of entrance of the power-supply assembly and shall read, as appropriate:

THIS CONNECTION IS FOR 110–125-VOLT AC, 60 HZ, 30 AMPERE SUPPLY or
THIS CONNECTION IS FOR 208Y/120-VOLT OR 120/240-VOLT AC, 3-POLE, 4-WIRE, 60 HZ, _____ AMPERE SUPPLY.
followed by
DO NOT EXCEED THE CIRCUIT RATING. EXCEEDING THE CIRCUIT RATING MAY CAUSE A FIRE AND RESULT IN DEATH OR SERIOUS INJURY.

(Revised) 555.3 Ground-Fault Protection. The overcurrent protective devices that supply the marina, boatyards, and commercial and noncommercial docking facilities shall have ground-fault protection not exceeding 30 mA.

(NEW) 555.24 Signage. Permanent safety signs shall be installed to give notice of electrical shock hazard risks to persons using or swimming near a boat dock or marina and shall comply with all of the following:

(1) The signage shall comply with 110.21(B)(1) and be of sufficient durability to withstand the environment.
(2) The signs shall be clearly visible from all approaches to a marina or boatyard facility.
(3) The signs shall state “WARNING — POTENTIAL SHOCK HAZARD — ELECTRICAL CURRENTS MAY BE PRESENT IN THE WATER.”

(Revised) 600.1 Scope. This article covers the installation of conductors, equipment, and field wiring for electric signs, retrofit kits, and outline lighting, regardless of voltage. All installations and equipment using neon tubing, such as signs, decorative elements, skeleton tubing, or art forms, are covered by this article.

(NEW) 600.2 Photovoltaic (PV) Powered Sign. A complete sign powered by solar energy consisting of all components and subassemblies for installation either as an off-grid stand-alone, on-grid interactive, or non-grid interactive system.

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**PART 2 EXAM QUESTIONS**

146. If an RV park has a 50-ampere receptacle at each recreational vehicle site, what other receptacle, if any, should be installed?

| A. 40 amp |  |
| B. 15 amp |  |
| C. 20 amp |  |
| D. 30 amp |  |

147. What section are the branch circuits that supply 15- and 20-ampere outlets in manufactured homes required to comply with?

| A. 215.12 |  |
| B. 220.10 |  |
| C. 210.12 |  |
| D. 210.15 |  |
148. A plastic laminate park trailer label is required to have what minimum thickness?
   A. 0.020 in.
   B. 0.005 in.
   C. .5 in.
   D. 0.050 in.

149. Recreational vehicle site supply equipment distribution systems are calculated as per what listed section?
   A. 551.77
   B. 551.72 (B)
   C. 551.71 (C)
   D. 551.73

150. What is the maximum current of ground fault protection allowed that supply the overcurrent protective devices in a marina?
   A. 10 mA
   B. 20 mA
   C. 30 mA
   D. 40 mA

151. At what height are the letters on each park trailer safety label with the signal word WARNING required to be?
   A. 3/8 in.
   B. 1/4 in.
   C. 1/8 in.
   D. 3/4 in.

152. What listed term best defines a complete sign powered by solar energy consisting of all components and subassemblies for installation either as an off-grid stand-alone, on-grid interactive, or non-grid interactive system?
   A. Induction (IP) Powered Sign
   B. Turbine (TB) Powered Sign
   C. Battery (BP) Powered Sign
   D. Photovoltaic (PV) Powered Sign

153. What article should be referenced for the installation of skeleton tubing and equipment?
   A. 724
   B. 604
   C. 555
   D. 600

154. What is the permanent safety sign that gives notice of an electrical shock hazard risk to persons using or swimming near a boat marina?
   A. “WARNING — SHOCK HAZARD — ELECTRICAL CURRENTS MAY BE PRESENT IN THE WATER.”
   B. “WARNING — POTENTIAL SHOCK HAZARD — ELECTRICAL CURRENTS MAY BE PRESENT IN THE WATER.”
   C. “WARNING — POTENTIAL HAZARD — ELECTRICAL CURRENTS MAY BE PRESENT IN THE WATER.”
   D. “WARNING — POTENTIAL SHOCK HAZARD — ELECTRICAL CURRENTS MAY BE PRESENT.”

(NEW) 600.4 (B) Signs with a Retrofitted Illumination System.

1. The retrofitted sign shall be marked that the illumination system has been replaced.
2. The marking shall include the kit provider’s and installer’s name, logo, or unique identifier.
3. Signs equipped with tubular light-emitting diode lamps powered by the existing sign sockets shall include a label alerting the service personnel that the sign has been modified. The label shall meet the requirements of 110.21(B). The label shall also include a warning not to install fluorescent lamps and shall also be visible during re-lamping.

(Revised) 600.24 (B) Grounding. Metal parts of Class 2 power supplies and power sources shall be grounded by connecting to the equipment grounding conductor.

(NEW) 604.6 Listing Requirements. Manufactured wiring systems and associated components shall be listed.
(Revised) 605.9 (C) Receptacle, Maximum. An individual office furnishing or groups of interconnected individual office furnishings shall not contain more than 13 15-ampere, 125-volt receptacles. For purposes of this requirement, a receptacle is considered (1) up to two (simplex) receptacles provided within a single enclosure and that are within 0.3 m (1 ft) of each other or (2) one duplex receptacle.

(Revised) 620.11 (A) Hoistway Door Interlock Wiring. The conductors to the hoistway door interlocks from the hoistway riser shall be one of the following:

(1) Flame retardant and suitable for a temperature of not less than 200°C (392°F). Conductors shall be Type SF or equivalent.

(2) Physically protected using an approved method, such that the conductor assembly is flame retardant and suitable for a temperature of not less than 200°C (392°F).

(Revised) 620.23 (A) Separate Branch Circuits. The branch circuit(s) supplying the lighting for machine rooms, control rooms, machinery spaces, or control spaces shall be separate from the branch circuit(s) supplying the receptacle(s) in those places. These circuits shall supply no other loads.

(NEW) 620.51(D)(2) Available Short-Circuit Current Field Marking. Where an elevator control panel is used, it shall be legibly marked in the field with the maximum available short-circuit current at its line terminals. The field marking(s) shall include the date the short-circuit current calculation was performed and be of sufficient durability to withstand the environment involved. When modifications to the electrical installation occur that affect the maximum available short-circuit current at the elevator control panel, the maximum available short-circuit current shall be verified or recalculated as necessary to ensure the elevator control panel’s short-circuit current rating is sufficient for the maximum available short-circuit current at the line terminals of the equipment. The required field marking(s) shall be adjusted to reflect the new level of maximum available short-circuit current.

(NEW) 620.51(E) Surge Protection. Where any of the disconnecting means in 620.51 has been designated as supplying an emergency system load, surge protection shall be provided.

(Revised) 625.1 Scope. This article covers the electrical conductors and equipment external to an electric vehicle that connect an electric vehicle to a supply of electricity by conductive, inductive, or wireless power transfer (contactless inductive charging) means, and the installation of equipment and devices related to electric vehicle charging.

(Revised) 625.2 Cable Management System. An apparatus designed to control and organize the output cable to the electric vehicle or to the primary pad.

(NEW) 625.2 Charger Power Converter. The device used to convert energy from the power grid to a high-frequency output for wireless power transfer.

(NEW) 625.2 Fastened in Place. Mounting means of an EVSE in which the fastening means are specifically designed to permit periodic removal for relocation, interchangeability, maintenance, or repair without the use of a tool.
155. What listed term is the mounting means of an EVSE in which the fastening means are specifically designed to permit periodic removal for relocation, interchangeability, maintenance, or repair without the use of a tool?
   A. Charger Power Converter
   B. Fixed in Place
   C. Cable Management System
   D. Fastened in Place

156. What is the disconnect that supplies an emergency system load as designated in 620.51 required to be provided with?
   A. Cartridge fuses
   B. Edison fuses
   C. Surge protection
   D. Thermal overloads

157. What are manufactured wiring systems and associated components required to be?
   A. Guarded
   B. Listed
   C. Readily accessible
   D. Accessible

158. What type of branch circuit is required to power the lighting for a machine room?
   A. 20 amp
   B. Dedicated
   C. 15 amp
   D. 277 volt

159. What is the minimum temperature protection for conductors to a hoistway door interlock from a hoistway riser required to be?
   A. 100°C
   B. 392°C
   C. 200°C
   D. 200°F

160. Where is the maximum available short-circuit current required to be marked when using an elevator control panel?
   A. At the fire alarm control panel (FACP)
   B. On the elevator equipment room door
   C. At the service disconnect
   D. At its line terminals

161. What device is used to convert energy from the power grid to a high-frequency output for wireless power transfer?
   A. Cable Management System
   B. Fixed in Place
   C. Charger Power Converter
   D. Fastened in Place

162. What article applies to electric vehicle charging?
   A. 625
   B. 620
   C. 680
   D. 630

163. What is the maximum number of 15 amp receptacles allowed to be installed in interconnected individual office furnishings?
   A. 5
   B. 10
   C. 13
   D. There are no limits

164. What listed term describes an apparatus designed to control and organize the output cable to the electric vehicle or to the primary pad?
   A. Fixed in Place
   B. Cable Management System
   C. Charger Power Converter
   D. Fastened in Place

165. Where are the metal parts of Class 2 power supplies used in electric signs required to be connected?
   A. Equipment grounding conductor
   B. Grounded conductor
   C. Grounding electrode conductor
   D. Building steel

166. The label affixed to a retrofitted sign is required to meet the requirements of what listed section?
   A. 110.25
   B. 210.12
   C. 555.3
   D. 110.21(B)
(NEW) 625.2 Fixed in Place. Mounting means of an EVSE attached to a wall or surface with fasteners that require a tool to be removed.

(NEW) 625.2 Output Cable to the Primary Pad. A multi-conductor, shielded cable assembly consisting of conductors to carry the high-frequency energy and any status signals between the charger power converter and the primary pad.

(NEW) 625.2 Portable (as applied to EVSE). A device intended for indoor or outdoor use that can be carried from charging location to charging location and is designed to be transported in the vehicle when not in use.

(NEW) 625.2 Primary Pad. A device external to the EV that provides power via the contactless coupling and may include the charger power converter.

(NEW) 625.2 Wireless Power Transfer (WPT). The transfer of electrical energy from a power source to an electrical load via electric and magnetic fields or waves by a contactless inductive means between a primary and a secondary device.

(NEW) 625.2 Wireless Power Transfer Equipment (WPTE). Equipment consisting of a charger power converter and a primary pad. The two devices are either separate units or contained within one enclosure.

(Revised) 625.50 Location. The electric vehicle supply equipment shall be located for direct electrical coupling of the EV connector (conductive or inductive) to the electric vehicle. Unless specifically listed and marked for the location, the coupling means of the electric vehicle supply equipment shall be stored or located at a height of not less than 450 mm (18 in.) above the floor level for indoor locations or 600 mm (24 in.) above the grade level for outdoor locations. This requirement does not apply to portable electric vehicle supply equipment constructed in accordance with 625.44(A).

(Revised) 630.31 Ampacity of Supply Conductors. The ampacity of the supply conductors for resistance welders shall be in accordance with 630.31(A) and (B).

(Revised) 640.3 (B) Ducts, Plenums, and Other Air-Handling Spaces. Section 300.22(B) shall apply to circuits and equipment installed in ducts specifically fabricated for environmental air. Section 300.22(C) shall apply to circuits and equipment installed in other spaces used for environmental air (plenums).

(NEW) 640.21(C) Informational Note: See 770.3 for the classification of composite optical fiber cables.

(Revised) 640.42 (C) Between Equipment and/or Between Equipment Racks. Installation of flexible cords and cables used for the distribution of audio signals between equipment shall comply with Parts I and II of Article 400 and Parts I, II, and III of Article 725, respectively. Cords and cables listed for portable use, either hard or extra-hard service as defined by Article 400, shall also be permitted. Other listed cable types and assemblies, including optional hybrid communications, signal, and composite optical fiber cables, shall be permitted.

645.3 (E) Fire Alarm Cables and Equipment. Parts I, II, and III of Article 760 shall apply to fire alarm
systems cables and equipment installed in an information technology equipment room. Only fire alarm cables listed in accordance with Part IV of Article 760 and listed fire alarm equipment shall be permitted to be installed in an information technology equipment room.

(NEW) 645.3 (H) Optical Fiber Cables. Only optical fiber cables listed in accordance with 770.179 shall be permitted to be installed in an information technology equipment room.

**PART 2 EXAM QUESTIONS**

167. How many provisions are required to be followed when determining the ampacity of supply conductors for resistance welders?
   A. 2  
   B. 3  
   C. 4  
   D. 1

168. What is a device external to the EV that provides power via the contactless coupling and may include the charger power converter?
   A. Portable (as applied to EVSE)  
   B. Output Cable to the Primary Pad  
   C. Primary Pad  
   D. Wireless Power Transfer (WPT)

169. What is a multi-conductor, shielded cable assembly consisting of conductors to carry the high-frequency energy and any status signals between the charger power converter and the primary pad?
   A. Wireless Power Transfer (WPT)  
   B. Portable (as applied to EVSE)  
   C. Primary Pad  
   D. Output Cable to the Primary Pad

170. What term embodies the transfer of electrical energy from a power source to an electrical load via electric and magnetic fields or waves by a contactless inductive means between a primary and a secondary device?
   A. Output Cable to the Primary Pad  
   B. Wireless Power Transfer (WPT)  
   C. Portable (as applied to EVSE)  
   D. Wireless Power Transfer Equipment (WPTE)

171. The mounting means of an EVSE attached to a surface with fasteners that require a tool to be removed best describes what term?
   A. Fixed in Place  
   B. Fastened in Place  
   C. Cable Management System  
   D. Charger Power Converter

172. What is the minimum outdoor height above finish grade that the coupling means of electric vehicle supply equipment is required to be installed?
   A. 36 inches  
   B. 18 inches  
   C. 30 inches  
   D. 24 inches

173. What part(s) of Article 400 is the installation of flexible cords and cables used for the distribution of audio signals between equipment required to comply with?
   A. IV  
   B. I, II, and III  
   C. I and II  
   D. V and VI

174. What section applies to circuits and equipment installed in ducts specifically fabricated for environmental air?
   A. 300.22(C)  
   B. 300.22(B)  
   C. 310.15(C)  
   D. 310.15(B)

175. What part of Article 760 applies to fire alarm systems cables and equipment installed in an information technology equipment room?
   A. V and VI  
   B. I and II  
   C. IV  
   D. I, II, and III

176. What section applies to circuits and equipment installed in other spaces used for environmental air (plenums)?
   A. 300.22(C)  
   B. 300.22(B)  
   C. 310.15(C)  
   D. 310.15(B)
177. What section must be referenced to determine if specific optical fiber cables can be installed in an information technology equipment room?
   A. 770.3
   B. 770.179
   C. 300.22(B)
   D. 800.32

178. What section should be referenced to determine the classification of composite optical fiber cables?
   A. 300.22(B)
   B. 770.179
   C. 770.3
   D. 800.32

179. What term matches equipment consisting of a charger power converter and a primary pad where the two devices are in either separate units or contained within one enclosure?
   A. Wireless Power Transfer (WPT)
   B. Output Cable to the Primary Pad
   C. Portable (as applied to EVSE)
   D. Wireless Power Transfer Equipment (WPTE)

180. The description of a device intended for indoor or outdoor use that can be carried from charging location to charging location and is designed to be transported in the vehicle when not in use matches what listed term?
   A. Primary Pad
   B. Output Cable to the Primary Pad
   C. Portable (as applied to EVSE)
   D. Wireless Power Transfer (WPT)

(NEW) 645.5 (E)(2) Installation Requirements for Electrical Supply Cords, Data Cables, Interconnecting Cables, and Grounding Conductors Under a Raised Floor. The following cords, cables, and conductors shall be permitted to be installed under a raised floor:

(1) Supply cords of listed information technology equipment in accordance with 645.5(B).

(2) Interconnecting cables enclosed in a raceway.

(3) Equipment grounding conductors.

(4) In addition to wiring installed in compliance with 725.135(C), Types CL2R, CL3R, CL2, and CL3 and substitute cables including CMP, CMR, CM, and CMG installed in accordance with 725.154(A), shall be permitted under raised floors.

Informational Note: Figure 725.154(A) illustrates the cable substitution hierarchy for Class 2 and Class 3 cables.

(5) Listed Type DP cable having adequate fire-resistant characteristics suitable for use under raised floors of an information technology equipment room.

(NEW) 645.5 (E)(3) Installation Requirements for Optical Fiber Cables Under a Raised Floor. In addition to optical fiber cables installed in accordance with 770.113(C), Types OFNR, OFCR, OFN, and OFC shall be permitted under raised floors.

(F) Securing in Place. Power cables; communications cables, connecting cables, interconnecting cables, and associated boxes, connectors, plugs, and receptacles that are listed as part of, or for, information technology equipment shall not be required to be secured in place where installed under raised floors.

Informational Note: Securement requirements for raceways and cables not listed as part of, or for, information technology equipment are found in 300.11.
(Revised) 646.3 (E) Fire Alarm Equipment. Parts I, II, and III of Article 760 shall apply to fire alarm systems, cables, and equipment installed in an MDC, where provided. Only fire alarm cables listed in accordance with Part IV of Article 760 and listed fire alarm equipment shall be permitted to be installed in an MDC.

(Revised) 646.3 (F) Cable Routing Assemblies and Communications Wires, Cables, Raceways, and Equipment. Parts I, II, III, IV, and V of Article 800 shall apply to cable routing assemblies, communications wires, cables, raceways, and equipment installed in an MDC. Only communications wires and cables listed in accordance with 800.179, cable routing assemblies and communications raceways listed in accordance with 800.182, and communications equipment listed in accordance with 800.170 shall be permitted to be installed in an MDC.

(Revised) 646.3(G) Community Antenna Television and Radio Distribution Systems Cables and Equipment. Parts I, II, III, IV, and V of Article 820 shall apply to community antenna television and radio distribution systems equipment installed in an MDC. Only community antenna television and radio distribution cables listed in accordance with 820.179 and listed CATV equipment shall be permitted to be installed in an MDC.

(Revised) 650.1 Scope. This article covers those electrical circuits and parts of electrically operated pipe organs that are employed for the control of the keyboards and of the sounding apparatus, typically organ pipes.

(NEW) 650.2 Electronic Organ. A musical instrument that imitates the sound of a pipe organ by producing sound electronically.

(Revised) 668.11 (B) Metal Enclosures Grounded. All metal enclosures of power-supply apparatus for the direct-current cell line process operating with a power supply over 50 volts shall be grounded by either of the following means:

1. Through protective relaying equipment
2. By a minimum 2/0 AWG copper grounding conductor or a conductor of equal or greater conductance

(Revised) 670.5(1) Industrial machinery shall not be installed where the available short-circuit current exceeds its short-circuit current rating as marked in accordance with 670.3(A)(4).

(NEW) 670.5 (2) Industrial machinery shall be legibly marked in the field with the maximum available short-circuit current. The field marking(s) shall include the date the short-circuit current calculation was performed and be of sufficient durability to withstand the environment involved.

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**PART 2 EXAM QUESTIONS**

181. How close to a box under a raised floor does communication cable need to be secured?
   A. Within 15 inches
   B. Communication cable installed under a raised floor does not need to be secured
   C. 12 inches
   D. No less than 24 inches

182. What figure in the 2017 code illustrates the cable substitution hierarchy for Class 2 and Class 3 cables?
   A. 725.135(C)
   B. 725.154(A)
   C. 770.179
   D. 300.22(C)
183. What part of Article 760 is required to be referenced for the only type of fire alarm cable permitted in a Modular Data Center (MDC)?
A. I  B. III  C. II  D. IV

184. What is required to be listed on the field marking regarding industrial machinery and its short-circuit current calculation?
A. The person who did the calculation  B. The time of the calculation  C. The date of the calculation  D. All listed answers

185. What article applies to a radio distribution systems equipment installed in an MDC?
A. 800  B. 720  C. 760  D. 820

186. What article applies to 3/4 inch EMT installed in a modular data center (MDC) with communications wires inside the raceway?
A. 720  B. 800  C. 760  D. 820

187. What article should be referenced if performing work on a pipe organ?
A. 645  B. 820  C. 650  D. 646

188. What size copper grounding conductor needs to ground all metal enclosures that deal with direct-current cell line process power-supply conductors or equipment operating at 60 volts dc?
A. 1/0 AWG  B. 2/0 AWG  C. 3/0 AWG  D. 4/0 AWG

189. What is a musical instrument that imitates the sound of a pipe organ by producing sound electronically?
A. Synthesizing array, Electronic  B. Electric forced air organ  C. Steam powered organ  D. Electronic organ

190. What must be done if a newly arrived piece of industrial equipment’s short-circuit current exceeds its short-circuit current rating?
A. Use adjustable electronic heaters and adjust the ratings to match  B. Install an inline disconnect that matches the short-circuit current rating  C. Do not install the equipment  D. All listed answers

(NEW) 670.6 Surge Protection. Industrial machinery with safety interlock circuits shall have surge protection installed.

(NEW) 680.2 Electrically Powered Pool Lift. An electrically powered lift that provides accessibility to and from a pool or spa for people with disabilities.

(Revised) 680.2 Storable Swimming, Wading, or Immersion Pools; or Storable/Portable Spas and Hot Tubs. Swimming, wading, or immersion pools that are intended to be stored when not in use, constructed on or above the ground and are capable of holding water to a maximum depth of 1.0 m (42 in.), or a pool, spa,
or hot tub constructed on or above the ground, with nonmetallic, molded polymeric walls or inflatable fabric walls regardless of dimension.

(NEW) 680.7 Grounding and Bonding Terminals. Grounding and bonding terminals shall be identified for use in wet and corrosive environments. Field-installed grounding and bonding connections in a damp, wet, or corrosive environment shall be composed of copper, copper alloy, or stainless steel. They shall be listed for direct burial use.

(NEW) 680.14 (A) General. Areas where pool sanitation chemicals are stored, as well as areas with circulation pumps, automatic chlorinators, filters, open areas under decks adjacent to or abutting the pool structure, and similar locations shall be considered to be a corrosive environment. The air in such areas shall be considered to be laden with acid, chlorine, and bromine vapors, or any combination of acid, chlorine, or bromine vapors, and any liquids or condensation in those areas shall be considered to be laden with acids, chlorine, and bromine vapors, or any combination of acid, chlorine, or bromine vapors.

(Revised) 680.22 (2) Circulation and Sanitation System, Location. Receptacles that provide power for water-pump motors or for other loads directly related to the circulation and sanitation system shall be located at least 1.83 m (6 ft) from the inside walls of the pool. These receptacles shall have GFCI protection and be of the grounding type.

(NEW) 680.22 (B)(7) Low-Voltage Gas-Fired Luminaires, Decorative Fireplaces, Fire Pits, and Similar Equipment. Listed low-voltage gas-fired luminaires, decorative fireplaces, fire pits, and similar equipment using low-voltage ignitors that do not require grounding, and are supplied by listed transformers or power supplies that comply with 680.23(A)(2) with outputs that do not exceed the low-voltage contact limit shall be permitted to be located less than 1.5 m (5 ft) from the inside walls of the pool. Metallic equipment shall be bonded in accordance with the requirements in 680.26(B). Transformers or power supplies supplying this type of equipment shall be installed in accordance with the requirements in 680.24. Metallic gas piping shall be bonded in accordance with the requirements in 250.104(B) and 680.26(B)(7).

(Revised) 680.23 (F)(1) Wiring Methods. Where branch-circuit wiring on the supply side of enclosures and junction boxes connected to conduits run to underwater luminaires are installed in corrosive environments as described in 680.14, the wiring method of that portion of the branch circuit shall be as required in 680.14(B) or shall be liquid-tight flexible nonmetallic conduit. Wiring methods installed in corrosive environments as described in 680.14 shall contain an insulated copper equipment grounding conductor sized in accordance with Table 250.122, but not smaller than 12 AWG. Where installed in noncorrosive environments, branch circuits shall comply with the general requirements in Chapter 3.

(Revised) 680.25(A) Feeders. Where feeders are installed in corrosive environments as described in 680.14, the wiring method of that portion of the feeder shall be as required in 680.14(B) or shall be liquid-tight flexible nonmetallic conduit. Wiring methods installed in corrosive environments as described in 680.14 shall contain an insulated copper equipment grounding conductor sized in accordance with Table 250.122, but not smaller than 12 AWG. Where installed in noncorrosive environments, feeders shall comply with the general requirements in Chapter 3.

(NEW) 680.28 Gas-Fired Water Heater. Circuits serving gas-fired swimming pool and spa water heaters operating at voltages above the low-voltage contact limit shall be provided with ground-fault circuit-interrupter protection for personnel.
### Part 2 Exam Questions

191. What term best describes an electrically powered lift that provides accessibility to and from a pool or spa for people with disabilities?  
   A. Powered Pool Lift, Electronic  
   B. Electronically Powered Pool Lift  
   C. Powered Pool Lift, Electric  
   D. Electrically Powered Pool Lift

192. What is industrial machinery with safety interlock circuits required to have installed?  
   A. Surge protection  
   B. Resistor banks for load breaking  
   C. In line capacitors  
   D. An induction array

193. What is a grounding terminal installed in the wet and corrosive environment around a pool required to be listed for?  
   A. Direct burial  
   B. Hard usage  
   C. Moisture resistance  
   D. All listed answers

194. What maximum depth is listed for a nonmetallic pool to still be considered storable?  
   A. 48 inches  
   B. 46 inches  
   C. 42 inches  
   D. 40 inches

195. How far from the inside wall of a pool are receptacles that power water-pump motors for the sanitation system required to be?  
   A. 4 ft  
   B. 6 ft  
   C. 5 ft  
   D. 10 ft

196. What type of environment is the storage of pool chemicals considered?  
   A. Particulate hazard  
   B. Class 1 division 1  
   C. Combustible  
   D. Corrosive

197. What is the smallest insulated copper equipment grounding conductor that can be installed to comply with 680.14?  
   A. 12 AWG  
   B. 10 AWG  
   C. 14 AWG  
   D. 8 AWG

198. How far from the inside wall of a pool can a fire pit using low-voltage ignitors not requiring grounding supplied by a listed power supply be installed?  
   A. 4 ft  
   B. 5 ft  
   C. 6 ft  
   D. 10 ft

199. What are circuits serving gas-fired spa water heaters operating at voltages above the low-voltage contact limit required to be provided with?  
   A. Ground-fault circuit-interrupter  
   B. Arc-fault circuit-interrupter  
   C. Fused disconnects  
   D. Bi-metal overloads

200. What table is required to be used to size equipment grounding conductors?  
   A. 250.103(A)  
   B. 250.66  
   C. 250.102(D)  
   D. 250.122

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(Revised) **682.15 Ground-Fault Circuit-Interrupter (GFCI) Protection.** Fifteen- and 20-ampere single-phase, 125-volt through 250-volt receptacles installed outdoors and in or on floating buildings or structures within the electrical datum plane area shall be provided with GFCI protection for personnel. The GFCI protection device shall be located not less than 300 mm (12 in.) above the established electrical datum plane.

(Revised) **690.2 Array.** A mechanically integrated assembly of module(s) or panel(s) with a support structure and foundation, tracker, and other components, as required, to form a dc or ac power producing unit.
(Revised) 690.2 Bipolar Photovoltaic Array. A dc PV array that has two outputs, each having opposite polarity to a common reference point or center tap.

(NEW) 690.2 DC-to-DC Converter Output Circuit. Circuit conductors between the dc-to-dc converter source circuit(s) and the inverter or dc utilization equipment.

(NEW) 690.2 DC-to-DC Converter Source Circuit. Circuits between dc-to-dc converters and from dc-to-dc converters to the common connection point(s) of the dc system.

(NEW) 690.2 Generating Capacity. The sum of parallel-connected inverter maximum continuous output power at 40°C in kilowatts.

(NEW) 690.2 Interactive Inverter Output Circuit. The conductors between the interactive inverter and the service equipment or another electrical power production and distribution network.

(Revised) 690.2 Inverter Input Circuit. Conductors connected to the dc input of an inverter.

(Revised) 690.2 Inverter Output Circuit. Conductors connected to the ac output of an inverter.

690.7 Maximum Voltage. The maximum voltage of PV system dc circuits shall be the highest voltage between any two circuit conductors or any conductor and ground. PV system dc circuits on or in one- and two-family dwellings shall be permitted to have a maximum voltage of 600 volts or less. PV system dc circuits on or in other types of buildings shall be permitted to have a maximum voltage of 1000 volts or less. Where not located on or in buildings, listed dc PV equipment, rated at a maximum voltage of 1500 volts or less, shall not be required to comply with Parts II and III of Article 490.

(NEW) 691.10 Arc-Fault Mitigation. PV systems that do not comply with the requirements of 690.11 shall include details of fire mitigation plans to address dc arc-faults in the documentation required in 691.6.

(NEW) 691.1 Scope. This article covers the installation of large-scale PV electric power production facilities with a generating capacity of no less than 5000 kW, and not under exclusive utility control.

(NEW) 691.11 Fence Grounding. Fence grounding requirements and details shall be included in the documentation required in 691.6.

(Revised) 692.1 Scope. This article applies to the installation of fuel cell systems.

(NEW) 700.5 (E) Documentation. The short-circuit current rating of the transfer equipment, based on the specific overcurrent protective device type and settings protecting the transfer equipment, shall be field marked on the exterior of the transfer equipment.
201. The circuit conductors between the dc-to-dc converter source circuit(s) and the inverter or dc utilization equipment best describes what listed term?
A. DC-to-DC Converter Output Circuit
B. Array
C. Bipolar Photovoltaic Array
D. DC-to-DC Converter Source Circuit

202. Where is the short-circuit current rating of transfer equipment required to be field marked?
A. Inside the equipment disconnect
B. On the interior
C. On the exterior
D. On the equipment disconnect

203. What is the minimum distance above the electrical datum plane area is the GFCI protection for a 20-ampere single-phase, 125-volt receptacle required to be installed on a floating building?
A. 24 inches
B. 18 inches
C. 12 inches
D. 30 inches

204. What term best defines a dc PV array that has two outputs, each having opposite polarity to a common reference point or center tap?
A. Bipolar Photovoltaic Array
B. Array
C. DC-to-DC Converter Output Circuit
D. DC-to-DC Converter Source Circuit

205. What are the conductors between an interactive inverter and the service equipment or another electrical power production and distribution network known as?
A. Inverter Output Circuit
B. Generating Capacity
C. Inverter Input Circuit
D. Interactive Inverter Output Circuit

206. What is the maximum PV system dc circuit voltage permitted for a two-family dwelling?
A. 1000
B. 600
C. 240
D. 300

207. What is the sum of parallel-connected inverter maximum continuous output power at 40°C in kilowatts?
A. Inverter Output Circuit
B. Interactive Inverter Output Circuit
C. Inverter Input Circuit
D. Generating Capacity

208. What term best defines the conductors connected to the dc input of an inverter?
A. Generating Capacity
B. Inverter Input Circuit
C. Interactive Inverter Output Circuit
D. Inverter Output Circuit

209. What article applies to the installation of fuel cell systems?
A. 691.6
B. 690.10
C. 690.7
D. 692

210. What are conductors connected to the ac output of an inverter known as?
A. Interactive Inverter Output Circuit
B. Generating Capacity
C. Inverter Output Circuit
D. Inverter Input Circuit

211. What section requires fence grounding requirements and details to be included in the documentation with regards to large-scale PV electric power production facilities?
A. 692
B. 690.10
C. 690.7
D. 691.6

212. At what power output is a PV electric power production facility considered a large-scale PV electric power production facility?
A. 2000 kW
B. 5000 kW
C. 15000 kW
D. 25000 kW
213. How are circuits between dc-to-dc converters and from dc-to-dc converters to the common connection point(s) of the dc system defined in the 2017 code?
   A. Bipolar Photovoltaic Array  
   B. Array  
   C. DC-to-DC Converter Source Circuit  
   D. DC-to-DC Converter Output Circuit

214. What section does a PV system, if not in compliance, require the inclusion of details of fire mitigation plans to address dc arc-faults in the documentation?
   A. 691.6  
   B. 690.10  
   C. 690.7  
   D. 690.11

215. What is a mechanically integrated assembly of module(s) or panel(s) with a support structure and foundation, tracker, and other components, as required, to form a dc or ac power producing unit?
   A. Array  
   B. Bipolar Photovoltaic Array  
   C. DC-to-DC Converter Output Circuit  
   D. DC-to-DC Converter Source Circuit

(Revised) 700.10 (A) Identification. Emergency circuits shall be permanently marked so they will be readily identified as a component of an emergency circuit or system by the following methods:
   (1) All boxes and enclosures (including transfer switches, generators, and power panels) for emergency circuits shall be permanently marked as a component of an emergency circuit or system.
   (2) Where boxes or enclosures are not encountered, exposed cable or raceway systems shall be permanently marked to be identified as a component of an emergency circuit or system, at intervals not to exceed 7.6 m (25 ft). Receptacles supplied from the emergency system shall have a distinctive color or marking on the receptacle cover plates or the receptacles.

(Revised) 700.12 (A) Storage Battery. Storage batteries shall be of suitable rating and capacity to supply and maintain the total load for a minimum period of 1 1/2 hours, without the voltage applied to the load falling below 87 1/2 percent of normal. Automotive-type batteries shall not be used.

702.12 (C) Power Inlets Rated at 100 Amperes or Greater, for Portable Generators. Equipment containing power inlets for the connection of a generator source shall be listed for the intended use. Systems with power inlets shall be equipped with an interlocked disconnecting means.

(Revised) 705.2 Interactive Inverter Output Circuit. The conductors between the interactive inverter and the service equipment or another electric power production source, such as a utility, for electrical production and distribution network.

(Revised) 705.2 Microgrid Interconnect Device (MID). A device that allows a microgrid system to separate from and reconnect to a primary power source.
(Revised) 705.2 Microgrid System. A premises wiring system that has generation, energy storage, and load(s), or any combination thereof, that includes the ability to disconnect from and parallel with the primary source.

(Revised) 705.2 Multimode Inverter. Equipment having the capabilities of both the interactive inverter and the stand-alone inverter.

(NEW) 705.23 Interactive System Disconnecting Means. A readily accessible means shall be provided to disconnect the interactive system from all wiring systems including power systems, energy storage systems, and utilization equipment and its associated premises wiring.

(NEW) 706.1 Scope. This article applies to all permanently installed energy storage systems (ESS) operating at over 50 volts ac or 60 volts dc that may be stand-alone or interactive with other electric power production sources.

(NEW) 706.34 (C) Gas Piping. Gas piping shall not be permitted in dedicated battery rooms.

(Revised) 710.1 Scope. This article covers electric power production sources operating in stand-alone mode.

(NEW) 712.1 Scope. This article applies to direct current microgrids.

### PART 2 EXAM QUESTIONS

216. How often is a cable tray that has emergency circuits required to be labeled as a component of an emergency circuit or system?
   - A. 30 ft
   - B. 10 ft
   - C. 25 ft
   - D. 15 ft

217. What type of storage battery cannot be used for emergency systems?
   - A. Sealed cell
   - B. Automotive-type batteries
   - C. Lead acid
   - D. Nickle-cadmium

218. What are portable generators with power inlets rated at 100 amps or more required to be equipped with?
   - A. Resistor bank
   - B. Fused disconnect
   - C. Current transformers
   - D. Interlocked disconnecting means

219. What term best describes the conductors between the interactive inverter and the service equipment or another electric power production source, such as a utility, for electrical production and distribution networks?
   - A. Microgrid System
   - B. Microgrid Interconnect Device (MID)
   - C. Interactive Inverter Output Circuit
   - D. Multimode Inverter

220. What is a device that allows a microgrid system to separate from and reconnect to a primary power source?
   - A. Interactive Inverter Output Circuit
   - B. Microgrid Interconnect Device (MID)
   - C. Microgrid System
   - D. Multimode Inverter

221. A premises wiring system that has generation, energy storage, and load(s), or any combination thereof, that includes the ability to disconnect from and parallel with the primary source best describes what listed term?
   - A. Microgrid Interconnect Device (MID)
   - B. Interactive Inverter Output Circuit
   - C. Microgrid System
   - D. Multimode Inverter
222. What does the 2017 Code define as equipment having the capabilities of both an interactive inverter and a stand-alone inverter?
   A. Interactive Inverter Output Circuit
   B. Multimode Inverter
   C. Microgrid Interconnect Device (MID)
   D. Microgrid system

223. Where does the disconnect of an interactive system need to be installed?
   A. Within 36 inches of the source
   B. An accessible location
   C. Within 12 inches on the system source
   D. A readily accessible location

224. At what dc voltage are permanently installed energy storage systems that may be stand-alone or interactive with other electric power production sources considered complying with Article 706?
   A. Over 50 dc volts
   B. Over 60 dc volts
   C. 24 dc volts
   D. 36 dc volts and over

225. What type of piping is not allowed in dedicated battery rooms?
   A. Gas piping
   B. Sprinkler piping
   C. Aluminum piping
   D. Galvanized EMT

226. What article applies to electric power production sources operating in stand-alone mode?
   A. 708
   B. 710
   C. 712
   D. 705

227. What new article applies to microgrids in the 2017 code?
   A. 705
   B. 708
   C. 710
   D. 712

(NEW) 712.52 (A) General. Direct-current microgrids shall be grounded in accordance with 250.162

(Revised) 725.179(G) Class 2 and Class 3 Cable Voltage Ratings. Class 2 cables shall have a voltage rating of not less than 150 volts. Class 3 cables shall have a voltage rating of not less than 300 volts. Class 2 and Class 3 cables shall have a temperature rating of not less than 60°C (140°F).

(Revised) 760.176 Listing and Marking of NPLFA Cables. Non-powerlimited fire alarm cables installed as wiring within buildings shall be listed in accordance with 760.176(A) and (B) and as being resistant to the spread of fire in accordance with 760.176(C) through (F), and shall be marked in accordance with 760.176(G). Cable used in a wet location shall be listed for use in wet locations or have a moisture-impervious metal sheath. Non-power-limited fire alarm cables shall have a temperature rating of not less than 60°C (140°F).

(Revised) 770.1 Scope. This article covers the installation of optical fiber cables. This article does not cover the construction of optical fiber cables.

(NEW) 800.3(H) Temperature Limitation of Conductors. Section 310.15(A)(3) shall apply.

(Revised) 800.44 (B) Exception No. 1: Communications wires and cables shall not be required to have a vertical clearance of not less than 2.5 m (8 ft) above auxiliary buildings, such as garages and the like.
(Revised) **800.179 (I) Hybrid Power and Communications Cables.** Listed hybrid power and communications cables shall be permitted where the power cable is a listed Type NM or NM-B, conforming to Part III of Article 334, and the communications cable is a listed Type CM, the jackets on the listed NM or NM-B, and listed CM cables are rated for 600 volts minimum, and the hybrid cable is listed as being resistant to the spread of fire.

(Revised) **800.182 Cable Routing Assemblies and Communications Raceways.** Cable routing assemblies and communications raceways shall be listed in accordance with 800.182(A) through (C). Cable routing assemblies shall be marked in accordance with Table 800.182(a). Communications raceways shall be marked in accordance with Table 800.182(B).

(NEW) **820.110(A)(3) Innerduct for Coaxial Cables.** Listed plenum communications raceways, listed riser communications raceways, and listed general-purpose communications raceways selected in accordance with Table 800.154(b) shall be permitted to be installed as innerduct in any type of listed raceway permitted in Chapter 3.

(Revised) **830.44 (C) Clearance from Ground.** Overhead (aerial) spans of network-powered broadband communications cables shall conform to not less than the following:

1. 2.9 m (9 1/2 ft) — above finished grade, sidewalks, or from any platform or projection from which they might be reached and accessible to pedestrians only
2. 3.5 m (11 1/2 ft) — over residential property and driveways, and those commercial areas not subject to truck traffic
3. 4.7 m (15 1/2 ft) — over public streets, alleys, roads, parking areas subject to truck traffic, driveways on other than residential property, and other land traversed by vehicles such as cultivated, grazing, forest, and orchard

(NEW) **840.3 (F) Other Communications Systems.** As appropriate for the system involved, traditional communications systems shall comply with the requirements of the following:

1. Communications Circuits — Article 800
2. Radio and Television Equipment — Article 810
3. Community Antenna Television and Radio Distribution Systems — Article 820
4. Network-Powered Broadband Communications Systems — Article 830

(NEW) **840.47 (B) Communications Wires and Cables.** Installations of communications wires and multi-pair communications cables shall comply with 800.47.

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**PART 2 EXAM QUESTIONS**

228. What table is required to be referenced to determine how communication raceways are to be marked?

A. 800.182(A)
B. 800.182(B)
C. 800.179 (I)
D. 800.154(b)

229. How far above a residential driveway are an overhead (aerial) span of network-powered broadband communications cables required to be installed?

A. 20 ft
B. 9 1/2 ft
C. 15 1/2 ft
D. 11 1/2 ft
230. What section is required to be referenced to determine the grounding for direct-current microgrids?
A. 250.66
B. 250.122
C. 250.162
D. 250.102(C)

231. What section are multi-pair communications cables required to comply with?
A. 800.47
B. 830.44 (C)
C. 800.154(b)
D. 800.182(B)

232. What is the minimum temperature rating for non-power-limited fire alarm cables?
A. 120°F
B. 60°F
C. 140°F
D. 50°F

233. Above what type of structure do communication cables not have to maintain their minimum vertical clearance?
A. Above roofs
B. Grain silo
C. Industrial crane
D. Garages

234. What does Article 770 not cover?
A. The installation of optical fiber cables
B. The construction of optical fiber cables
C. Overhead spans of optical fiber cables
D. Installation of optical fiber cables above roofs

235. What is a hybrid cable required to be listed as being resistant to?
A. Harmonics
B. Induction
C. Temperature
D. The spread of fire

236. What table allows listed general-purpose communications raceways to be installed as innerduct in any type of listed raceway permitted in Chapter 3?
A. 800.179 (I)
B. 800.182(A)
C. 800.154(b)
D. 800.182(B)

237. What article is radio and television equipment required to comply with?
A. 830
B. 810
C. 820
D. 800

238. How far above a sidewalk are an overhead (aerial) span of network-powered broadband communications cables required to be installed?
A. 20 ft
B. 11 1/2 ft
C. 15 1/2 ft
D. 9 1/2 ft

239. What is the minimum voltage rating for Class 2 cables?
A. 150 volts
B. 300 volts
C. 600 volts
D. 1000 volts

240. What section must be referenced to determine the temperature limitation of conductors used with communication circuits?
A. 310.15(A)(3)
B. 315.15(A)(3)
C. 315.10(A)(2)
D. 310.15(B)(2)