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.
2014 Code Changes • Part 1

The following course will summarize many of the important changes to the NEC code.

The 2014 code has added four new articles as listed below:

(NEW): Article 393. Low-Voltage Suspended Ceiling Power Distribution Systems: These systems are used as a support for a finished ceiling surface and contain a busbar and busbar support system to distribute power to utilization equipment supplied by a Class 2 power supply.

(NEW): Article 646. Modular Data Centers: These contain customizable equipment to provide data center operations that are not always permanently installed.

(NEW): Article 728. Fire-Resistive Cable Systems: These must be installed with very specific materials, requirements, and supports which are crucial for the survivability of life safety circuits.

(NEW): Article 750. Energy Management Systems: These systems provide general requirements and address the types of loads to be controlled through energy management.

(REVISED): 90(A) Practical Safeguarding. The purpose of this Code is the practical safeguarding of persons and property from hazards arising from the use of electricity. This Code is not intended as a design specification or an instruction manual for untrained persons.

Article 100. Definitions:

(NEW): Adjustable Speed Drive. Power conversion equipment that provides a means of adjusting the speed of an electric motor.

(NEW): Informational Note: A variable frequency drive is one type of electronic adjustable speed drive that controls the rotational speed of an ac electric motor by controlling the frequency and voltage of the electrical power supplied to the motor.

(NEW): Adjustable Speed Drive System. A combination of an adjustable speed drive, its associated motor(s), and auxiliary equipment.

(NEW): Battery System. Interconnected battery subsystems consisting of one or more storage batteries and battery chargers, and can include inverters, converters, and associated electrical equipment.

Part 1 Exam Questions:

1. Article ________ should be referenced when installing Low-Voltage Suspended Ceiling Power Distribution Systems.
   A. 646
   B. 343
   C. 393
   D. 750

2. A busbar and busbar support system used to distribute power utilization equipment supplied by a ________ power supply.
   A. All listed answers
   B. Class 1
   C. Class 3
   D. Class 2
3. If you were installing electrical systems for a data center, article _______ should be referenced.
   A. 728  
   B. 646  
   C. 393  
   D. No listed answer

4. When using cable systems for the survivability of life safety circuits, article _______ should be used.
   A. 392  
   B. 393  
   C. 750  
   D. 728

5. Energy management systems should have their systems installed as required by article _______ of the 2014 code.
   A. 728  
   B. 750  
   C. 760  
   D. No listed answer

6. The NEC code _______ intended as a design instruction manual for untrained persons.
   A. Shall be  
   B. Is  
   C. Is not  
   D. No listed answer

7. Power conversion equipment that provides a means of adjusting the speed of an electric motor is known as a _______.
   A. Variable Speed Drive System  
   B. Adjustable Speed Drive System  
   C. Variable speed Drive  
   D. Adjustable Speed Drive

8. A _______ is one type of electronic adjustable speed drive that controls the rotational speed of an ac electric motor by controlling the frequency.
   A. Variable frequency drive  
   B. Adjustable Speed Drive System  
   C. Variable speed Drive  
   D. Variable Speed Drive System

9. A combination of an adjustable speed drive, its associated motor(s), and auxiliary equipment is known as a _______.
   A. Variable speed Drive  
   B. Variable frequency drive  
   C. Adjustable Speed Drive System  
   D. Variable Speed Drive System

10. An interconnected battery subsystem consisting of one or more storage batteries and battery chargers would be defined as a _______.
    A. Capacitor bank  
    B. Battery system  
    C. Induction system  
    D. Hysteresis system

(NEW): **Cable Routing Assembly.** A single channel or connected multiple channels, as well as associated fittings, forming a structural system that is used to support and route communications wires and cables, optical fiber cables, data cables associated with information technology and communications equipment, Class 2 and Class 3 cables, and power-limited fire alarm cables.

(NEW): **Charge Controller.** Equipment that controls dc voltage or dc current, or both, and that is used to charge a battery or other energy storage device.

(NEW): **Communications Raceway.** An enclosed channel of nonmetallic materials designed expressly for holding communications wires and cables, typically communications wires and cables and optical fiber and data (Class 2 and Class 3) in plenum, riser, and general-purpose applications.

(NEW): **Control Circuit.** The circuit of a control apparatus or system that carries the electric signals directing the performance of the controller but does not carry the main power current.
Part 1 Exam Questions:

11. A structural system that is used to support and route communications wires and cables, optical fiber cables, data cables associated with information technology and communications equipment is known as a ________.
   A. All listed answers
   B. Routing Assembly
   C. Routing Cable Assembly
   D. Cable Routing Assembly

12. A ________ is used to charge a battery or other energy storage device.
   A. Battery pack
   B. Charge Controller
   C. Charge System
   D. Rectifier Controller

13. A ________ is an enclosed channel of nonmetallic materials designed expressly for holding communications wires and cables.
   A. Communications Raceway
   B. Din Rail Raceway
   C. Panduit Raceway
   D. ENT Raceway

14. A ________ controls an apparatus or system that carries electric signals directing the performance of a controller and does not carry main power current.
   A. Signal Circuit
   B. Rectifier Circuit
   C. Control circuit
   D. Relay Circuit
15. The definition ________ could be described as the localization of an overcurrent condition to restrict outages to the circuit or equipment affected by the selection and installation of overcurrent protective devices and their ratings or settings.
   A. COPS
   B. Selective Coordination
   C. Darwinian Selection
   D. Coordination Selective

16. An intentional low-impedance conductive path intended to carry current under ground-fault conditions from the point of a ground fault to the electrical supply source is best described as a?
   A. Ground Fault
   B. Effective Ground-Fault Current Path
   C. Grounded, Solidly
   D. Solidly, Grounded

17. Neon tubing is a type of ________.
   A. Resonance Gas Discharge Lighting (RGDL)
   B. Inert Gas Discharge Lighting
   C. Ion Discharge Lighting
   D. Electric-Discharge Lighting

18. A type of fuse depending on the type of control selected may or may not operate in a current-limiting fashion.
   A. Electronically Actuated Fuse
   B. Edison Fuse
   C. Fixed Trip Fuse
   D. Adjustable Trip Fuse

19. A conductive path from the point of a ground fault through the normally non–current-carrying part of an electrical system to the electrical supply source is best described as a?
   A. Effective Ground-Fault Current Path
   B. Ground-Fault Current Path
   C. Ground Fault
   D. Grounded, Solidly

20. A ground-fault current path could be a ________.
   A. Metal Duct
   B. Metallic raceway
   C. All Listed answers
   D. Gas Pipe

(NEW): Hermetic Refrigerant Motor-Compressor. A combination consisting of a compressor and motor, both of which are enclosed in the same housing, with no external shaft or shaft seals, with the motor operating in the refrigerant.

(NEW): Industrial Control Panel: An assembly of two or more components consisting of one of the following: (1) power circuit components only, such as motor controllers, overload relays, fused disconnect switches, and circuit breakers; (2) control circuit components only, such as push buttons, pilot lights, selector switches, timers, switches, and control relays; (3) a combination of power and control circuit components. These components, with associated wiring and terminals, are mounted on, or contained within, an enclosure or mounted on a subpanel. The industrial control panel does not include the controlled equipment.

(NEW): Lighting Track (Track Lighting): A manufactured assembly designed to support and energize luminaires that are capable of being readily repositioned on the track. Its length can be altered by the addition or subtraction of sections of track.

(NEW): Photovoltaic (PV) System: The total components and subsystem that, in combination, convert solar energy into electric energy suitable for connection to a utilization load.

(NEW): Retrofit Kit: A general term for a complete subassembly of parts and devices for field conversion of utilization equipment.

(REVISED): Separately Derived System: An electrical source, other than a service, having no direct connection(s) to circuit conductors of any other electrical source other than those established by grounding and bonding connections.
21. A compressor and motor housed together with the motor operating in the refrigerant would be best defined as a ________.
   A. Hermetic Motor
   B. Hermetic Refrigerant Motor-Compressor
   C. Hermetic Refrigerant Compressor
   D. No listed answers

22. True or False. An industrial control panel must include the controlled equipment or circuitry.
   A. False
   B. True

23. Luminaires that are capable of being readily repositioned on a track would be best defined as ________.
   A. Lighting Rail
   B. Light Rail
   C. Lighting Track
   D. Repositioning Fixtures

24. Solar energy that is converted into electric energy for use in utilization loads is considered a ________.
   A. Fuel Cell System
   B. Solar Cell System
   C. Photovoltaic System
   D. Energy Conversion System

25. The general term used for a complete subassembly of parts and devices for field conversion of utilization equipment would be a ________.
   A. Retro Kit
   B. Retrofit Kit
   C. Sub Assembly kit
   D. Quality Assurance Kit
26. An example of a separately derived system could be a ________.
   A. Photovoltaic System  
   B. Transformer  
   C. Generator  
   D. All listed answers

27. A place through which electric energy is passed for the purpose of distribution and switching would be considered a ________.
   A. Switch Yard  
   B. MCC  
   C. Substation  
   D. Utility

28. A completely enclosed assembly that contains primary power circuit switching, interrupting devices, or both with buses and connections would be considered ________.
   A. Gear  
   B. Switch Panels  
   C. Power Panels  
   D. Switchgear

29. All switchgear subject to NEC requirements is ________ enclosed.
   A. Always  
   B. Metal  
   C. Partially  
   D. Never

30. Part II in Article 100, definitions, applies to equipment operating at ________.
   A. Under 600v  
   B. Over 600v  
   C. Under 575v  
   D. No listed answer

31. A descriptive marking by which an organization responsible for an electrical product is required to be identified on all electrical equipment is referenced in article ________ of the 2014 code.
   A. 110.22 (A)  
   B. 110.21 (B)  
   C. 110.21 (C)  
   D. 110.21 (A)

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

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

   Informational Note: ANSI Z535.4-2011, Product Safety Signs and Labels, provides guidelines for suitable font sizes, words, colors, symbols, and location requirements for labels.

(2) The label shall be permanently affixed to the equipment or wiring method and shall not be hand written.

   Exception to (2): Portions of labels or markings that are variable, or that could be subject to changes, shall be permitted to be hand written and shall be legible.

(3) The label shall be of sufficient durability to withstand the environment involved.

(NEW): 110.25 Lockable Disconnecting Means: Where a disconnecting means is required to be lockable open elsewhere in this Code, it shall be capable of being locked in the open position. The provisions for locking shall remain in place with or without the lock installed.

(NEW): 110.26 (E) (2) Outdoor. Outdoor installations shall comply with 110.26(E) (2)(a) and (b).

   (a) Installation Requirements. Outdoor electrical equipment shall be installed in suitable enclosures and shall be protected from accidental contact by unauthorized personnel, or by vehicular traffic, or by accidental spillage or
leakage from piping systems. The working clearance space shall include the zone described in 110.26(A). No architectural appurtenance or other equipment shall be located in this zone.

(b) Dedicated Equipment Space. The space equal to the width and depth of the equipment, and extending from grade to a height of 1.8 m (6 ft) above the equipment, shall be dedicated to the electrical installation. No piping or other equipment foreign to the electrical installation shall be located in this zone. Exception: Cord-and-plug connection locking provisions shall not be required to remain in place without the lock installed.

(New): 110.27 Guarding of Live Parts. (A) (4) Live Parts are required to be guarded against accidental contact by the elevation above the floor or other working surface as shown in (a) or (b) below:

a. A minimum of 2.5 m (8 ft) for 50 to 300 volts
b. A minimum of 2.6 m (8 1⁄2 ft) for 301 to 600 volts

(NEW/REVISED): 200.4 Neutral conductors shall be installed in accordance with 200.4(A) and (B). (A) Installation. Neutral conductors shall not be used for more than one branch circuit, for more than one multiwire branch circuit, or for more than one set of ungrounded feeder conductors unless specifically permitted elsewhere in this Code.

(B) Multiple Circuits. Where more than one neutral conductor associated with different circuits is in an enclosure, grounded circuit conductors of each circuit shall be identified or grouped to correspond with the ungrounded circuit conductor(s) by wire markers, cable ties, or similar means in at least one location within the enclosure.

Exception No. 1: The requirement for grouping or identifying shall not apply if the branch-circuit or feeder conductors enter from a cable or a raceway unique to the circuit that makes the grouping obvious.

Exception No. 2: The requirement for grouping or identifying shall not apply where branch-circuit conductors pass through a box or conduit body without a loop as described in 314.16(B)(1) or without a splice or termination.

(NEW): 210.5 (C) (2) Branch Circuits Supplied From Direct-Current Systems. Where a branch circuit is supplied from a dc system operating at more than 50 volts, each ungrounded conductor of 4 AWG or larger shall be identified by polarity at all termination, connection, and splice points by marking tape, tagging, or other approved means; each ungrounded conductor of 6 AWG or smaller shall be identified by polarity at all termination, connection, and splice points in compliance with 210.5(C)(2)(a) and (b). The identification methods utilized for conductors originating within each branchcircuit panelboard or similar branch-circuit distribution equipment shall be documented in a manner that is readily available or shall be permanently posted at each branchcircuit panelboard or similar branch-circuit distribution equipment.

(a) Positive Polarity, Sizes 6 AWG or Smaller. Where the positive polarity of a dc system does not serve as the connection point for the grounded conductor, each positive ungrounded conductor shall be identified by one of the following means:

(1) A continuous red outer finish
(2) A continuous red stripe durably marked along the conductor’s entire length on insulation of a color other than green, white, gray, or black
32. A hazard sign applied in the field located on a piece of equipment is required to use _____ to identify the hazard.
   A. Colors
   B. Symbols
   C. Words
   D. All listed answers

33. True or False, at no time is a field applied equipment hazard label allowed to be hand written.
   A. True
   B. False

34. A field applied warning label is required to be of sufficient durability to withstand the ________ involved.
   A. Temperature
   B. Environment
   C. Location
   D. All listed answers

35. What 2014 code section requires that where a disconnecting means is required to be lockable elsewhere in this Code, it shall be capable of being locked in the open position?
   A. 240.36 (B)
   B. 110.24 (A)
   C. 110.25
   D. 100.25

36. Outdoor electrical equipment is required to be installed and protected from accidental contact by ________.
   A. Piping systems
   B. Vehicular traffic
   C. Accidental spillage
   D. All listed answers

37. The 2014 code requires that from grade to a height of ________ above electrical equipment, it shall be dedicated for the electrical installation.
   A. 18”
   B. 24”
   C. 6’
   D. 7’

38. Live parts are required to be guarded against accidental contact for a 240 circuit to a minimum height of ________.
   A. 8 1/2’
   B. 8’
   C. 6’ 8”
   D. 72”

39. Live parts are required to be guarded against accidental contact for a 480 circuit to a minimum height of ________.
   A. 6’ 8”
   B. 8’
   C. 8 1/2’
   D. 72”

40. As a general rule, would it be acceptable or a violation of this code to have 1 neutral conductor for 2 multiwire branch circuit conductors?
   A. Violation
   B. Acceptable

(3) Imprinted plus signs (+) or the word POSITIVE or POS durably marked on insulation of a color other than green, white, gray, or black, and repeated at intervals not exceeding 610 mm (24 in.) in accordance with 310.120(B)

(b) Negative Polarity, Sizes 6 AWG or Smaller. Where the negative polarity of a dc system does not serve as the connection point for the grounded conductor, each negative ungrounded conductor shall be identified by one of the following means:
   (1) A continuous black outer finish
   (2) A continuous black stripe durably marked along the conductor’s entire length on insulation of a color other than green, white, gray, or red
   (3) Imprinted minus signs (−) or the word NEGATIVE or NEG durably marked on insulation of a color other than green, white, gray, or red, and repeated at intervals not exceeding 610 mm (24 in.) in accordance with 310.120(B)
41. If more than one neutral conductor and its phase conductors share an enclosure with different circuits, the grounded circuit conductors of each circuit are required to be ________.
   A. White with a yellow stripe
   B. Listed
   C. Identified
   D. All listed answers

42. When multiple neutrals share the same enclosure, they are required to be ________ with their corresponding phase conductors.
   A. Listed
   B. Grouped
   C. Marked white with a black stripe
   D. Marked the same

43. If a branch circuit is supplied from a dc system operating at more than ________ volts, each ungrounded conductor is required to be identified by polarity.
   A. 24
   B. 40
   C. 50
   D. 12

44. If a conductor is 6 AWG and smaller serving a DC branch circuit, the positive conductor is required to be_______ in color or have a ________ continuous stripe down its entire length.
   A. Yellow, Gray
   B. Blue, Yellow
   C. Orange, Red
   D. Red, Red

45. If a conductor is 6 AWG and smaller serving a DC branch circuit, the negative conductor is required to be_______ in color or have a ________ continuous stripe down its entire length.
   A. Black, Red
   B. Red, Black
   C. Black, Black
   D. Yellow, Red

46. True or False, DC systems operating at over 50 volts are not required to indicate polarity markings so long as they are phased.
   A. False
   B. True

(NEW): 210.8 (D) Kitchen Dishwasher Branch Circuit. The 2014 Code added this section to 210.8. GFCI protection shall be provided for outlets that supply dishwashers installed in dwelling unit locations.

(NEW): 210.12 Arc-Fault Circuit-Interrupter Protection. Arcfault circuit-interrupter protection shall be provided as required in 210.12(A) (B), and (C). The arc-fault circuit interrupter shall be installed in a readily accessible location.


(A) Dwelling Units. All 120-volt, single-phase, 15- and 20-ampere branch circuits supplying outlets or devices installed in dwelling unit kitchens, family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, laundry areas, or similar rooms or areas shall be protected by any of the means described in 210.12(A)(1) through (6):

(1) A listed combination-type arc-fault circuit interrupter, installed to provide protection of the entire branch circuit.

(2) A listed branch/feeder-type AFCI installed at the origin of the branch-circuit in combination with a listed outlet branch-circuit type arc-fault circuit interrupter installed at the first outlet box on the branch circuit. The first outlet box in the branch circuit shall be marked to indicate that it is the first outlet of the circuit.

(3) A listed supplemental arc protection circuit breaker installed at the origin of the branch circuit in combination with a listed outlet branch-circuit type arc-fault circuit interrupter installed at the first outlet box on the branch circuit where all of the following conditions are met:
a. The branch-circuit wiring shall be continuous from the branch-circuit overcurrent device to the outlet branch-circuit arc-fault circuit interrupter.

b. The maximum length of the branch-circuit wiring from the branch-circuit overcurrent device to the first outlet shall not exceed 15.2 m (50 ft) for a 14 AWG conductor or 21.3 m (70 ft) for a 12 AWG conductor.

c. The first outlet box in the branch circuit shall be marked to indicate that it is the first outlet of the circuit.

(4) A listed outlet branch-circuit type arc-fault circuit interrupter installed at the first outlet on the branch circuit in combination with a listed branch-circuit overcurrent protective device where all of the following conditions are met:

a. The branch-circuit wiring shall be continuous from the branch-circuit overcurrent device to the outlet branch-circuit arc-fault circuit interrupter.

b. The maximum length of the branch-circuit wiring from the branch-circuit overcurrent device to the first outlet shall not exceed 15.2 m (50 ft) for a 14 AWG conductor or 21.3 m (70 ft) for a 12 AWG conductor.

c. The first outlet box in the branch circuit shall be marked to indicate that it is the first outlet of the circuit.

d. The combination of the branch-circuit overcurrent device and outlet branch-circuit AFCI shall be identified as meeting the requirements for a system combination–type AFCI and shall be listed as such.

(5) If RMC, IMC, EMT, Type MC, or steel-armored Type AC cables meeting the requirements of 250.118, metal wireways, metal auxiliary gutters, and metal outlet and junction boxes are installed for the portion of the branch circuit between the branch-circuit overcurrent device and the first outlet, it shall be permitted to install a listed outlet branch-circuit type AFCI at the first outlet to provide protection for the remaining portion of the branch circuit.

(6) Where a listed metal or nonmetallic conduit or tubing or Type MC cable is encased in not less than 50 mm (2 in.) of concrete for the portion of the branch circuit between the branch-circuit overcurrent device and the first outlet, it shall be permitted to install a listed outlet branch-circuit type AFCI at the first outlet to provide protection for the remaining portion of the branch circuit.

(REVISED): 210.12 Arc-Fault Circuit-Interrupter Protection (C) Dormitory Units. All 120-volt, single-phase, 15- and 20-ampere branch circuits supplying outlets installed in dormitory unit bedrooms, living rooms, hallways, closets, and similar rooms shall be protected by a listed arc-fault circuit interrupter meeting the requirements of 210.12(A)(1) through (6) as appropriate.

(NEW): 210.13 Ground-Fault Protection of Equipment. Each branch-circuit disconnect rated 1000 A or more and installed on solidly grounded wye electrical systems of more than 150 volts to ground, but not exceeding 600 volts phase-to-phase, shall be provided with ground-fault protection of equipment in accordance with the provisions of 230.95.

(NEW): 210.17 Electric Vehicle Branch Circuit. An outlet(s) installed for the purpose of charging electric vehicles shall be supplied by a separate branch circuit. This circuit shall have no other outlets.

(NEW): 210.22 Permissible Loads, Individual Branch Circuits. An individual branch circuit shall be permitted to supply any load for which it is rated, but in no case shall the load exceed the branch-circuit ampere rating.
47. The 2014 Code requires all dish washer outlets to be.
   A. Water proof
   B. AFCI protected
   C. GFCI protected
   D. Weather proof

48. An ARC fault circuit interrupter is required to be instated where it is?
   A. Accessible
   B. Readily accessible
   C. Convenient
   D. No requirement

49. True or False, the 2014 Code requires Laundry facilities to be Arc Fault protected.
   A. True
   B. False

50. A listed ________ arc-fault circuit interrupter is to provide protection for the entire branch circuit.
   A. All listed answers
   B. Rated
   C. Engineered
   D. Combination-type

51. What is the maximum length in feet allowed by the 2014 code when using 14 AWG wire to the first outlet box from the breaker if installing an AFCI?
   A. 60
   B. 70
   C. 50
   D. No limit

52. AFCI protection is permitted to be provided in one of ______ ways or methods.
   A. 5
   B. 6
   C. 12
   D. 8

53. What is the maximum length allowed by the 2014 code when using 12 AWG wire to the first outlet box from the breaker if installing an AFCI?
   A. 65
   B. 50
   C. 75
   D. 70

54. If using a _____ system, the first outlet is allowed to protect the rest of the branch when using an AFCI outlet.
   A. Newly Installed
   B. Assured Grounding
   C. Equipment Grounding
   D. Metal wireway

55. If using MC cable encased in at least ________ of concrete, it can be used to feed the first AFCI receptacle and provide protection for the rest of the branch.
   A. 4”
   B. 2”
   C. 6”
   D. 3”

56. True or false, only metal raceway systems and cables are allowed to protect an AFCI circuit to the first box from its breaker.
   A. True
   B. False

57. The 2014 Code requires that_______ also are required to have AFCI protection installed in specific area.
   A. Warehouses
   B. Hospitals
   C. Dormitory’s
   D. All Listed answers

58. A branch-circuit disconnect rated 1000 A or more and installed on solidly grounded wye electrical system is required to have ________ of equipment.
   A. Ground-fault protection
   B. Arc-Fault Circuit-Interrupter Protection
   C. No protection required
   D. Both A and B

59. An Electric Vehicle Branch Circuit is required to be______.
   A. Dedicated
   B. Isolated
   C. Engineered
   D. Submitted for plan review

60. An individual Branch circuit load is not allowed to exceed the branch-circuit ________ rating.
   A. Voltage
   B. Ampere
   C. Wattage
   D. All listed answers
(NEW): 210.64 Electrical Service Areas. At least one 125-volt, single-phase, 15- or 20-ampere-rated receptacle outlet shall be installed within 15 m (50 ft) of the electrical service equipment.


(1) General. Feeder conductors shall have an ampacity not less than required to supply the load as calculated in Parts III, IV, and V of Article 220. Conductors shall be sized to carry not less than the larger of 215.2(A)(1)(a) or (b).

(a) Where a feeder supplies continuous loads or any combination of continuous and non-continuous loads, the minimum feeder conductor size shall have an allowable ampacity not less than the non-continuous load plus 125 percent of the continuous load.

(b) The minimum feeder conductor size shall have an allowable ampacity not less than the maximum load to be served after the application of any adjustment or correction factors.

(NEW): 215.12 Identification for Feeders (C)(2)(a) and (b).

(2) Feeders Supplied from Direct-Current Systems. Where a feeder is supplied from a dc system operating at more than 50 volts, each ungrounded conductor of 4 AWG or larger shall be identified by polarity at all termination, connection, and splice points by marking tape, tagging, or other approved means; each ungrounded conductor of 6 AWG or smaller shall be identified by polarity at all termination, connection, and splice points in compliance with 215.12(C)(2)(a) and (b). The identification methods utilized for conductors originating within each feeder panelboard or similar feeder distribution equipment shall be documented in a manner that is readily available or shall be permanently posted at each feeder panelboard or similar feeder distribution equipment.

(a) Positive Polarity, Sizes 6 AWG or Smaller. Where the positive polarity of a dc system does not serve as the connection for the grounded conductor, each positive ungrounded conductor shall be identified by one of the following means:

(1) A continuous red outer finish

(2) A continuous red stripe durably marked along the conductor’s entire length on insulation of a color other than green, white, gray, or black

(3) Imprinted plus signs (+) or the word POSITIVE or POS durably marked on insulation of a color other than green, white, gray, or black, and repeated at intervals not exceeding 610 mm (24 in.) in accordance with 310.120(B)

(b) Negative Polarity, Sizes 6 AWG or Smaller. Where the negative polarity of a dc system does not serve as the connection for the grounded conductor, each negative ungrounded conductor shall be identified by one of the following means:

(1) A continuous black outer finish

(2) A continuous black stripe durably marked along the conductor’s entire length on insulation of a color other than green, white, gray, or red

(3) Imprinted minus signs (−) or the word NEGATIVE or NEG durably marked on insulation of a color other than green, white, gray, or red, and repeated at intervals not exceeding 610 mm (24 in.) in accordance with 310.120(B)
220.12 Lighting Load for Specified Occupancies. The 2014 has added an exception for calculating lighting loads based on energy codes.

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

(1) A power monitoring system is installed that will provide continuous information regarding the total general lighting load of the building.

(2) The power monitoring system will be set with alarm values to alert the building owner or manager if the lighting load exceeds the values set by the energy code.

(3) The demand factors specified in 220.42 are not applied to the general lighting load.

(NEW): 225.11 Feeder and Branch-Circuit Conductors Entering, Exiting, or Attached to Buildings or Structures.
Feeder and branch-circuit conductors entering or exiting buildings or structures shall be in installed in accordance with the requirements of 230.52. Overhead branch circuits and feeders attached to buildings or structures shall be installed in accordance with the requirements of 230.54.

(REVISED): 225.17 Masts as Supports (A) and (B). Only feeder or branch-circuit conductors specified within this section shall be permitted to be attached to the feeder and/or branch-circuit mast. Masts used for the support of final spans of feeders or branch circuits shall be installed in accordance with 225.17(A) and (B).

(A) Strength. The mast shall be of adequate strength or be supported by braces or guys to withstand safely the strain imposed by the overhead feeder or branch-circuit conductors. Hubs intended for use with a conduit that serves as a mast for support of feeder or branch-circuit conductors shall be identified for use with a mast.

(B) Attachment. Feeder and/or branch-circuit conductors shall not be attached to a mast between a weatherhead or the end of the conduit and a coupling where the coupling is located above the last point of securement to the building or other structure or is located above the building or other structure.

(REVISED): 225.36 Type. The disconnecting means specified in 225.31 shall be comprised of a circuit breaker, molded case switch, general-use switch, snap switch, or other approved means. Where applied in accordance with 250.32(B), Exception, the disconnecting means shall be suitable for use as service equipment. Section 225.31 simply states that a means shall be provided for disconnecting all ungrounded conductors that supply or pass through the building or structure.

Part 1 Exam Questions:

61. The 2014 code requires at least one receptacle to be installed within ________ of the electrical service equipment.
   A. No limit
   B. 25 ft.
   C. 15 ft.
   D. 50 ft.

62. The minimum feeder conductor size is required to have an allowable ampacity not less than the non-continuous load plus ________ percent of the continuous load.
   A. 100
   B. 125
   C. 95
   D. 115
63. After all the adjustment correction factors for determining the minimum conductor feeder size have been done, the ________ feeder conductor size shall not be less than the maximum load to be served.
   A. The lesser
   B. Maximum
   C. Minimum
   D. No listed answer

64. If a feeder is supplied from a dc system operating at more than ________ volts, each ungrounded conductor is required to be identified by polarity.
   A. 24
   B. 40
   C. 50
   D. 12

65. If a conductor is 6 AWG and smaller serving a DC feeder, the positive conductor is required to be ________ in color or have a ________ continuous stripe down its entire length.
   A. Red, Red
   B. Blue, Yellow
   C. Orange, Red
   D. Yellow, Gray

66. If a conductor is 6 AWG and smaller serving a DC feeder, the negative conductor is required to be ________ in color or have a ________ continuous stripe down its entire length.
   A. Black, Red
   B. Red, Black
   C. Black, Black
   D. Yellow, Red

67. True or False, DC feeders operating at over 50 volts are required to indicate polarity markings so long as they are phase.
   A. True
   B. False

68. How many conditions must be met by the 2014 code to use the article 220.12 exception?
   A. 5
   B. 2
   C. 3
   D. 4

69. If installing new feeders that exit the building you’re in, the 2014 code requires the provisions of ________ be used.
   A. 225.12
   B. 230.54
   C. 225.10
   D. 230.52

70. If installing overhead feeders that attach to a building, the 2014 code requires using ________.
   A. 225.12
   B. 230.52
   C. 230.54
   D. 225.10

71. Masts used for the support of final spans of feeders or branch circuits are required to be be installed in accordance with ________.
   A. 225.17(A) and (B)
   B. 225.11(A) and (B)
   C. 225.15(A) and (B)
   D. 225.11(B) and (C)

72. A feeder ________ be attached to a mast between a weather head or the end of the conduit and a coupling where the coupling is located above the last point of securement to the building.
   A. Can
   B. Shall
   C. Shall not
   D. Must

73. Hubs used with conduit that serves as a mast for support of feeder or branch-circuit conductors is required to be ________ for use with a mast.
   A. All listed answers
   B. A single assembly
   C. A listed assembly
   D. Identified

74. Would using a snap switch to disconnect all ungrounded conductors be considered acceptable or a violation on this code for use with service equipment?
   A. Violation
   B. Acceptable
(REVISED): 225.52 Disconnecting Means. (A) Location. A building or structure disconnecting means shall be located in accordance with 225.32, or, if not readily accessible, it shall be operable by mechanical linkage from a readily accessible point. For multibuilding industrial installations under single management, it shall be permitted to be electrically operated by a readily accessible, remote-control device in a separate building or structure.

(REVISED): 225.56 Inspections and Tests. (A) Pre-Energization and Operating Tests. The complete electrical system design, including settings for protective, switching, and control circuits, shall be prepared in advance and made available on request to the authority having jurisdiction and shall be performance tested when first installed on-site. Each protective, switching, and control circuit shall be adjusted in accordance with the system design and tested by actual operation using current injection or equivalent methods as necessary to ensure that each and every such circuit operates correctly to the satisfaction of the authority having jurisdiction.

(REVISED): 230.6 (5) Conductors Considered Outside the Building. Where installed within rigid metal conduit (Type RMC) or intermediate metal conduit (Type IMC) used to accommodate the clearance requirements in 230.24 and routed directly through an eave but not a wall of a building.

(REVISED): 230.24 Clearances. Overhead service conductors shall not be readily accessible and shall comply with 230.24(A) through (E) for services not over 1000 volts, nominal.

(REVISED): 230.26 Point of Attachment. The point of attachment of the overhead service conductors to a building or other structure shall provide the minimum clearances as specified in 230.9 and 230.24. In no case shall this point of attachment be less than 3.0 m (10 ft) above finished grade.

(REVISED): 230.28 Service Masts as Supports. Only power service drop or overhead service conductors shall be permitted to be attached to a service mast. Service masts used for the support of service-drop or overhead service conductors shall be installed in accordance with 230.28(A) and (B).

(A) Strength. The service mast shall be of adequate strength or be supported by braces or guys to withstand safely the strain imposed by the service-drop or overhead service conductors. Hubs intended for use with a conduit that serves as a service mast shall be identified for use with service-entrance equipment.

(B) Attachment. Service-drop or overhead service conductors shall not be attached to a service mast between a weatherhead or the end of the conduit and a coupling, where the coupling is located above the last point of securement to the building or other structure or is located above the building or other structure.

(NEW): 230.30 Installation (B) Wiring Methods. Underground service conductors shall be installed in accordance with the applicable requirements of this Code covering the type of wiring method used and shall be limited to the following methods:

1. Type RMC conduit
2. Type IMC conduit
3. Type NUCC conduit
4. Type HDPE conduit
5. Type PVC conduit
6. Type RTRC conduit
7. Type IGS cable
8. Type USE conductors or cables
9. Type MV or Type MC cable identified for direct burial applications
10. Type MI cable, where suitably protected against physical damage and corrosive conditions
75. If a disconnect is not installed in a readily accessible location, then ______ must be provided making it operable from a readily accessible point.
   A. Electrical motors
   B. Mechanical linkage
   C. Servos
   D. All listed answers

76. For industrial installations under single management, a disconnect is permitted to be electrically operated by a readily accessible, ______ device in a separate building or structure.
   A. Remote-control
   B. Relay
   C. Repeater
   D. Solenoid

77. A complete electrical system design, including settings for protective switching and control circuits is required to be prepared in advance and made available on request to the ______.
   A. Owner
   B. GC
   C. Building Codes Division
   D. Authority having jurisdiction

78. Each disconnect and control circuit is required to be adjusted in accordance with the system design and tested by ______ using current injection.
   A. A soft start
   B. Simulation
   C. Actual operation
   D. The program

79. True or False, Service conductors are considered outside a building if installed in RMC and installed on the wall of a building.
   A. False
   B. True

80. Service conductors installed overhead are not required to be readily accessible if not operating over ______.
   A. 600
   B. 1000
   C. 300
   D. 240

81. The point of attachment for overhead service conductors to a building shall be no less than ______ above finish grade.
   A. 10'
   B. 12'
   C. 15'
   D. 25'

82. Only power drop/overhead service conductors are allowed to be attached to the ______.
   A. Service mast
   B. Service Pole
   C. Eve
   D. Guy wire

83. What 2014 code section gives the installation requirements for installing service masts as supports?
   A. 230.26
   B. 230.31
   C. 230.28
   D. 240.32

84. How many requirements does the 2014 code require when installing service masts as supports.
   A. 4
   B. 1
   C. 3
   D. 2

85. If using hubs and conduit when installing a service mast, the hubs are required to be identified for use with ______.
   A. Service Conductors
   B. Service-entrance equipment
   C. Service Raceway systems
   D. All listed answers

86. Overhead service conductors ______ be attached to a service mast between a weatherhead or the end of the conduit and coupling.
   A. Must
   B. Will
   C. Shall not
   D. Will
87. Type _______ cable can be used as underground service conductors if protected against corrosive conditions and physical damage.

A. MI
B. MV
C. MC
D. All listed answers

88. Would it be considered acceptable or a violation of this code to use Intermediate Metal Conduit as a raceway for service conductors if buried directly in the ground?

A. Acceptable
B. Violation

(REvised): 230.44 Cable Trays. The code requires cable trays with service entrance conductors to be identified with permanently affixed labels with the wording “Service-Entrance Conductors.” The labels shall be located so as to be visible after installation with a spacing not to exceed 3 m (10 ft) so that the service-entrance conductors are able to be readily traced through the entire length of the cable tray.

(REvised): 230.82 Equipment Connected to the Supply Side of Service Disconnect. (3) Meter disconnect switches nominally rated not in excess of 1000 V that have a short-circuit current rating equal to or greater than the available short-circuit current, provided that all metal housings and service enclosures are grounded in accordance with Part VII and bonded in accordance with Part V of Article 250. A meter disconnect switch shall be capable of interrupting the load served. A meter disconnect shall be legibly field marked on its exterior in a manner suitable for the environment as follows:

METER DISCONNECT
NOT SERVICE EQUIPMENT

230.208 Protection Requirements. (B) Enclosed Overcurrent Devices. The restriction to 80 percent of the rating for an enclosed overcurrent device for continuous loads shall not apply to overcurrent devices installed in systems operating at over 1000 volts.

(REvised): 230.212 Over 35,000 Volts. Where the voltage exceeds 35,000 volts between conductors that enter a building, they shall terminate in a switchgear compartment or a vault conforming to the requirements of 450.41 through 450.48.

(REvised): 240.1 Scope. Parts I through VII of this article provide the general requirements for overcurrent protection and overcurrent protective devices not more than 1000 volts, nominal. Part VIII covers overcurrent protection for those portions of supervised industrial installations operating at voltages of not more than 1000 volts, nominal. Part IX covers overcurrent protection over 1000 volts, nominal.

(REvised): 240.87 Arc Energy Reduction. Where the highest continuous current trip setting for which the actual overcurrent device installed in a circuit breaker is rated or can be adjusted is 1200 A or higher, 240.87(A) and (B) shall apply.

(A) Documentation. Documentation shall be available to those authorized to design, install, operate, or inspect the installation as to the location of the circuit breaker(s).

(B) Method to Reduce Clearing Time. One of the following or approved equivalent means shall be provided:

(1) Zone-selective interlocking
(2) Differential relaying
(3) Energy-reducing maintenance switching with local status indicator
(4) Energy-reducing active arc flash mitigation system
(5) An approved equivalent means

(NEW): 240.87 Informational Note No. 2: An energy-reducing active arc flash mitigation system helps in reducing arcing duration in the electrical distribution system.
system. No change in the circuit breaker or the settings of other devices is required during maintenance when a worker is working within an arc flash boundary as defined in NFPA 70E-2012, Standard for Electrical Safety in the Workplace.

(REVISED): 250.10 Protection of Ground Clamps and Fittings. Ground clamps or other fittings exposed to physical damage shall be enclosed in metal, wood, or equivalent protective covering.

Part 1 Exam Questions:

89. If installing cable tray Service-Entrance conductors labels on a cable tray system, the labels can be placed no further than ________ apart.
   A. 25 ft.
   B. 15 ft.
   C. 20 ft.
   D. 10 ft.

90. What is the maximum voltage rating of a meter disconnect switch that will comply with article 230.82?
   A. 300V
   B. 600V
   C. 1000V
   D. 575V

91. The metal housing of a service enclosure is required to be grounded in accordance with Part ________ of article 250.
   A. V
   B. VII
   C. IV
   D. III

92. The metal housing of a service enclosure is required to be bonded in accordance with Part ________ of article 250.
   A. III
   B. VII
   C. IV
   D. V

93. A meter disconnect is required to be legibly field marked on its ________ in a manner suitable for the environment.
   A. Load Side
   B. Interior
   C. Exterior
   D. Line Side

94. A meter disconnect is required to be marked with the words ________.
   A. METER DISCONNECT NOT SERVICE EQUIPMENT
   B. METER NOT SERVICE EQUIPMENT
   C. METER DISCONNECT FOR SERVICE EQUIPMENT
   D. METER DISCONNECT SERVICE EQUIPMENT

95. The 80 percent restriction rule does not apply for an enclosed overcurrent device with continuous loads operating at over ________.
   A. 600
   B. 240
   C. 1000
   D. 575

96. If the voltage exceeds ________ volts between conductors and enter a building, they are required to terminate in a switchgear compartment or vault.
   A. 35,000
   B. 1000
   C. 600
   D. 300

97. This article provides the general requirements for overcurrent protection and overcurrent devices not operating over 1000 volts.
   A. 250
   B. 230
   C. 225
   D. 240

98. What part of article 240 covers overcurrent protection for supervised industrial installations not operating at over 1000 volts?
   A. VII
   B. XI
   C. VIII
   D. IV
### Question 99
What part of article 240 covers overcurrent protection for systems operating at over 1000 volts?

- A. XI
- B. IX
- C. V
- D. IV

### Question 100
The highest continuous current trip setting of _______ A or higher is specifically addressed in 240.87.

- A. 1200
- B. 600
- C. 800
- D. 2000

### Question 101
How many requirements does the 2014 code require with regards to arc energy reduction?

- A. 3
- B. 7
- C. 5
- D. 2

### Question 102
An _______ helps reduce arcing duration in an electrical distribution system.

- A. Energy active arc flash mitigation reducing system
- B. Energy-reducing active arc flash mitigation system
- C. Energy active arc flash mitigation system
- D. Energy-reducing arc flash mitigation system

### Question 103
A ground clamp exposed to physical damage can be protected by a _______ encasement.

- A. Wood
- B. Metal
- C. All listed answers
- D. Fiberglass

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(REVISED): 250.21 Alternating-Current Systems of 50 Volts to 1000 Volts Not Required to Be Grounded (C) Marking. Ungrounded systems shall be legibly marked “Caution: Ungrounded System Operating — _____ Volts Between Conductors” at the source or first disconnecting means of the system. The marking shall be of sufficient durability to withstand the environment involved.

(REVISED): 250.24 Grounding Service-Supplied Alternating-Current Systems. (A)(1) General. The grounding electrode conductor connection shall be made at any accessible point from the load end of the overhead service conductors, service drop, underground service conductors, or service lateral to, including the terminal or bus to which the grounded service conductor is connected at the service disconnecting means.


(REVISED): 250.24 Grounding Service-Supplied Alternating-Current Systems. (E) Ungrounded System Grounding Connections. A premises wiring system that is supplied by an ac service that is ungrounded shall have, at each service, a grounding electrode conductor connected to the grounding electrode(s) required by Part III of this article. The grounding electrode conductor shall be connected to a metal enclosure of the service conductors at any accessible point from the load end of the overhead service conductors, service drop, underground service conductors, or service lateral to the service disconnecting means.

(REVISED): 250.30 Grounding Separately Derived Alternating-Current Systems. In addition to complying with 250.30(A) for grounded systems, or as provided in 250.30(B) for ungrounded systems, separately derived systems shall comply with 250.20, 250.21, 250.22, or 250.26, as applicable. Multiple separately derived systems that are connected in parallel shall be installed in accordance with 250.30.

(REVISED): 250.36 High-Impedance Grounded Neutral Systems. (F) Grounding Electrode Conductor Connection Location. For services or separately derived systems, the grounding electrode conductor shall be connected
at any point from the grounded side of the grounding impedance to the equipment grounding connection at the service equipment or the first system disconnecting means of a separately derived system.

(REVISIED): 250.62 Grounding Electrode Conductor Material. The grounding electrode conductor shall be of copper, aluminum, copper-clad aluminum, or the items as permitted in 250.68(C). The material selected shall be resistant to any corrosive condition existing at the installation or shall be protected against corrosion. Conductors of the wire type shall be solid or stranded, insulated, covered, or bare.

(REVISIED): 250.64 Grounding Electrode Conductor Installation. (D) Building or Structure with Multiple Disconnecting Means in Separate Enclosures. For a service or feeder with two or more disconnecting means in separate enclosures supplying a building or structure, the grounding electrode connections shall be made in accordance with 250.64(D)(1), (D)(2), or (D)(3).

(REVISIED): 250.64 Grounding Electrode Conductor Installation. (D)(1) Common Grounding Electrode Conductor and Taps. A common grounding electrode conductor and grounding electrode conductor taps shall be installed. The common grounding electrode conductor shall be sized in accordance with 250.66, based on the sum of the circular mil area of the largest ungrounded conductor(s) of each set of conductors that supplies the disconnecting means. If the service-entrance conductors connect directly to the overhead service conductors, service drop, underground service conductors, or service lateral, the common grounding electrode conductor shall be sized in accordance with Table 250.66, note 1. A grounding electrode conductor tap shall extend to the inside of each disconnecting means enclosure. The grounding electrode conductor taps shall be sized in accordance with 250.66 for the largest service-entrance or feeder conductor serving the individual enclosure. The tap conductors shall be connected to the common grounding electrode conductor by one of the following methods in such a manner that the common grounding electrode conductor remains without a splice or joint:

(1) Exothermic welding.
(2) Connectors listed as grounding and bonding equipment.
(3) Connections to an aluminum or copper busbar not less than 6 mm thick × 50 mm wide (1/4 in. thick × 2 in. wide) and of sufficient length to accommodate the number of terminations necessary for the installation. The busbar shall be securely fastened and shall be installed in an accessible location. Connections shall be made by a listed connector or by the exothermic welding process. If aluminum busbars are used, the installation shall comply with 250.64(A).

Part 1 Exam Questions:

104. Ungrounded systems are required to be legibly marked ______ at the source or first disconnecting means of the system.
   A. “Caution: Ungrounded System Operating — _____ Volts Per Conductor”
   B. “Caution: Ungrounded System With — _____ Volts Between Conductors”
   C. “Caution: System Operating — _____ Volts Between Conductors”
   D. “Caution: Ungrounded System Operating — _____ Volts Between Conductors”

105. A grounding electrode conductor connection is required to be made so it is ________.
   A. Accessible
   B. Readily accessible
   C. Exposed
   D. No requirement

106. What table is referenced in the 2014 with regards to the grounded conductor and its minimum size?
   A. 250.122(C)(1)
   B. 250.101(C)(1)
   C. 250.102(C)(1)
   D. 250.52(C)(1)
107. What part of article 250 requires premises wiring systems that are supplied by an ac service and ungrounded to have a grounding electrode conductor at each service that is connected to the grounding electrode?
   A. VI
   B. IV
   C. III
   D. IX

108. If you have multiple separately derived systems connected in parallel, they are required to be installed in accordance with ________.
   A. 450
   B. 250.122
   C. 250.40
   D. 250.30

109. A ________ grounding electrode conductor is required to be connected between the grounded side of the grounding impedance and the equipment grounding connection at the service equipment.
   A. Services
   B. Separately derived systems
   C. Industrial facilities
   D. All listed answers

110. The grounding electrode conductor is required to resist ________.
    A. Faults
    B. Theft
    C. Lightning
    D. Corrosion

111. A grounding electrode conductor can be ________.
    A. All listed answers
    B. Solid
    C. Stranded
    D. Bare

112. The 2014 code has ________ provisions when a grounding electrode connection for a service or feeder has two or more disconnecting means with separate enclosures.
    A. 4
    B. 2
    C. 3
    D. 1

113. A common grounding electrode conductor that serves multiple taps is ________ by the 2014 Code.
    A. A violation
    B. Allowed
    C. Required
    D. Not allowed

114. A common grounding electrode conductor is required to be sized in accordance with ________.
    A. 250.52
    B. 250.122
    C. 250.66
    D. 250.64(D)

115. The grounding electrode conductor is sized based on the sum of the ________ of the largest ungrounded conductor(s) of each set that supplies the disconnecting means.
    A. Circular mil area
    B. Lug size
    C. Cross sectional area
    D. Both A and C

116. How many approved ways does the 2014 code list when attaching a grounding electrode conductor tap?
    A. 5
    B. 2
    C. 4
    D. 3

117. A grounding electrode conductor tap is required to extend inside each ________ enclosure.
    A. Service panel
    B. Service
    C. Sub panel
    D. Disconnecting means

118. An aluminum busbar used for multiple grounding electrode conductor taps must have a minimum thickness of ________.
    A. 1 inch
    B. 3/8 inch
    C. ¼ inch
    D. 2 inches
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119. A copper busbar used for multiple grounding electrode conductor taps must have a minimum width of _______.
A. 3/8 inch  
B. 2 inches  
C. 1 inch  
D. 1 7/8 inches

120. An aluminum busbar used for multiple grounding electrode conductor taps is required to meet the requirements of _______.
A. 250.64(A)  
B. 250.66  
C. 250.122  
D. 250.64(B)

(REVISED): 250.64 Grounding Electrode Conductor Installation. (D)(2) Individual Grounding Electrode Conductors. A grounding electrode conductor shall be connected between the grounding electrode system and one or more of the following, as applicable:

(1) Grounded conductor in each service equipment disconnecting means enclosure
(2) Equipment grounding conductor installed with the feeder
(3) Supply-side bonding jumper

Each grounding electrode conductor shall be sized in accordance with 250.66 based on the service-entrance or feeder conductor(s) supplying the individual disconnecting means.

(REVISED): 250.64 Grounding Electrode Conductor Installation. (D)(3) Common Location. A grounding electrode conductor shall be connected in a wireway or other accessible enclosure on the supply side of the disconnecting means to one or more of the following, as applicable:

(1) Grounded service conductor(s)
(2) Equipment grounding conductor installed with the feeder
(3) Supply-side bonding jumper

(REVISED): 250.64 Grounding Electrode Conductor Installation. (E) Raceways and Enclosures for Grounding Electrode Conductors. (1) General. Ferrous metal raceways and enclosures for grounding electrode conductors shall be electrically continuous from the point of attachment to cabinets or equipment to the grounding electrode and shall be securely fastened to the ground clamp or fitting. Ferrous metal raceways and enclosures shall be bonded at each end of the raceway or enclosure to the grounding electrode or grounding electrode conductor. Nonferrous metal raceways and enclosures shall not be required to be electrically continuous.

(2) Methods. Bonding shall be in compliance with 250.92(B) and ensured by one of the methods in 250.92(B)(2) through (B)(4).

(3) Size. The bonding jumper for a grounding electrode conductor raceway or cable armor shall be the same size as, or larger than, the enclosed grounding electrode conductor.

(4) Wiring Methods. If a raceway is used as protection for a grounding electrode conductor, the installation shall comply with the requirements of the appropriate raceway article.


(A) Connections to a Rod, Pipe, or Plate Electrode(s). Where the grounding electrode conductor is connected to a single or multiple rod, pipe, or plate electrode(s), or any combination thereof, as permitted in 250.52(A)(5) or (A)(7), that portion of the conductor that is the sole connection to the grounding electrode(s) shall not be required to be larger than 6 AWG copper wire or 4 AWG aluminum wire.
(B) Connections to Concrete-Encased Electrodes. Where the grounding electrode conductor is connected to a single or multiple concrete-encased electrode(s) as permitted in 250.52(A)(3), that portion of the conductor that is the sole connection to the grounding electrode(s) shall not be required to be larger than 4 AWG copper wire.

(REVISED): 250.68 Grounding Electrode Conductor and Bonding Jumper Connection to Grounding Electrodes. (C) Grounding Electrode Connections. Grounding electrode conductors and bonding jumpers shall be permitted to be connected at the following locations and used to extend the connection to an electrode(s):

1. Interior metal water piping located not more than 1.52 m (5 ft) from the point of entrance to the building shall be permitted to be used as a conductor to interconnect electrodes that are part of the grounding electrode system.

   Exception: In industrial, commercial, and institutional buildings or structures, if conditions of maintenance and supervision ensure that only qualified persons service the installation, interior metal water piping located more than 1.52 m (5 ft) from the point of entrance to the building shall be permitted as a bonding conductor to interconnect electrodes that are part of the grounding electrode system, or as a grounding electrode conductor, if the entire length, other than short sections passing perpendicularly through walls, floors, or ceilings, of the interior metal water pipe that is being used for the conductor is exposed.

2. The metal structural frame of a building shall be permitted to be used as a conductor to interconnect electrodes that are part of the grounding electrode system, or as a grounding electrode conductor.

3. A concrete-encased electrode of either the conductor type, reinforcing rod or bar installed in accordance with 250.52(A)(3) extended from its location within the concrete to an accessible location above the concrete shall be permitted.

Part 1 Exam Questions:

121. An individual grounding electrode conductor is required to be connected between the grounding electrode system and ________.
   A. Equipment grounding conductor installed with the feeder
   B. Each service equipment disconnecting means enclosure
   C. Supply-side bonding jumper
   D. All listed answers

122. A grounding electrode conductor is required to be sized in accordance with 250.66 based on the service-entrance or feeder conductor(s) supplying an individual________.
   A. Enclosure
   B. Fuse
   C. Disconnect
   D. Gear section

123. A grounding electrode conductor is required to be connected in a wireway or other accessible enclosure on the supply side of the disconnecting means by ________.
   A. All listed answers
   B. Grounded service conductor(s)
   C. Supply-side bonding jumper
   D. Equipment grounding conductor installed with the feeder

124. ________metal raceways and enclosures are not required to be electrically continuous.
   A. Ferrous
   B. Nonferrous
   C. Nickel Clad
   D. Aluminum
125. _______ metal raceways and enclosures are required to be bonded at each end of the raceway or enclosure to the grounding electrode or grounding electrode conductor.
   A. Aluminum
   B. Nonferrous
   C. Nickel Clad
   D. Ferrous

126. Ferrous metal raceways used for grounding electrode conductors are required to be electrically continuous from the point of ________ to cabinets or equipment to the grounding electrode.
   A. Connection
   B. Attachment
   C. Service
   D. Utility

127. The ______ for a grounding electrode conductor raceway or cable armor is required to be the same size as, or larger than, the enclosed grounding electrode conductor.
   A. Conductor
   B. Bonding jumper
   C. Area
   D. Cross section

128. A grounding electrode conductor that is connected to a single ground rod and the sole connection to the grounding electrode is not required to be larger than ______ AWG copper.
   A. 2
   B. 4
   C. 3
   D. 6

129. A grounding electrode conductor that is connected to a concrete-encased 1/2” diameter 20‘ long piece of rebar and the sole connection to the grounding electrode is not required to be larger than ______ AWG copper.
   A. 3
   B. 6
   C. 4
   D. 2

130. Within how many feet of entering a building does a metal water pipe have to be bonded?
   A. 7'
   B. 10'
   C. 5'
   D. 12"

131. True or False, there are no exceptions to 250.68(C)(1) with regards to bonding a water pipe within the specified footage.
   A. True
   B. False

132. The ______ of a building can be used to inter connect grounding electrodes.
   A. Mechanical system
   B. Metal structural frame
   C. Light poles
   D. All listed answers

133. In an industrial facility, the 250.68(C)(1) requirement can be ignored if they can ensure that only ______ service the installation.
   A. Supervisors
   B. Qualified persons
   C. Communication Techs
   D. No requirement

(NEW TABLE/REVISED): 250.102 Bonding Conductors and Jumpers. (C) Size — Supply-Side Bonding Jumper.

(1) Size for Supply Conductors in a Single Raceway or Cable. The supply-side bonding jumper shall not be smaller than specified in Table 250.102(C)(1).

(2) Size for Parallel Conductor Installations in Two or More Raceways. Where the ungrounded supply conductors are paralleled in two or more raceways or cables, and an individual supply-side bonding jumper is used for bonding these raceways or cables, the size of the supply-side bonding jumper for each raceway or cable shall be selected from Table 250.102(C)(1) based on the size of the ungrounded supply conductors in each raceway or cable. A single supply-side bonding jumper installed for bonding two or more raceways or cables shall be sized in accordance with 250.102(C)(1).
(NEW): Informational Note: The term supply conductors includes ungrounded conductors that do not have overcurrent protection on their supply side and terminate at service equipment or the first disconnecting means of a separately derived system.

(NEW): Informational Note: See Chapter 9, Table 8, for the circular mil area of conductors 18 AWG through 4/0 AWG.

(REvised): 250.104 Bonding of Piping Systems and Exposed Structural Metal. (B) Other Metal Piping. If installed in, or attached to, a building or structure, a metal piping system(s), including gas piping, that is likely to become energized shall be bonded to any of the following:

1. Equipment grounding conductor for the circuit that is likely to energize the piping system
2. Service equipment enclosure
3. Grounded conductor at the service
4. Grounding electrode conductor, if of sufficient size
5. One or more grounding electrodes used

(REvised): 250.112 Specific Equipment Fastened in Place (Fixed) or Connected by Permanent Wiring Methods. The normally non–current-carrying metal parts of equipment and enclosures described in 250.112(L) and (M), are required to be connected to an equipment grounding conductor. 250.112(A) has added “Switchgear and Switchboard” to the article.

(A) Switchgear and Switchboard Frames and Structures. Switchgear or switchboard frames and structures supporting switching equipment, except frames of 2-wire dc switchgear or switchboards where effectively insulated from ground.

(REvised): 250.119 Identification of Equipment Grounding Conductors. The 2014 code allows an equipment grounding conductor to be bare, covered, or insulated. Article 250.119 has added 2 new exceptions and an informational note.

(NEW): Exception No. 2: Flexible cords having an integral insulation and jacket without an equipment grounding conductor shall be permitted to have a continuous outer finish that is green.

(NEW): Informational Note: An example of a flexible cord with integral-type insulation is Type SPT-2, 2 conductor.

(NEW): Exception No. 3: Conductors with green insulation shall be permitted to be used as ungrounded signal conductors where installed between the output terminations of traffic signal control and traffic signal indicating heads. Signaling circuits installed in accordance with this exception shall include an equipment grounding conductor in accordance with 250.118. Wire-type equipment grounding conductors shall be bare or have insulation or covering that is green with one or more yellow stripes.

134. Table 250.102(C)(1) indicates _____ different scenarios with regards to sizing the supply side bonding jumper.
   A. 2
   B. 3
   C. 4
   D. 6

135. A single ________ can be run with parallel sets of phase conductors.
   A. Supply-side bonding jumper
   B. Grounded conductor
   C. Circuit
   D. Both A and C

136. What chapter contains helpful tables to find the circular mil area of conductors up to 4/0?
   A. 10
   B. 8
   C. 9
   D. 9 annex J

137. A metal natural gas pipe installed in a 15 story building needs to be bonded to ________.
   A. The grounding electrode system
   B. The service equipment enclosure
   C. The grounding electrode conductor
   D. All listed answers

138. The switchgear frame for a DC 2 wire system is ________ to be connected to an equipment grounding conductor if insulated from ground.
   A. Required
   B. Not Required
   C. Sometimes required
   D. Suggested

139. A Flexible cord that has an integral insulation and jacket without an equipment grounding conductor is allowed to have a continuous outer finish that is ________.
   A. Green
   B. Gray
   C. White
   D. Orange

140. A type of flexible cord you would see with integral-type insulation is ________.
   A. USE, 2 conductor
   B. STP-2, 2 conductor
   C. SPT-2, 2 conductor
   D. All listed answers

141. The 2014 code allows conductors with green insulation to be used as ________.
   A. Service Conductors
   B. Phase conductors
   C. Grounded conductors
   D. Ungrounded signal conductors

142. If using 250.119 exception 3, a traffic signal indicating head is required to have a?
   A. Green phase conductors
   B. Grounded Conductor
   C. Equipment grounding conductor
   D. All listed answers
143. If an equipment grounding conductor ________ and larger is installed, it must be marked at each end and at every point where the conductor is accessible.

A. 6 AWG  
B. 4 AWG  
C. 2 AWG  
D. 8 AWG

144. True or False, an equipment grounding conductor 4 AWG and larger is required to be marked in conduit bodies that contain no splices or unused hubs.

A. False  
B. True

145. An equipment grounding conductor ________ be used as a grounding electrode conductor under normal circumstances.

A. May  
B. Shall  
C. Must  
D. Shall not

146. A wire-type equipment grounding conductor installed as per ________ and meeting the requirements of part II, III, and VI of article 250 can be used as both an equipment grounding conductor and a grounding electrode conductor.

A. 250.122  
B. 250.5(A)  
C. 250.66  
D. 250.6(A)

(REVISED): 250.122 Size of Equipment Grounding Conductors. (B) Increased in Size. Where ungrounded conductors are increased in size from the minimum size that has sufficient ampacity for the intended installation, wire-type equipment grounding conductors, where installed, shall be increased in size proportionately according to the circular mil area of the ungrounded conductors.

(REVISED): 250.146 Connecting Receptacle Grounding Terminal to Box. (B) Contact Devices or Yokes. Contact devices or yokes designed and listed as self-grounding shall be permitted in conjunction with the supporting screws to establish equipment bonding between the device yoke and flush-type boxes.

(REVISED): 250.166 Size of the Direct-Current Grounding Electrode Conductor. The size of the grounding electrode conductor for a dc system shall be as specified in 250.166(A) and (B), except as permitted by 250.166(C) through (E). The grounding electrode conductor for a dc system shall meet the sizing requirements in this section but shall not be required to be larger than 3/0 copper or 250 kcmil aluminum.

(NEW): 250.167 Direct-Current Ground-Fault Detection.

(A) Ungrounded Systems. Ground-fault detection systems shall be required for ungrounded systems.

(B) Grounded Systems. Ground-fault detection shall be permitted for grounded systems.

(C) Marking. Direct-current systems shall be legibly marked to indicate the grounding type at the dc source or the first disconnecting means of the system. The marking shall be of sufficient durability to withstand the environment involved.

(REVISED): 250.170 Instrument Transformer Circuits. Secondary circuits of current and potential instrument transformers shall be grounded where the primary windings are connected to circuits of 300 volts or more to ground, and, where installed on or in switchgear and on switchboards, shall be grounded irrespective of voltage.

(REVISED): 250.174 Cases of Instruments, Meters, and Relays Operating at 1000 Volts or Less. Instruments, meters, and relays operating with windings or working parts at 1000 volts or less shall be connected to the equipment grounding conductor as specified in 250.174(A), (B), or (C).
147. If the size of phase conductors are increased from an existing service, the size of the equipment grounding conductor________ proportionately to the circular mil area of the phase conductors.
   A. Must parallel
   B. Remains the same
   C. Must also increase
   D. No listed answer

148. Yokes listed as ________shall be permitted in conjunction with the supporting screws to establish equipment bonding between the device yoke.
   A. Grounded
   B. Isolated
   C. Self-grounding
   D. Grounding

149. To size the grounding electrode conductor for a ________ system, 250.166(A) and (B) Shall be used.
   A. Capacitive
   B. AC
   C. Induction
   D. DC

150. What is the maximum size according to the 2014 code that a copper grounding electrode conductor for a direct current system has to be?
   A. 1/0
   B. 2/0
   C. 250
   D. 3/0
151. An ungrounded DC system is required to have ________.
   A. Current detectors
   B. Ground-fault detection
   C. Ground Spike monitors
   D. Voltage regulators

152. True or False, ground-fault detection systems are required to be installed on grounded DC systems.
   A. True
   B. False

153. Direct-current systems are required to be marked to indicate the grounding type at the dc ________.
   A. Source
   B. All listed answers
   C. First disconnect
   D. System Origination

154. Instrument transformers are required to be grounded where the primary windings are connected to circuits of ________ volts or more to ground.
   A. 240
   B. 50
   C. 300
   D. 100

155. Article 250.174 deals with the cases of Instruments, meters, and relays operating at ________ Volts or Less.
   A. 50
   B. 600
   C. 300
   D. 1000

156. The case of an instrument not located in the switchgear of an industrial facility with exposed metal parts is required to be connected to the equipment grounding conductor if operating at over ________ volts to ground.
   A. 50
   B. 1000
   C. 600
   D. 300

157. The case of a meter on the dead-front of a panel with no exposed live parts ________ to be connected to the equipment grounding conductor.
   A. Is required
   B. Is not required
   C. No such requirement
   D. Is suggested, but optional

158. AC systems operating at over ________ volts and are grounded at any point with a grounded conductor at the service point, a grounded conductor is also required to be installed and routed with the ungrounded conductors to each service disconnect.
   A. 600
   B. 1000
   C. 300
   D. 50

159. In systems over 1000 volts, a ________ is required to connect the grounded conductor(s) to each service disconnecting means enclosure.
   A. Current transformer
   B. Main bonding jumper
   C. Grounding Conductor
   D. Grounding electrode conductor

160. A single assembly used as service equipment operating at over 1000 volts containing 2 or more disconnects can connect the grounded conductor to a ________ terminal.
   A. All listed answers
   B. Equipment
   C. Isolated
   D. Common

161. What table is used in the 2014 code to size the grounding electrode conductor for systems over 1000 volts,
   A. 250.102 (C)(1)
   B. 250.122
   C. 250.66
   D. 250.185(C)

162. The grounding electrode conductor ________ be required to be larger than the largest ungrounded service-entrance conductor.
   A. Shall not
   B. Shall
   C. Must
   D. Is to

163. If you were to install sets of ungrounded service-entrance conductors larger than 1100 kcmil copper, you would be required to size the grounded conductor no less than ________ percent of the service conductors.
   A. 25
   B. 12 ½
   C. 15
   D. 18
(NEW): 250.186 Ground-Fault Circuit Conductor Brought to Service Equipment. (A)(2) Parallel Conductors in Two or More Raceways or Overhead Conductors. If the ungrounded service-entrance conductors are installed in parallel in two or more raceways or as overhead parallel conductors, the grounded conductors shall also be installed in parallel. The size of the grounded conductor in each raceway or overhead shall be based on the total circular mil area of the parallel ungrounded conductors in the raceway or overhead, as indicated in 250.186(A)(1), but not smaller than 1/0 AWG.

(NEW): 250.186 Ground-Fault Circuit Conductor Brought to Service Equipment. (A)(3) & (4) Delta-Connected Service. The grounded conductor of a 3-phase, 3-wire delta service shall have an ampacity not less than that of the ungrounded conductors. Impedance Grounded Neutral Systems. Impedance grounded neutral systems shall be installed in accordance with 250.187.

(NEW): 250.186 Ground-Fault Circuit Conductor Brought to Service Equipment. (B) Systems without a Grounded Conductor at the Service Point. Where an ac system operating at greater than 1000 volts is grounded at any point and is not provided with a grounded conductor at the service point, a supply-side bonding jumper shall be installed and routed with the ungrounded conductors to each service disconnecting means and shall be connected to each disconnecting means equipment grounding conductor terminal or bus. The supply-side bonding jumper shall be installed in accordance with 250.186(B)(1) through (B)(3). Exception: Where two or more service disconnecting means are located in a single assembly listed for use as service equipment, it shall be permitted to connect the supply-side bonding jumper to the assembly common equipment grounding terminal or bus.

(NEW): 250.186 Ground-Fault Circuit Conductor Brought to Service Equipment. (B) (1) Sizing for a Single Raceway or Overhead Conductor. The supply-side bonding jumper shall not be smaller than the required grounding electrode conductor specified in Table 250.66 but shall not be required to be larger than the largest ungrounded service-entrance conductor(s). In addition, for sets of ungrounded service-entrance conductors larger than 1100 kcmil copper or 1750 kcmil aluminum, the supply-side bonding jumper shall not be smaller than 121/2 percent of the circular mil area of the largest set of service-entrance ungrounded conductor(s).

(NEW): 250.186 Ground-Fault Circuit Conductor Brought to Service Equipment. (B) (2) Parallel Conductors in Two or More Raceways or Overhead Conductors. If the ungrounded service-entrance conductors are installed in parallel in two or more raceways or overhead conductors, the supply-side bonding jumper shall also be installed in parallel. The size of the supply-side bonding jumper in each raceway or overhead shall be based on the total circular mil area of the parallel ungrounded conductors in the raceway or overhead, as indicated in 250.186(A)(1), but not smaller than 1/0 AWG.

(REVISED): 250.188 Grounding of Systems Supplying Portable or Mobile Equipment. (D) Ground-Fault Detection and Relaying. Ground-fault detection and relaying shall be provided to automatically de-energize any component of a system over 1000 volts that has developed a ground fault. The continuity of the equipment grounding conductor shall be continuously monitored so as to automatically de-energize the circuit of the system over 1000 volts to the portable or mobile equipment upon loss of continuity of the equipment grounding conductor.
164. If installing 3 parallel runs of 2000 kcmil overhead with an operating voltage of 4160, the 2014 code requires the ________ to also be paralleled.
   A. Grounding conductor
   B. Grounded conductor
   C. Equipment grounding conductor
   D. Bond

165. On parallel systems operating over 1000 volts, the size of the grounded conductor shall be based on the total ________ of the parallel ungrounded conductors.
   A. All listed answers
   B. Length
   C. Total diameter
   D. Circular mil area

166. What is the minimum size grounded conductor allowed by the 2014 code for systems operating over 1000 volts.
   A. 3/0
   B. 2/0
   C. 1/0
   D. 4/0

167. For systems operating at over 1000 volts, the grounded conductor of a 3-phase, 3-wire ________ system is required to have the same ampacity as the ungrounded conductors.
   A. Grounded
   B. Wye
   C. Delta
   D. Ungrounded

168. A 4160 impedance grounded neutral system is required to be installed as per the requirements of ________.
   A. 250.187
   B. 250.186
   C. 250.174
   D. 250.66

169. A ________ is required to be installed and routed with all ungrounded conductors to each service disconnecting means on systems operating over 1000 volts if a grounded conductor is not supplied.
   A. High leg
   B. Grounded conductor
   C. Grounding Conductor
   D. Supply-side bonding jumper

170. The 2014 code lists ________ provisions for systems operating over 1000 volts that require a supply-side bonding jumper.
   A. 3
   B. 2
   C. 4
   D. 5

171. A single assembly used as service equipment operating at over 1000 volts containing 2 or more disconnects can connect the supply-side bonding to a ________ terminal.
   A. All listed answers
   B. Dedicated
   C. Isolated
   D. Common

172. What table is used in the 2014 code to size the supply-side bonding jumper for systems over 1000 volts,
   A. 250.185(C)
   B. 250.122
   C. 250.102 (C)(1)
   D. 250.66

173. The supply-side bonding jumper ________ be required to be larger than the largest ungrounded service-entrance conductor.
   A. Shall
   B. Shall not
   C. Must
   D. Is to

174. If you were to install sets of ungrounded service-entrance conductors larger than 1100 kcmil copper, you would be required to size the supply-side bonding jumper no less than ________ percent of the service conductors.
   A. 18
   B. 25
   C. 15
   D. 12 ½

175. If installing 3 parallel runs of 2200 kcmil overhead with an operating voltage of 4160, the 2014 code requires the ________ to also be paralleled.
   A. Grounding conductor
   B. Supply-side bonding jumper
   C. Equipment grounding conductor
   D. Bond
176. On parallel systems operating over 1000 volts, the size of the supply-side bonding jumper shall be based on the total ________ of the parallel ungrounded conductors.
   A. Length
   B. Circular mil area
   C. Total diameter
   D. All listed answers

177. What is the minimum size supply-side bonding jumper allowed by the 2014 code for systems operating over 1000 volts.
   A. 1/0
   B. 2/0
   C. 3/0
   D. 4/0

178. Ground-fault detectors and relaying ________ be provided to automatically de-energize any component of a system over 1000 volts that has developed a ground fault.
   A. Shall
   B. Shall not
   C. Will
   D. May

179. For systems over 1000 volts with ground fault detectors, the continuity of the ________ shall be continuously monitored.
   A. Grounding conductor
   B. Grounded conductor
   C. Equipment grounding conductor
   D. Bond jumper

(NEW): 250.194 Grounding and Bonding of Fences and Other Metal Structures. Metallic fences enclosing, and other metal structures in or surrounding, a substation with exposed electrical conductors and equipment shall be grounded and bonded to limit step, touch, and transfer voltages.

(NEW): 250.194 Grounding and Bonding of Fences and Other Metal Structures. (A) Metal Fences. Where metal fences are located within 5 m (16 ft) of the exposed electrical conductors or equipment, the fence shall be bonded to the grounding electrode system with wire-type bonding jumpers as follows:
   (1) Bonding jumpers shall be installed at each fence corner and at maximum 50 m (160 ft) intervals along the fence.
   (2) Where bare overhead conductors cross the fence, bonding jumpers shall be installed on each side of the crossing.
   (3) Gates shall be bonded to the gate support post, and each gate support post shall be bonded to the grounding electrode system.
   (4) Any gate or other opening in the fence shall be bonded across the opening by a buried bonding jumper.
   (5) The grounding grid or grounding electrode systems shall be extended to cover the swing of all gates.
   (6) The barbed wire strands above the fence shall be bonded to the grounding electrode system. Alternate designs performed under engineering supervision shall be permitted for grounding or bonding of metal fences.

(NEW): 250.194 Grounding and Bonding of Fences and Other Metal Structures. (B) Metal Structures. All exposed conductive metal structures, including guy wires within 2.5 m (8 ft) vertically or 5 m (16 ft) horizontally of exposed conductors or equipment and subject to contact by persons, shall be bonded to the grounding electrode systems in the area.

(REVISED): 285.1 Scope. This article covers general requirements, installation requirements, and connection requirements for surge-protective devices (SPDs) permanently installed on premises wiring systems of 1000 volts or less.

(REVISED): 285.4 Number Required. Where used at a point on a circuit, the SPD shall be connected to each ungrounded conductor.

(NEW): 285.13 Type 4 and Other Component Type SPDs. Type 4 component assemblies and other component type SPDs shall only be installed by the equipment manufacturer.
180. The metal fence surrounding a substation is required to be bonded to limit ________.
A. Step voltages
B. Transfer voltages
C. Touch voltages
D. All listed answers

181. If a substations metal fence is located within ________ of the exposed electrical conductors, the fence is required to be bonded to the grounding electrode system with wire-type bonding jumpers.
A. 10 ft.
B. 12 ft.
C. 16 ft.
D. 15 ft.

182. What is the maximum interval allowed by the 2014 code when bonding a substations metal fence.
A. 50 ft.
B. 150 ft.
C. 100 ft.
D. 160 ft.

183. If bare overhead conductors cross the fence of a substation within the specified distance, ________ are required to be installed on each side of the crossing.
A. Insulators
B. Warning signs
C. Caution signs
D. Bonding jumpers

184. Substation fence posts are ________ to be bonded to the grounding electrode system.
A. Not
B. Prohibited
C. Required
D. No listed answers

185. True or False, the barbed wire strands above the fence of a substation are required to be bonded to the grounding electrode system.
A. False
B. True

186. All exposed conductive metal structures within ________ vertically of exposed conductors operating at over 1000 volts subject to contact by people is required to be bonded to the grounding electrode system.
A. 10 ft.
B. 16 ft.
C. 12 ft.
D. 8 ft.

187. All exposed conductive metal structures within ________ horizontally of exposed conductors operating at over 1000 volts subject to contact by people is required to be bonded to the grounding electrode system.
A. 8 ft.
B. 16 ft.
C. 12 ft.
D. 10 ft.
188. Article 285 covers ________.
   A. Surge-protective devices
   B. Surge-arrester devices
   C. Standard-protective devices
   D. Surge-personnel devices

189. What is the maximum voltage covered in article 285?
   A. No maximum voltage listed
   B. 600 Volts
   C. 300 volts
   D. 1000 volts

190. An SPD is required to be connected to the ________ when used at a point on a circuit.
   A. Grounded conductor
   B. Ungrounded conductor
   C. Grounding conductor
   D. Equipment grounding conductor

191. A type 4 SPD can only be installed by the ________.
   A. Equipment manufacturer
   B. Electrician
   C. Maintenance personnel
   D. Qualified individual

192. A type ________ can be installed on the load side of branch-circuit overcurrent protection up to the equipment served.
   A. 2 SPD
   B. 4 SPD
   C. 1 SPD
   D. 3 SPD

193. True or False, can AC and DC systems of 1000 volts occupy the same raceway?
   A. True
   B. False

194. The secondary wiring to electric-discharge lamps of 1000 volts or less, and insulated for the secondary voltage involved, ________ be permitted to occupy the same luminaire.
   A. No such provision
   B. Shall not
   C. Must
   D. Shall

195. In most cases, conductors run under a building are required to be in ________.
   A. A vault
   B. Concrete
   C. A raceway
   D. All listed answers

(REVISED): 300.5 Underground Installations. (D)(4) Enclosure or Raceway Damage. Where the enclosure or raceway is subject to physical damage, the conductors shall be installed in rigid metal conduit, intermediate metal conduit, RTRC-XW, Schedule 80 PVC conduit, or equivalent.

300.22 Wiring in Ducts Not Used for Air Handling, Fabricated Ducts for Environmental Air, and Other Spaces for Environmental Air (Plenums). (C)(1)

(NEW): Informational Note: One method to determine low smoke and heat release properties is that the nonmetallic cable ties and other nonmetallic cable accessories exhibit a maximum peak optical density of 0.50 or less, an average optical density of 0.15 or less, and a peak heat release rate of 100 kW or less when tested in accordance with ANSI/UL 2043-2008, Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.

(NEW): 300.38 Raceways in Wet Locations Above Grade. Where raceways are installed in wet locations above grade, the interior of these raceways shall be considered to be a wet location. Insulated conductors and cables installed in raceways in wet locations above grade shall comply with 310.10(C).

(NEW): 300.45 Warning Signs. Warning signs shall be conspicuously posted at points of access to conductors in all conduit systems and cable systems. The warning sign(s) shall be legible and permanent and shall carry the following wording:

DANGER—HIGH VOLTAGE—KEEP OUT
196. If conduit may be subject to physical damage when run underground, type ________ is required to be used.

A. All listed answers
B. Rigid metal conduit
C. RTRC-XW
D. Intermediate metal conduit

197. The low smoke and heat release properties of nonmetallic cable ties should exhibit a maximum peak optical density of ________ or less.

A. 0.25
B. 0.15
C. 0.50
D. 0.30
198. Nonmetallic cable ties should have an average optical density of _______or less.
   A. 0.12
   B. 0.15
   C. 0.25
   D. 0.50

199. What is the maximum allowable heat release rate for nonmetallic cable ties according to ANSI standards?
   A. 75 kW
   B. 100 W
   C. 50 kW
   D. 100 kW

200. Raceways that are installed in wet locations above grade are considered to have their interior classified as a ________.
   A. Damp location
   B. Dry location
   C. Wet location
   D. Classified location

201. Raceways that house insulated conductors and cables installed in wet locations are required to meet the requirements of ________.
   A. 310.13(D)
   B. 310.10(B)
   C. 310.12(C)
   D. 310.10(C)

202. ________ are required to be posted at the points of access to conductors in all raceway systems.
   A. Location markers
   B. Warning signs
   C. Voltage ratings
   D. Current ratings

203. A conductor warning sign is required by the 2014 code to read:
   A. HIGH VOLTAGE—KEEP OUT—DANGER
   B. HIGH VOLTAGE—DANGER—KEEP OUT
   C. DANGER—HIGH VOLTAGE—KEEP OUT
   D. No such requirement

204. Non-shielded single-conductor cables with insulation types of up to _______volts are allowed in industrial establishments where qualified persons service the installed cable.
   A. 2000
   B. 1000
   C. 600
   D. 10,000

205. True or False, the 2014 code allows paralleling equipment bonding conductors only if smaller than 1/0 AWG.
   A. False
   B. True

206. Parallel equipment bonding conductors are sized using ________
   A. 250.122 (D)
   B. 250.105
   C. 250.66
   D. 250.122

207. How many provisions are listed for sizing multifamily dwellings service and feeder conductors supplied by a single-phase 120/240-volt system.
   A. 4
   B. 5
   C. 3
   D. 6

208. Service conductors rated 100 to 400 amps supplying an entire single family dwelling are permitted to have an ampacity not less than _______ percent of the service rating.
   A. 90
   B. 75
   C. 85
   D. 83

209. Feeder conductors rated 100 to 400 amps supplying an entire single family dwelling or multifamily dwelling are permitted to have an ampacity not less than _______ percent of the service rating.
   A. 85
   B. 75
   C. 83
   D. 90

210. 310.15(B)(7)(1) through (4) ________ grounded conductors to be sized smaller than the ungrounded conductors.
   A. Allow
   B. Require
   C. Suggest
   D. Deter
(REVISED): 314.15 Damp or Wet Locations. In damp or wet locations, boxes, conduit bodies, and fittings shall be placed or equipped so as to prevent moisture from entering or accumulating within the box, conduit body, or fitting. Boxes, conduit bodies, and fittings installed in wet locations shall be listed for use in wet locations. Approved drainage openings not larger than 6 mm (1/4 in.) shall be permitted to be installed in the field in boxes or conduit bodies listed for use in damp or wet locations. For installation of listed drain fittings, larger openings are permitted to be installed in the field in accordance with manufacturer's instructions.

(REVISED): 314.16 Number of Conductors in Outlet, Device, and Junction Boxes, and Conduit Bodies (B)(2) Clamp Fill. Where one or more internal cable clamps, whether factory or field supplied, are present in the box, a single volume allowance in accordance with Table 314.16(B) shall be made based on the largest conductor present in the box. No allowance shall be required for a cable connector with its clamping mechanism outside the box. A clamp assembly that incorporates a cable termination for the cable conductors shall be listed and marked for use with specific nonmetallic boxes. Conductors that originate within the clamp assembly shall be included in conductor fill calculations covered in 314.16(B)(1) as though they entered from outside the box. The clamp assembly shall not require a fill allowance, but the volume of the portion of the assembly that remains within the box after installation shall be excluded from the box volume as marked in 314.16(A)(2).

(REVISED): 314.25 Covers and Canopies. In completed installations, each box shall have a cover, faceplate, lampholder, or luminaire canopy, except where the installation complies with 410.24(B). Screws used for the purpose of attaching covers, or other equipment, to the box shall be either machine screws matching the thread gauge or size that is integral to the box or shall be in accordance with the manufacturer's instructions.

(REVISED): 314.25 Covers and Canopies. (C) Flexible Cord Pendants. Covers of outlet boxes and conduit bodies having holes through which flexible cord pendants pass shall be provided with identified bushings or shall have smooth, well-rounded surfaces on which the cords may bear. So-called hard rubber or composition bushings shall not be used.

(REVISED): 314.27 Outlet Boxes. (A)(2) Boxes at Luminaire or Lampholder Outlets. (2) Ceiling Outlets. At every outlet used exclusively for lighting, the box shall be designed or installed so that a luminaire or lampholder may be attached. Boxes shall be required to support a luminaire weighing a minimum of 23 kg (50 lb). A luminaire that weighs more than 23 kg (50 lb) shall be supported independently of the outlet box, unless the outlet box is listed and marked on the interior of the box to indicate the maximum weight the box shall be permitted to support.

(REVISED): 314.28 Pull and Junction Boxes and Conduit Bodies. (A)(3) Minimum Size. (3) Smaller Dimensions. Listed boxes or listed conduit bodies of dimensions less than those required in 314.28(A)(1) and (A)(2) shall be permitted for installations of combinations of conductors that are less than the maximum conduit or tubing fill (of conduits or tubing being used) permitted by Table 1 of Chapter 9. Listed conduit bodies of dimensions less than those required in 314.28(A)(2), and having a radius of the curve to the centerline not less than that indicated in Table 2 of Chapter 9 for one-shot and full-shoe benders, shall be permitted for installations of combinations of conductors permitted by Table 1 of Chapter 9. These conduit bodies shall be marked to show they have been specifically evaluated in accordance with this provision. Where the permitted combinations of conductors for which the box or conduit body has been listed are less than the maximum conduit or tubing fill permitted by Table 1 of Chapter 9, the box or conduit body shall be permanently marked with the maximum number and maximum size of conductors permitted.
211. Weep holes not larger than ________ inches are allowed to be installed in the field in boxes or conduit bodies listed for use in damp or wet locations.
   A. 1/16
   B. ¼
   C. 3/8
   D. 3/16

212. If one or more internal cable clamps are in a box, a single volume allowance can be made based on the ________ conductor present in the box.
   A. Grounded
   B. Smallest
   C. Largest
   D. Grounding

213. True or False, no fill allowance is required to be made for a cable connector with its clamping mechanism outside a box.
   A. False
   B. True

214. A ________ that incorporates a cable termination for cable conductors is required to be listed and marked for use with specific nonmetallic boxes.
   A. Clamp rating
   B. Clamp assembly
   C. Termination lug
   D. Equipment terminal

215. Conductors that originate within a clamp assembly shall be included in the conductor fill calculations covered in ________.
   A. 314.16(B)(1)
   B. 314.16(B)(2)
   C. 316.14(B)(1)
   D. 314.15(B)(1)

216. What type of screws does the 2014 code require for attaching the faceplate of a receptacle?
   A. Self tapping
   B. Self drilling
   C. Machine screws
   D. Bi-metal

217. Holes through which flexible cord pendants pass is required to have ________.
   A. Rated
   B. Identified bushings
   C. Listed
   D. Integral

218. The holes that flexible cord pendants pass ________ use hard rubber or composition bushings.
   A. May
   B. Shall
   C. Shall not
   D. Will

219. All outlet boxes used exclusively for lighting are required to support ________ pounds.
   A. 100
   B. 25
   C. 75
   D. 50

220. Where is a box required to be marked with its maximum weight rating?
   A. Nail or screw side
   B. Outside
   C. Inside
   D. All listed answers

221. True or False, conduit bodies smaller than what is specified in 314.28(A)(1) and (A)(2) are not allowed to be used.
   A. False
   B. True

222. A smaller conduit body than what is listed in 314.28(A)(1) and (A)(2) is required to be ______ to show they have been specifically evaluated in accordance with this provision.
   A. Listed
   B. Marked
   C. Rated
   D. Manufactured

223. A box or conduit body that is smaller than the requirements of 314.28(A)(1) and (A)(2) is required to be permanently marked with the maximum number and maximum size of ________ permitted.
   A. Conductors
   B. Conduits
   C. Hubs
   D. Entrances
REVISED): 320.23 In Accessible Attics. (A) Cables Run Across the Top of Floor Joists. Where run across the top of floor joists, or within 2.1 m (7 ft) of the floor or floor joists across the face of rafters or studding, the cable shall be protected by guard strips that are at least as high as the cable. Where this space is not accessible by permanent stairs or ladders, protection shall only be required within 1.8 m (6 ft) of the nearest edge of the scuttle hole or attic entrance.

(REVISED): 324.41 Floor Coverings. Floor-mounted Type FCC cable, cable connectors, and insulating ends shall be covered with carpet squares not larger than 1.0 m (39.37 in.) square. Carpet squares that are adhered to the floor shall be attached with release-type adhesives.

(REVISED): 330.30 Securing and Supporting. Type MC (B) Securing. Unless otherwise provided, cables shall be secured at intervals not exceeding 1.8 m (6 ft). Cables containing four or fewer conductors sized no larger than 10 AWG shall be secured within 300 mm (12 in.) of every box, cabinet, fitting, or other cable termination. In vertical installations, listed cables with ungrounded conductors 250 kcmil and larger shall be permitted to be secured at intervals not exceeding 3 m (10 ft).

(NEW): 330.30 Securing and Supporting. (D)(3) Unsupported Cables. Type MC of the interlocked armor type in lengths not exceeding 900 mm (3 ft) from the last point where it is securely fastened and is used to connect equipment where flexibility is necessary to minimize the transmission of vibration from equipment or to provide flexibility for equipment that requires movement after installation.

338.10 Uses Permitted. (B)(4)(b) Branch Circuits or Feeders.

(NEW): Exception: Single-conductor Type USE and multi-rated USE conductors shall not be subject to the ampacity limitations of Part II of Article 340.

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224. If a cable is run across the top of floor joists, or across the face of rafters or studding, the cable is required to be protected by ________.
   A. Planking
   B. Guard rails
   C. Guard strips
   D. Blocking

225. If running a cable across an attic that is not accessible by stairs or a ladder, the cable protection is only required to be within ________ of the nearest edge of the attic entrance.
   A. 8 ft.
   B. 5 ft.
   C. 6 ft.
   D. 10 ft.

226. What is the maximum size carpet squares that can be used to cover type FCC cable?
   A. 39.73" square
   B. 38.37" square
   C. 39.37" square
   D. 37.97" square

227. Carpet squares used to cover type FCC cable are required to use ________ adhesives.
   A. Permanent
   B. Release-type
   C. Velcro
   D. All listed answers

228. What is the maximum distance apart for supports when using MC cable?
   A. 5 ft.
   B. 8 ft.
   C. 10 ft.
   D. 6 ft.

229. Interlocked armor type MC cable is allowed to be supported within ________ of a motor termination enclosure.
   A. 36"
   B. 24"
   C. 18"
   D. 48"
230. USE conductors are not subject to the ampacity limitations of Part ______ of Article 340.

A. III
B. II
C. IV
D. V

(REVISED): 344.30 Securing and Supporting. (A) Securely Fastened. RMC shall be secured in accordance with one of the following:

(1) RMC shall be securely fastened within 900 mm (3 ft) of each outlet box, junction box, device box, cabinet, conduit body, or other conduit termination.

(2) Fastening shall be permitted to be increased to a distance of 1.5 m (5 ft) where structural members do not readily permit fastening within 900 mm (3 ft).

(3) Where approved, conduit shall not be required to be securely fastened within 900 mm (3 ft) of the service head for above-the-roof termination of a mast.

(NEW): 344.100 Construction. RMC shall be made of one of the following:

(1) Steel (ferrous), with or without protective coatings
(2) Aluminum (nonferrous)
(3) Red brass
(4) Stainless steel

348.30 Securing and Supporting (FMC). (A) Securely Fastened.

(REVISED): Exception No. 4: Lengths not exceeding 1.8 m (6 ft) from the last point where the raceway is securely fastened for connections within an accessible ceiling to a luminaire(s) or other equipment. For the purposes of this exception, listed flexible metal conduit fittings shall be permitted as a means of support.

(REVISED): 350.42 Couplings and Connectors. Only fittings listed for use with LFMC shall be used. Angle connectors shall not be concealed. Straight LFMC fittings shall be permitted for direct burial where marked.

(REVISED): 352.24 Bends (PVC) — How Made. Bends shall be so made that the conduit will not be damaged and the internal diameter of the conduit will not be effectively reduced. Field bends shall be made only with identified bending equipment. The radius of the curve to the centerline of such bends shall not be less than shown in Table 2, Chapter 9.

(REVISED): 354.2 Definition. Nonmetallic Underground Conduit with Conductors

(NUCC). A factory assembly of conductors or cables inside a nonmetallic, smooth wall raceway with a circular cross section.

(REVISED): 355.2 Definition. Reinforced Thermosetting Resin Conduit (RTRC). A rigid nonmetallic raceway of circular cross section, with integral or associated couplings, connectors, and fittings for the installation of electrical conductors and cables.
231. RMC needs to be securely fastened within ________ of an outlet box.
   A. 7'
   B. 6'
   C. 4'
   D. 3'

232. RMC can be supported at ________ from a box if structural members do not readily permit fastening,
   A. 5'
   B. 6'
   C. 8'
   D. 7'

233. RMC can be made of ________.
   A. Stainless steel
   B. All listed answers
   C. Red brass
   D. Steel

234. Exception number ________ of article 348.30 allows listed flexible metal conduit fittings to be permitted as a means of support.
   A. 5
   B. 3
   C. 4
   D. 2

235. Straight ________ fittings are allowed to be used for direct burial if marked.
   A. NMC
   B. MC
   C. All listed answers
   D. LFMC

236. LFMC angle connectors ________ be concealed.
   A. May
   B. Can
   C. Shall
   D. Shall not

237. PVC field bends shall be made only with ________ bending equipment.
   A. Listed
   B. Manufactured
   C. Identified
   D. Rated

238. The radius of the curve to the centerline of PVC pipe bends shall not be less than shown in Table ________, Chapter 9.
   A. 3
   B. 2
   C. 1
   D. 7

239. Type ________ is a factory assembly of conductors inside a nonmetallic smooth wall raceway with a circular cross section.
   A. NUCC
   B. RTRC
   C. LFNC
   D. XTTR

240. Type ________ is a rigid nonmetallic raceway with integral or associated couplings, connectors, and fittings for the installation of electrical conductors and cables.
   A. RNC
   B. NUCC
   C. RTRC
   D. ENT

[See Page 83 to fill out the Answer Sheet]
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