

Wisconsin Contractors Institute
Electrical Continuing Education

Article 517 Course

4 hours

Article 517 Health Care Facilities

As stated in the 2011 Code, health care facilities are comprised of seven (7) different sections.

I. General,

II. Wiring and Protection,

III. Essential Electrical Systems,

IV. Inhalation Anesthetizing Locations,

V. X-Ray Installations,

VI. Communications, Signaling Systems, Data Systems, Fire Alarm Systems, and systems less than 120 volts, Nominal,

VII. Isolated Power Systems.

Parts I and II are the most general of the article. Part I gives a general scope and the definitions portion of the entire article. Part II is the Wiring and Protection section for all patient care areas of health care facilities. The other five (5) parts are dedicated to specific locations and/or systems through out Health Care Facilities.

Article 517.1:

According to the 2011 Code, the provisions of this article shall apply to electrical construction and installation criteria in health care facilities that provide services to humans. The requirements in part II and III not only apply to single function buildings but also intended to be individually used to their respective forms of occupancy with in a multifunction building. (e.g. a doctors examining room located within a limited care facility would be required to meet the provisions of 517.10).

EXAM QUESTIONS:

1) Out of the seven (7) different parts of Article 517, where would you find the definitions portion of the article?

- A) VII. Isolated Power Systems
- B) II. Wiring and Protection
- C) I. General
- D) V. X-Ray Installations

2) How many parts are there in Article 517?

- A) 7
- B) 5
- C) 9
- D) 8

3) Which part would you find the Wiring and Protection section at?

- A) I
- B) VI
- C) VII
- D) II

4) Would a doctor's examining room located in a limited care facility be required to meet the provisions of 517.10?

- A) Yes
- B) No

5) _____ includes hospitals, nursing homes, limited care facilities, clinics, dental offices, and portable and permanent ambulatory care centers.

- A) Limited Care Facility
- B) Health care facility
- C) Nursing home
- D) Hospital

Article 517.2 Definitions:

Equipment System is a system of circuits and equipment arranged for delayed, automatic, or manual connection to a alternative power source and that serves mainly 3-phase power equipment.

Battery Powered Lighting Units are individual unit equipment for back up lighting consisting of the following.

- 1) Rechargeable battery
- 2) Battery-charging means
- 3) Provisions for one or more lamps mounted on the equipment, or with terminals for remote lamps or both.
- 4) Relaying device arranged to energize the lamps automatically upon failure of the power to the unit or equipment.

Patient Bed Location: The area of a patients' sleeping bed or the bed or procedure table of a critical care area.

Patient Care Area is any portion of a health facility where patients are intended to be examined or treated. Areas of a health care facility are determined by the governing body of the facility. The governing body designates these areas in accordance with the type of patient care anticipated in each area.

Informational note: Business offices, corridors, lounges, day rooms, dining rooms, or similar areas are not classified as patient care areas.

Emergency System: is a system of circuitry and equipment specifically to supply alternate power to a limited number of prescribed functions vital to the protection of life and safety.

Patient Equipment Grounding Point 's are jack's or terminal's that serve as the collection point for redundant grounding of electrical appliances for patient care vicinity or for grounding other items in order to eliminate electromagnetic interference problems.

Patient Care Vicinity is an area in which patients are cared for. It is a space with surfaces likely to be contacted by the patient or an attendant who can come in contact with the patient. In a patient room, the space within the room is not less than 6 ft. (1.8m) beyond the perimeter of the bed in its normal location, and extending vertically no more than 7 ½ ft. (2.3 m) above the floor.

Selected Receptacles are a minimum number of electrical receptacles to accommodate equipment normally required for local area tasks or likely to be used in patient care emergencies.

Task Illumination is provisions for the minimum lighting required to carry out necessary tasks in certain areas, including but not limited to safe access to supplies and equipment, and access to exits.

6) A system of circuits and equipment set up for automatic, delayed, or a manual connection to an alternate power source and that serves primarily 3-phase power equipment.

- A) Essential electrical system
- B) Equipment system
- C) Isolated power system
- D) Life safety branch

7) Battery powered lighting units are individual equipment for back up illumination consisting of all but one of the following:

- A) Battery charging means
- B) Rechargeable battery
- C) Manual or automatic means of switching
- D) Provisions for one or more lamp to be mounted on the equipment

8) The location of a sleeping bed, or procedure table in a critical care area is called a ____?

- A) Nursing home
- B) Limited facility
- C) Patient care area
- D) Patient bed location

9) Who determines which areas will be designated to be patient care areas?

- A) AHJ
- B) Doctors
- C) The Contractor
- D) The governing body

10) Business offices, hall ways, lounges, day rooms, cafeterias or similar areas _____ classified as patient care areas.

- A) are
- B) are not

11) A system of circuitry and equipment specifically to supply alternate power to a limited number of prescribed functions vital to the protection of life and safety.

- A) Emergency system
- B) Critical branch
- C) Alternate power source
- D) Electrical life-support equipment

12) A jack or terminal that serves as the collection point for redundant grounding of electrical appliances for patient care vicinity or for grounding other items in order to eliminate electromagnetic interference problems.

- A) Reference grounding point
- B) Patient equipment grounding point
- C) Selected receptacles
- D) Psychiatric hospital

13) A patient care vicinity is an area in which the patient's are cared for. It is a space where the patient or attendant may come into contact with surfaces

- A) True
- B) False

14) In a patient room, the space within the room is not less than _____ beyond the perimeter of the bed in its normal location, and extending vertically no more than _____ above the floor.

- A) 7 ½ ft; 6 ft
- B) 8 ft; 7 ½ ft
- C) 6 ft; 7 ½ ft
- D) 5 ft; 8 ft

15) Selected receptacles are the orange with green dot receptacles designated for emergency equipment in a patient care facility.

- A) True
- B) False

16) Does the installation of exit lights fall under the definition of Task Illumination?

- A.) Yes
 - B.) No
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II. Wiring and Protection

Article 517.10 Applicability

The 2011 Code requires:

(A) Applicability – Part II shall apply to patient care areas of all health care facilities.

(B) Not Covered – Part II shall not apply to

(1) Business offices, corridors, waiting rooms, and the areas in like in a clinic, medical or dental office.

(2) Areas of a nursing home and limited care facilities wired in accordance with chapter one of the code where the named areas are used solely as patient sleeping rooms.

517.14 Panel Board Bonding:

As stated in the 2011 Code, the equipment grounding terminal buses of the normal and essential branch-circuit panel boards serving the same individual patient care vicinity shall be connected together with an insulated continuous copper conductor not smaller than 10 AWG. Where two or more panel boards serving the same individual patient care vicinity are served from separate transfer switches on the emergency system, the equipment grounding bus of those panels shall be connected together with an insulated continuous copper conductor no smaller than a 10 AWG. This conductor shall be permitted to be broken in order to terminate on the equipment grounding terminal bus in each panel board.

517.16 Receptacles with Insulated Ground Terminals:

As described in the 2011 Code, receptacles with insulated grounding terminals, as described in 250.146(D), shall not be permitted in Health Care Facilities.

517.18 General Care Area: (A) Patient Bed Location

As required by the 2011 Code, each patient bed location shall be supplied by at least two branch circuits, one from the emergency system and one from the normal system. All branch circuits from the normal system shall originate in the same panel board. The branch circuits serving patient bed locations shall not be part of a multi-wire branch circuit.

Exception NO 1: Branch circuits serving only special purpose outlets or receptacles, such as portable X-ray outlets, shall not be required to be served from the same panel board or distribution panel.

Exception NO 2: Requirements of 517.18(A) shall not apply to patient bed locations in clinics, medical and dental offices, and out patient facilities; psychiatric, substance abuse, and rehabilitation hospitals; sleeping rooms of nursing homes and limited care facilities meeting the requirements of 517.10(B)(2)

Exception NO 3: A general care patient bed location served from two separate transfer switches on the emergency system shall not be required to have circuits from the normal system.

17) Part II of this code _____ apply to business offices, corridors, waiting rooms, and the areas in like in a clinic, medical or dental office.

- A) Shall
- B) Shall not
- C) Will
- D) Will Not

18) The equipment grounding terminal buses of the normal and essential branch-circuit panel boards serving the same individual patient care vicinity are required to be connected together with an insulated continuous copper conductor not smaller than _____.

- A) 8 AWG
- B) 6 AWG
- C) 4 AWG
- D) 10 AWG

19) The equipment grounding terminal bus conductor _____ be permitted to be broken in order to terminate on the equipment grounding terminal bus in each panel board.

- A) Shall
- B) Will
- C) Will not
- D) Shall Not

20) If two or more panel boards serving the same individual patient care vicinity are served from separate _____ on the emergency system, the equipment grounding bus of those panels shall be connected together with an insulated continuous copper conductor no smaller than a 10 AWG.

- A) Panel boards
- B) Transfer switches
- C) Disconnects
- D) Terminals

21) Receptacles with insulated grounding terminals, as described in 250.146(D), _____ be permitted in Health Care Facilities.

- A) Shall
- B) Will
- C) Shall not
- D) Will not

22) Each patient bed location shall be supplied by at least two branch circuits, one from the _____ and one from the normal system.

- A) Isolated system
- B) Emergency system
- C) Essential electrical system
- D) Life safety system

23) _____ serving only special purpose outlets or receptacles, such as portable X-ray outlets, shall not be required to be served from the same panel board or distribution panel.

- A) Emergency systems
- B) Critical care systems
- C) Branch circuits
- D) Standby power

24) A general care patient bed location served from _____ separate transfer switches on the emergency system shall not be required to have circuits from the normal system.

- A) Two
- B) Three
- C) One
- D) Five

517.19 Critical Care Areas (A) Patient Bed Location Branch Circuits.

As stated in the 2011 Code, each patient bed location shall be supplied by at least two circuits, one or more from the emergency system and one or more from the normal system. At least one branch circuit from the emergency panel shall supply a receptacle only at that bed location. Emergency system outlets shall also indicate the panel board and circuit breaker number.

517.19 Critical Care Areas (B) Patient bed location receptacles.

As required by the 2011 Code, each patient bed location must be supplied with at least six receptacles; at least one shall be connected to either of the following:

- (1) The normal system branch circuit required in 517.19 (A)
- (2) A emergency system circuit supplied by a different transfer switch than the other outlets at the same patient bed location

517.19 Critical Care Areas (C) Patient care vicinity grounding and bonding (optional)

As stated in the 2011 Code, a patient care vicinity shall be permitted to have a patient equipment grounding point. The patient equipment grounding point, where installed, shall be permitted to contain one or more listed grounding and bonding jacks. An equipment bonding jumper no smaller than a 10 AWG shall be used to connect the grounding terminal of all ground type receptacles to the patient equipment grounding point. The bonding conductor shall be permitted to be arranged in the center of or looped as convenient.

517.19 Critical Care Areas (D) Equipment Grounding and Bonding

As required by the 2011 Code, and where a grounded electrical distribution system is used and metal feeder raceway or Type MC or MI cable that qualifies as an equipment grounding conductor in accordance with 250.118 is installed, grounding of enclosures and equipment, such as panel boards and switch boards, shall be ensured by one of the following bonding means at each termination or junction point of the metal raceway or type MC or MI cable:

- (1) A grounding bushing and a continuous copper bonding jumper, sized in accordance with 250.122, with the bonding jumper connected to the junction enclosure or the ground bus of the panel.
 - (2) Connection of feeder raceway or type MC or MI cable to threaded hubs or busses on termination enclosures.
 - (3) Other approved devices such as bonding type lock nuts or bushings.
-

25) At least one branch circuit from the emergency panel shall supply a _____ only at that bed location.

- A) Luminaries
- B) GFI
- C) Receptacle
- D) Outlet

26) Each patient bed location must be _____ with at least six receptacles.

- A) Supplied
- B) Equipped
- C) Connected
- D) Energized

27) An emergency system circuit supplied by a different _____ than the other outlets at the same patient bed location.

- A) Safety switch
- B) Transfer switch
- C) Life safety
- D) Patient safety

28) The patient equipment grounding point, if installed, is required to contain one or more _____ grounding and bonding jacks.

- A) Labeled
- B) Listed
- C) Approved
- D) All of the above

29) If a grounded electrical distribution system is used, the metal feeder raceway or type MC or MI cable that is made as an equipment grounding conductor must be installed as per _____.

- A) 210.16
- B) 250.66
- C) 310.16
- D) 250.118

30) Connection of feeder raceway or type MC or MI cable to threaded _____ or busses on termination enclosures.

- A) Hubs
- B) Raceway
- C) Conduit
- D) Connectors

517.19 Critical Care Areas (F) Isolated power system equipment grounding

As stated in the 2011 NEC, where an isolated ungrounded power source is used and limits the first fault current to a low magnitude, the equipment grounding conductor associated with the secondary circuit shall be permitted to run outside of the enclosure of the power conductors in the same circuit.

517.19 Critical Care Areas (G) Special Purpose Receptacle Grounding

As stated in the 2011 Code, the equipment grounding conductor for special purpose outlets, such as operation of mobile x-ray equipment, shall be extended to the reference grounding points of branch circuits for all locations likely to be served from each outlet. Where such a circuit is served from an isolated ungrounded system, the grounding conductor shall not be required to be run with the power conductors; however the equipment grounding terminal of the special purpose outlet shall be connected to the reference grounding point.

517.20 Wet Procedure Locations (A) Receptacles and fixed equipment

As required by the 2011 Code, wet procedure location patient care areas shall be provided with special protection against electric shock by one of the following:

- (1) Power distribution system that inherently limits the possible ground fault current due to the first fault to a low value, without interrupting the power supply.
- (2) Power distribution system in which the power supply is interrupted if the ground fault current does, in fact, exceed a value of 6 mA.

517.20 Wet Procedure Locations (B) Isolated Power Systems

As required by the 2011 Code where an isolated power system is utilized, the isolated power equipment shall be listed as isolated power equipment, and the isolated power system shall be designed and installed according to 517.160.

517.21 Ground Fault Circuit Interrupter Protection for Personnel

As stated in the 2011 Code, a ground fault circuit interrupter for protection of personnel shall not be required for receptacles installed in those critical care areas where the toilet and basin are installed within the patient room.

III Essential Electrical System

517.25 Scope

As stated in the 2011 Code, the essential electrical system for these facilities shall comprise a system capable of supplying a limited amount of lighting and power service, which is considered essential for life safety and orderly cessation of procedures during the time normal electrical service, is interrupted for any reason. This includes clinics, medical and dental offices, out patient facilities, nursing homes, limited care facilities, hospitals and other health care facilities serving patients.

31) The equipment grounding conductor used for critical care areas and associated with the _____ circuit shall be permitted to run outside of the enclosure of the power conductors in the same circuit.

- A) Secondary
- B) Primary
- C) Line side
- D) Load side

32) The grounding conductor for mobile x-ray equipment is not required to be run with the _____ conductors.

- A) Line
- B) Load
- C) Signal
- D) Power

33) A Power distribution system in wet procedure location patient care areas that inherently limits the possible ground fault current due to the first fault to a low value, without _____ the power supply.

- A) Spiking
- B) Ground fault
- C) Limiting
- D) Interrupting

34) The isolated power equipment shall be listed as _____.

- A) designed built
- B) Outdoor rated
- C) Isolated power equipment
- D) Nema 3R

35) A ground fault circuit interrupter for _____ of personnel shall not be required for receptacles installed in critical care areas where the toilet and basin are installed within the patient room.

- A) Patients
- B) Doctors
- C) Protection
- D) Nurses

36) The Scope of section III tells us that Essential Electrical Systems are required to do what in all health care facilities?

- A) Supply a limited amount of lighting and power service
- B) Supply only equipment power
- C) Supply emergency power to only hospitals
- D) Supply emergency lighting to dental offices

517.30 Essential Electrical Systems for Hospitals. (B)(1) General

As required by the 2011 Code, essential electrical systems for hospitals shall be comprised of two separate systems capable of supplying a limited amount of lighting and power service that is considered essential for life safety and effective hospital operation during the time the normal electrical service is interrupted for any reason. These two systems shall be the emergency system and the equipment system.

517.30 Essential Electrical Systems for Hospitals (B)(2) General

As required by the 2011 Code, the emergency system shall be limited to circuits essential to life safety and critical patient care. These are designated as the life safety branch and the critical branch.

517.30 Essential Electrical Systems for Hospitals (B)(3) General

As required by the 2011 Code, the equipment system shall supply major electrical equipment necessary for patient care and basic hospital operations.

517.30 Essential Electrical Systems for Hospitals (B)(4) General:

As required in the 2011 Code, the number of transfer switches to be used shall be based on reliability, design, and load considerations. Each branch of both the emergency and equipment system shall have more than one transfer switch. One transfer switch shall be permitted to serve one or more branches or systems in a facility with a maximum demand on the essential electrical system of 150 kVA.

37) _____ systems for hospitals shall be comprised of two separate systems capable of supplying a limited amount of lighting and power service that is considered essential for life safety

- A) Emergency electrical
- B) Essential electrical
- C) Equipment
- D) Normal Power

38) The Essential Electrical System is comprised of two different systems. What are they?

- A) Normal and emergency systems
- B) Emergency and equipment systems
- C) Equipment and normal systems
- D) Lighting and equipment systems

39) The emergency system is _____ to circuits essential to life safety and critical patient care.

- A) Critical
- B) Emergency
- C) Limited
- D) Branch circuits

40) The hospital emergency equipment is used to supply equipment _____ for care and hospital operation.

- A) Necessary
- B) Required
- C) Needed
- D) Wanted

41) The number of transfer switches to be used in hospitals shall be based on reliability, design, and _____ considerations.

- A) Load
- B) Manufacturer
- C) Authority having jurisdiction
- D) Contractor

42) One hospital transfer switch may be used to serve one or more branches or systems if the demand on the essential electrical system does not exceed _____.

- A) 125 kVA
- B) 200 kVA
- C) 150 kVA
- D) 100 kVA

517.30 Essential Electrical Systems for Hospitals (C) Wiring Requirements (1) Separation from Other Circuits

The life safety branch and the critical branch of the emergency system shall be kept entirely independent of all other wiring and equipment and shall not enter the same raceways, boxes, or cabinets with each other or other wiring.

Wiring of the life safety branch and the critical branch shall be permitted to occupy the same raceways, boxes, or cabinets of other circuits not part of the branch where such wiring complies with one of the following:

- 1) Is in transfer equipment enclosures
- 2) Is in exit or emergency luminaries supplied from two sources
- 3) Is in a common junction box attached to exit or emergency luminaries supplied from two sources
- 4) Is for two or more emergency circuits supplied from the same branch and same transfer switch

The wiring of the equipment system shall be permitted to occupy the same raceways, boxes, or cabinets of other circuits that are not part of the emergency system.

517.30 Essential Electrical Systems for Hospitals (C) Wiring Requirements (2) Isolated Power Systems

Where isolated power systems are installed in any of the areas in 517.33 (A) (1) and

(A) (2), each system shall be supplied by an individual circuit serving no other load.

517.30 Essential Electrical Systems for Hospitals (C)(3) Wiring Requirements

Mechanical Protection of the Emergency Circuits as required by the 2011 code, and the wiring of the emergency systems in hospitals shall be mechanically protected. Where installed as branch circuits in

patient care areas, the installation shall comply with the requirements of 517.13(A) and (B). The following wiring methods shall be permitted.

- (1) Nonflexible metal raceways, type MI cable, or schedule 80 PVC conduits. Nonmetallic raceways shall not be used for branch circuits that supply patient care areas.
- (2) Where encased in not less than 50mm (2in) of concrete, Schedule 40 PVC conduit, flexible nonmetallic or jacketed metallic raceways, or jacketed metallic cable assemblies listed for installation in concrete. Nonmetallic raceways shall not be used for branch circuits that supply patient care areas.
- (3) Listed flexible metal raceways and listed metal sheathed cable assemblies in any of the following:
 - a. Where used in listed prefabricated medical head walls.
 - b. In listed office furnishings.
 - c. Where fished into existing walls or ceilings, not otherwise accessible and not subject to physical damage.
 - d. Where necessary for flexible connection to equipment.
- (4) Flexible power cords of appliances or other utilization equipment connected to the emergency system.
- (5) Cables for class 2 or class 3 systems permitted by Part IV of this article, with or without raceways.

43) Which two branches of the hospital emergency system are required to be kept entirely independent of all other wiring and equipment and shall not enter the same raceways, boxes, or cabinets with each other or other wiring.

- A) Equipment branch and critical branch
- B) Life safety branch and emergency branch
- C) Transfer switch and emergency branch
- D) Life safety branch and the critical branch

44) The hospital wiring of the equipment systems shall be permitted to occupy the same raceways, boxes, or cabinets of other circuits that are not part of the emergency system.

- A) True
- B) False

45) Where a isolated system is installed, each system will be served by a individual circuit serving _____ load.

- A) One other
- B) Two other
- C) No other
- D) Four other

46) Where installed as branch circuits in patient care areas, the installation shall comply with the requirements of _____ (A) and (B).

- A) 517.13
- B) 518.13
- C) 514.13
- D) 310.16

47) _____ raceways shall not be used for branch circuits that supply patient care areas.

- A) Nonflexible
- B) Type MI
- C) Nonmetallic
- D) Schedule 80 PVC

48) Where a raceway is in _____ of concrete for a patient care area, the assemblies must be listed for installation in concrete.

- A) 3 inches
- B) 2 inches
- C) 4 inches
- D) 1 inches

49) Flexible metal raceways and listed metal sheathed cable assemblies for a patient care area are allowed only in which of the following.

- A) Where fished into existing walls or ceilings, not otherwise accessible and not subject to physical damage.
- B) Mechanical rooms
- C) Between the emergency and normal power systems
- D) Coming out of concrete

50) Cables for _____ systems are permitted by Part IV of article 517, with or without raceways.

- A) Class 2 or class 3
- B) Class 1 or class 3
- C) Class 2 or class 4
- D) Emergency

517.30 Essential Electrical Systems for Hospitals (D) Capacity of Systems

As stated in the 2011 Code, the essential electrical system shall have adequate capacity to meet the demand for the operation of all functions and equipment to be served by each system branch.

Feeders shall be sized in accordance with Article 215 and 220. The generator set shall have sufficient capacity and proper rating to meet the demand produced by the load of the essential electrical systems at any given time.

Demand calculations for sizing of the generator set shall be based on any of the following

- (1) Prudent demand factors and historical data

- (2) Connected load
- (3) Feeder calculations based on Article 220
- (4) Any combination of above.

The sizing requirements in 700.4 and 701.4 shall not apply to hospital generator sets.

517.30 Essential Electrical Systems for Hospitals (E) Receptacle Identification

As required by this article in the 2011 Code, the cover plates for the electrical receptacles or the electrical receptacles themselves, supplied from the emergency system shall have a distinctive color or marking so as to be readily identifiable.

517.31 Life Safety Branch

According to the 2011 Code, no function other than those listed in 517.32 (A) through (H) shall be connected to the life safety branch. The life safety branch of the emergency system shall supply power for the following lighting, receptacles, and equipment.

517.31 Life Safety Branch (A) Illumination of Means of Egress

As described in the 2011 code, illumination of means of egress, such as lighting required for corridors, passageways, stairways, and landings at exit doors, and all necessary ways of approach to exits. Switching arrangements to transfer patient corridor lighting in hospitals from general illumination circuits to night illumination circuits shall be permitted, provided only one of the two circuits can be selected and both circuits cannot be extinguished at the same time.

517.31 Life Safety Branch (B) Exit Signs

As stated in the 2011 NEC, exit signs and directional signs will be connected to the life safety branch of the emergency system.

51) Article 517 requires the essential electrical system shall have adequate capacity to meet the demand for the operation of all _____ and equipment to be served by each system branch.

- A) Systems
- B) Functions
- C) Electrical
- D) Loads

52) Demand calculations in article 517 for sizing of the generator conductor set(s) shall be based on any of the following.

- A) Connected load
- B) Feeder calculations based on Article 220
- C) Prudent demand factors and historical data
- D) All listed answers

53) Cover plates or the _____ it's self, supplied from the emergency system in essential electrical systems for hospitals shall have a distinctive color or markings.

- A) Wire
- B) Switch
- C) Device
- D) Receptacle

54) The life safety branch of the emergency system shall supply power for the following lighting, _____, and equipment.

- A) Devices
- B) Switch
- C) Receptacles
- D) Enclosures

55) Illumination for means of egress which is connected to the life safety branch circuit for the hospital emergency system lighting is _____ for corridors, passageways, stairways, and landings at exit doors, and all necessary ways of approach to exits.

- A) Required
- B) Selected
- C) Any lighting
- D) Approaches

56) Switching from day illumination to night illumination as stated in article 517 is allowed as long as _____.

- A) Both are on
- B) Both are off
- C) Only one of the two circuits can be selected.
- D) Both circuits can be switched simultaneously.

57) Exit and directional signs used in health care facilities will be connected to the _____ of the emergency system.

- A) Critical branch
- B) Life safety branch
- C) Source of power
- D) Emergency branch

517.31 Life Safety Branch (C) Alarm and Alerting Systems

As stated in the 2011 Code, alarm and alerting systems including all of the following:

- (1) Fire alarms
- (2) Alarms required for systems used for the piping of non flammable medical gases.
- (3) Mechanical, control, and other accessories required for effective life safety systems operation shall be permitted to be connected to the life safety branch.

517.31 Life Safety Branch (D) Communication Systems

As stated in the 2011 Code, hospital communications systems, where used for issuing instructions during emergency conditions can be connected to the life safety branch.

517.33 Critical Branch (A) Task Illumination and Selected Receptacles

The 2011 Code Requires the critical branch of the emergency system to supply power for task illumination, fixed equipment, selected receptacles, and special power circuits serving the following areas and functions related to patient care:

- (1) Critical care areas that utilize anesthetizing gases – task illumination, selected receptacles, and fixed equipment.
- (2) The isolated power system in special environments.
- (3) Patient care areas – task illumination and selected receptacles in the following areas:
 - (a) Infant nurseries
 - (b) Medication preparation areas
 - (c) Pharmacy dispensing areas
 - (d) Selected acute nursing areas
 - (e) Psychiatric bed areas (omit receptacles)
 - (f) Ward treatment rooms
 - (g) Nurses' stations (unless adequately lighted by corridor luminaries)
- (4) Additional specialized patient care task illumination and receptacles, where needed.
- (5) Nurse call system
- (6) Blood, bone, and tissue banks
- (7) Telephone equipment rooms and closets
- (8) Task illumination, selected receptacles, and selected power circuits for the following:
 - (a) General care beds (at least one duplex receptacle in each patient bedroom)
 - (b) Angiographic labs
 - (c) Cardiac catheterization labs
 - (d) Coronary care units
 - (e) Hemodialysis rooms or areas
 - (f) Emergency room treatment areas (selected)

(g) Human physiology labs

(h) Intensive care units

(i) Postoperative recovery rooms (selected)

(9) Additional task illumination, receptacles, and selected power circuits needed for effective hospital operation. Single-phase fractional horsepower motors shall be permitted to be connected to the critical branch.

58) Mechanical, control, and other accessories required for effective life safety systems operation in article 517 shall be permitted to be _____ to the life safety branch.

- A) Hooked
- B) Connected
- C) Directed
- D) In line

59) The hospital communication system will be allowed to be connected for

- A) Issuing instructions during emergency conditions.
- B) Paging of staff members
- C) Awareness
- D) Communication between doctors and other staff members.

60) The critical branch of the emergency system shall supply power for patient care areas. Which of the following is not a patient care area?

- A) Medication preparation areas
- B) General waiting rooms and corridors
- C) Psychiatric bed areas
- D) Infant nurseries

61) Task illumination, selected receptacles, and selected power circuits for General care beds will have?

- A) All lighting in patient rooms
- B) All receptacles adjacent to bed location
- C) Hallway receptacles closest to nurse's station
- D) At least one duplex receptacle in each patient bedroom

62) _____ fractional horsepower motors shall be permitted to be connected to the critical branch as described in article 517.

- A) Three phase
- B) Large
- C) Single-phase
- D) Over 1000 volts nominal AC

517.33 Critical Branch (B) Subdivision of the Critical Branch.

As required by the 2011 Code, it shall be permitted to subdivide the critical branch into two or more branches.

Informational Note:

It is important to analyze the consequences of supplying an area with only critical care branch power when failure occurs between the area and the transfer switch. Some proportion of normal and critical power or critical power from separate transfer switches may be appropriate.

517.34 Equipment System Connection to Alternate Power Source.

As required by this code, the equipment system shall be installed and connected to the alternate power source such that the equipment described in 517.34(A) is automatically restored to operation at appropriate time-lag intervals following the energizing of the emergency system. Its arrangement shall also provide for the subsequent connection of equipment described in 517.34(B).

Exception: For essential electrical systems less than 150 kVA, deletion of the time-lag intervals feature for delayed automatic connection to the equipment system shall be permitted.

517.34 Equipment System Connection to Alternate Power Source (A) Equipment for Delayed Automatic Connection.

As stated in the 2011 Code, the following equipment shall be permitted to be arranged for delayed automatic connection to the alternate power source:

- 1) Central suction systems serving medical and surgical functions, including controls. Such suction systems shall be permitted on the critical branch.
- (2) Sump pumps and other equipment required to operate for the safety of major apparatus, including associated control systems and alarms.
- (3) Compressed air systems serving medical and surgical functions, including controls. Such air systems shall be permitted on the critical branch.
- (4) Smoke control and stair pressurization systems, or both.
- (5) Kitchen hood supply or exhaust systems, or both, if required to operate during a fire in or under the hood.
- (6) Supply, return, and exhaust ventilating systems for airborne infectious/isolation rooms, protective environment rooms, exhaust fans for laboratory fume hoods, nuclear medicine areas where radioactive material is used, ethylene oxide evacuation, and anesthesia evacuation. Where delayed automatic connection is not appropriate; such ventilation systems shall be permitted to be placed on the critical branch.
- (7) Supply, return, and exhaust ventilating systems for operating and delivery rooms.

Exception: Sequential delayed automatic connection to the alternate power source to prevent overloading the generator shall be permitted where engineering studies indicate it is necessary.

517.34 Equipment System Connection to Alternate Power Source (B) Equipment for Delayed Automatic or Manual Connection

The 2011 Code describes the following equipment shall be permitted to be arranged for either delayed automatic or manual connection to the alternate power source:

(1) Heating equipment to provide heating for operating, delivery, labor, recovery, intensive care, coronary care, nurseries, infection/isolation rooms, emergency treatment spaces, and general patient rooms and pressure maintenance (jockey or make-up) pump(s) for water based fire protection systems.

Exception: Heating of general patient rooms and infection/isolation rooms during disruption of the normal source shall not be required under any of the following conditions:

(1) *The outside design temperature is higher than -6.7°C (20°F).*

(2) *The outside design temperature is lower than -6.7°C (20°F), and where a selected room(s) is provided for the needs of all confined patients, only such room(s) need be heated.*

(3) *The facility is served by a dual source of normal power.*

Informational Note No. 1: The design temperature is based on the 97 1/2 percent design value as shown in Chapter 24 of the ASHRAE *Handbook of Fundamentals* (1997).

Informational Note No. 2: For a description of a dual source of normal power, see 517.35(C) Informational Note.

(2) An elevator(s) selected to provide service to patient, surgical, obstetrical, and ground floors during interruption of normal power. In instances where interruption of normal power would result in other elevators stopping between floors, throw-over facilities shall be provided to allow the temporary operation of any elevator for the release of patients or other persons who may be confined between floors.

(3) Hyperbaric facilities.

(4) Hypobaric facilities.

(5) Automatically operated doors

(6) Minimal electrically heated autoclaving equipment shall be permitted to be arranged for either automatic or manual connection to the alternate source.

(7) Controls for equipment listed in 517.34.

(8) Other selected equipment shall be permitted to be served by the equipment system.

63) It shall be permitted to _____ the health care facility critical branch circuit into two or more branches.

A) Subdivide

B) Tap

C) Split

D) Narrow down

64) The health care facility equipment system shall be installed and connected to the alternate power source such that the equipment described in _____ is automatically restored to operation at appropriate time-lag intervals following the energizing of the emergency system.

- A) 517.12
- B) 322.38
- C) 517.34(A)
- D) 240.12(A)(2)(b)

65) Which of the following equipment shall not be permitted to be arranged for delayed automatic connection to the alternate power source with regards to health care facilities?

- A) Lighting control panels in critical care areas.
- B) Sump pumps and other equipment required to operate for the safety of major apparatus.
- C) Smoke control and stair pressurization systems, or both.
- D) Central suction systems serving medical and surgical functions, including controls

66) Sequential _____ automatic connection to the alternate power source to prevent overloading the generator in a health care facility shall be permitted where engineering studies indicate it is necessary

- A) Relayed
- B) Delayed
- C) Bypassed
- D) Ramp-up

67) Article 517 allows the following equipment shall be permitted to be arranged for either delayed automatic or manual connection to the alternate power source.

- A) Neo natal infant care unit
- B) Automatically operated doors
- C) Hypobaric facilities
- D) Hyperbaric facilities

**517.34 Equipment System Connection to Alternate Power Source
(C) AC Equipment for No delayed Automatic Connection.**

As required by the 2011 Code, generator accessories, including but not limited to, the transfer fuel pump, electrically operated louvers, and other generator accessories essential for generator operation, shall be arranged for automatic connection to the alternate power source.

517.35 Sources of Power (A) Two Independent Sources of Power

As required by the 2011 Code, the essential electrical systems shall have a minimum of two independent sources of power: a normal source generally supplying the entire electrical system and one or more alternate sources for use when the normal source is interrupted.

517.35 Sources of Power (B) Alternate Source of Power.

As stated in this code, the alternate source of power shall be one of the following:

- (1) Generator(s) driven by some form of prime mover(s) and located on the premises

(2) Another generating unit(s) where the normal source consists of a generating unit(s) located on the premises

(3) An external utility service when the normal source consists of a generating unit(s) located on the premises

(4) A battery system located on the premises

517.35 Sources of Power (C) Location of Essential Electrical System Components.

As required by the 2011 Code, careful consideration shall be given to the location of the spaces housing the components of the essential electrical system to minimize interruptions caused by natural forces common to the area (e.g., storms, floods, earthquakes, or hazards created by adjoining structures or activities). Consideration shall also be given to the possible interruption of normal electrical services resulting from similar causes as well as possible disruption of normal electrical service due to internal wiring and equipment failures.

517.40 Essential Electrical Systems for Nursing Homes and Limited Care Facilities (B) Inpatient Hospital Care Facilities

The 2011 code states that those nursing homes and limited care facilities that admit patients who need to be sustained by electrical life support equipment, the essential electrical system from the source to the portion of the facility where such patients are treated shall comply with the requirements of Part III, 517.30 through 517.35.

68) _____ accessories not limited to the transfer fuel pump, electrically operated louvers, and other generator accessories as described in article 517.

- A) Emergency
- B) Generator
- C) Equipment
- D) Fixed equipment

69) Essential health care facility electrical systems shall have a minimum of _____ independent sources of power

- A) Three
- B) One
- C) Five
- D) Two

70) In Article 517.35 (B), all alternate power sources have one main thing in common

- A) All are green energy
- B) All are generator power
- C) Must be on premises
- D) Utility driven

71) Article 517 requires careful consideration to be given to the location of the spaces housing the components of the _____ electrical system to minimize interruptions caused by natural forces common to the area

- A) Essential
- B) Emergency
- C) Isolated
- D) Life safety

72) Nursing homes and limited care facilities that admit patients who need to be sustained by _____ life support equipment.

- A) Emergency
- B) Essential
- C) Required
- D) Electrical

517.35 Sources of Power (C) Facilities Contiguous or Located on the Same Site with Hospitals

As stated in the 2011 Code, careful consideration shall be given to the location of the spaces housing the components of the essential electrical system to minimize interruptions caused by natural forces common to the area (e.g., storms, floods, earthquakes, or hazards created by adjoining structures or activities). Consideration shall also be given to the possible interruption of normal electrical services resulting from similar causes as well as possible disruption of normal electrical service due to internal wiring and equipment failures.

Informational Note: Facilities in which the normal source of power is supplied by two or more separate central station-fed services experience greater than normal electrical service reliability than those with only a single feed. Such a dual source of normal power consists of two or more electrical services fed from separate generator sets or a utility distribution network that has multiple power input sources and is arranged to provide mechanical and electrical separation so that a fault between the facility and the generating sources is not likely to cause an interruption of more than one of the facility service feeders.

517.40 Essential Electrical Systems for Nursing Homes and Limited Care Facilities. (A) Applicability.

In the 2011 Code, the requirements of Part III, 517.40(C) through 517.44, shall apply to nursing homes and limited care facilities.

Exception: The requirements of Part III, 517.40(C) through 517.44, shall not apply to freestanding buildings used as nursing homes and limited care facilities, provided that the following apply:

(a) Admitting and discharge policies are maintained that preclude the provision of care for any patient or resident who may need to be sustained by electrical life support equipment.

(b) No surgical treatment requiring general anesthesia is offered.

(c) An automatic battery-operated system(s) or equipment is provided that shall be effective for at least 1 1/2 hours and is otherwise in accordance with 700.12 and that

shall be capable of supplying lighting for exit lights, exit corridors, stairways, nursing stations, medical preparation areas, boiler rooms, and communications areas. This system shall also supply power to operate all alarm systems.

517.40 Essential Electrical Systems for Nursing Homes and Limited Care Facilities (B) Inpatient Hospital Care Facilities.

The 2011 Code states that for those nursing homes and limited care facilities that admit patients who need to be sustained by electrical life support equipment, the essential electrical system from the source to the portion of the facility where such patients are treated shall comply with the requirements of Part III, 517.30 through 517.35.

517.40 Essential Electrical Systems for Nursing Homes and Limited Care Facilities (C) Facilities Contiguous or Located on the Same Site with Hospitals.

As described in the 2011 Code, nursing homes and limited care facilities that are contiguous or located on the same site with a hospital shall be permitted to have their essential electrical systems supplied by that of the hospital.

517.41 Essential Electrical Systems (A) General.

As required by the 2011 Code, the essential electrical systems for nursing homes and limited care facilities shall be comprised of two separate branches capable of supplying a limited amount of lighting and power service, which is considered essential for the protection of life safety and effective operation of the institution during the time normal electrical service is interrupted for any reason. These two separate branches shall be the life safety branch and the critical branch.

73) Article 517 requires careful consideration to be given to the location of the essential electrical system to minimize interruptions created by natural _____ common to the area.

- A) Elements
- B) Forces
- C) Hazards
- D) Human

74) As described in article 517, an automatic battery-operated system(s) or equipment when provided shall be effective for at least _____ hours.

- A) 2
- B) ½
- C) 1 ½
- D) 3

75) If a limited care facility admits patients who need to be sustained by electrical life support equipment, the _____ electrical system from the source to the portion of the facility where patients are treated must comply with part III of article 517.

- A) Essential
- B) Emergency
- C) Life safety
- D) Normal

76) A _____ that is contiguous or on same site as a hospital is allowed to have its essential system supplied by the hospital.

- A) Hospital
- B) Nursing home
- C) ICU
- D) Entry way

77) Essential electrical systems for nursing homes and limited care facilities shall be comprised of two separate branches capable of supplying a _____ amount of lighting and power service.

- A) Limited
- B) Maximum
- C) Small
- D) Selected

517.41 Essential Electrical Systems (B) Transfer Switches.

As stated in the 2011 Code, the number of transfer switches to be used shall be based on reliability, design, and load considerations. Each branch of the essential electrical system shall be served by one or more transfer switches. One transfer switch shall be permitted to serve one or more branches or systems in a facility with a maximum demand on the essential electrical system of 150 kVA.

517.41 Essential Electrical Systems (C) Capacity of System.

As required by the 2011 NEC, the essential electrical system shall have adequate capacity to meet the demand for the operation of all functions and equipment to be served by each branch at one time.

517.41 Essential Electrical Systems (D) Separation from Other Circuits.

It states in the 2011 Code that the life safety branch shall be kept entirely independent of all other wiring and equipment and shall not enter the same raceways, boxes, or cabinets with other wiring except as follows:

- (1) In transfer switches
- (2) In exit or emergency luminaries supplied from two sources
- (3) In a common junction box attached to exit or emergency luminaries supplied from two sources

The wiring of the critical branch shall be permitted to occupy the same raceways, boxes, or cabinets of other circuits that are not part of the life safety branch.

517.41 Essential Electrical Systems (E) Receptacle Identification.

As required by the 2011 Code, the cover plates for the electrical receptacles or the electrical receptacles themselves supplied from the emergency electrical system shall have a distinctive color or marking so as to be readily identifiable.

517.42 Automatic Connection to Life Safety Branch.

As stated in the 2011 Code, the life safety branch shall be installed and connected to the alternate source of power so that all functions specified herein shall be automatically restored to operation within 10 seconds after the interruption of the normal source. No functions other than those listed in 517.42(A) through (G) shall be connected to the life safety branch. The life safety branch shall supply power for the following lighting, receptacles, and equipment.

78) The number of transfer switches to be used for essential electrical systems shall be based on reliability, design, and _____ considerations.

- A) Line
- B) Power
- C) Sustainability
- D) Load

79) The essential electrical system shall have adequate capacity to meet the _____ for the operation of all functions and equipment to be served by each branch at one time.

- A) Liability
- B) Authority having jurisdiction
- C) Demand
- D) Leverage

80) The life safety branch of an essential electrical system shall be kept entirely _____ of all other wiring and equipment.

- A) Separated
- B) Combined
- C) Independent
- D) Together

81) The wiring of the _____ branch shall be permitted to occupy the same raceways, boxes, or cabinets of other circuits that are not part of the life safety branch.

- A) Critical
- B) Emergency
- C) Life support
- D) Life safety

82) All receptacle cover plates or receptacles themselves will have a distinctive _____ or marking.

- A) Color
- B) Circuit
- C) Identifiable
- D) Etched

83) The life safety branch circuit is required to be installed and connected to the alternate source of power so that all functions specified herein shall be automatically restored to operation within _____ seconds after the interruption of the normal source.

- A) 20
- B) 10
- C) 30
- D) 5

517.42 Automatic Connection to Life Safety Branch (A) Illumination of Means of Egress

Required by the 2011 Code, the illumination of means of egress as is necessary for corridors, passageways, stairways, landings, and exit doors and all ways of approach to exits. Switching arrangement to transfer patient corridor lighting from general illumination circuits shall be permitted, providing only one of two circuits can be selected and both circuits cannot be extinguished at the same time.

517.42 Automatic Connection to Life Safety Branch (B) Exit Signs.

The 2011 Code states that exit signs and exit directional signs shall be connected to the life safety branch.

517.42 Automatic Connection to Life Safety Branch (C) Alarm and Alerting Systems

As stated in the 2011 Code for health care facilities, the alarm and alerting systems connected to the life safety branch circuit including the following:

- (1) Fire alarms
- (2) Alarms required for systems used for the piping of nonflammable medical gases

517.42 Automatic Connection to Life Safety Branch (D) Communications Systems

As required by the 2011 Code, the communications systems, where used for issuing instructions during emergency conditions.

517.42 Automatic Connection to Life Safety Branch (E),(F), and (G) Dining and Recreation Areas

Sufficient lighting in dining and recreation areas to provide illumination to exit ways. Task illumination and selected receptacles in the generator set location. Elevator cab lighting, control, communications, and signal systems shall be automatically connected to the life safety branch.

517.43 Connection to Critical Branch.

As required by the 2011 Code, the critical branch shall be installed and connected to the alternate power source so that the equipment listed in 517.43(A) shall be automatically restored to operation at appropriate time-lag intervals following the restoration of the life safety branch to operation. Its arrangement shall also provide for the additional connection of equipment listed in 517.43(B) by either delayed automatic or manual operation.

Exception: For essential electrical systems under 150 kVA, deletion of the time-lag intervals feature for delayed automatic connection to the equipment system shall be permitted.

84) The switching arrangement to transfer patient corridor lighting from general illumination circuits as described in article 517 shall be permitted, providing only one of two circuits can be selected and both circuits cannot be _____ at the same time.

- A) Turned
- B) Automated
- C) Extinguished
- D) Switched

85) The fire alarm, exit signs and nonflammable medical gases alarm are not required to be connected to the life safety branch.

- A) True
- B) False

86) Where used for issuing instructions during emergency conditions, the _____ system will be connected to the life safety branch circuit.

- A) Communications
- B) Telecom
- C) Intercom
- D) Telegraph

87) Which of the following is not required to be connected to the life safety?

- A) Generator set
- B) Elevators
- C) Parking lot lights
- D) Dining and recreation

88) As allowed in article 517 for essential electrical systems under _____, deleting the time-lag intervals feature shall be permitted.

- A) 150 kVA
- B) 200 kVA
- C) 100 kVA
- D) 500 kVA

517.43 Connection to Critical Branch (A) Delayed Automatic Connection.

As stated in this code, the following equipment shall be permitted to be connected to the critical branch and shall be arranged for delayed automatic connection to the alternate power source:

- (1) Patient care areas — task illumination and selected receptacles in the following:
 - a. Medication preparation areas
 - b. Pharmacy dispensing areas
 - c. Nurses' stations (unless adequately lighted by corridor luminaries)
- (2) Sump pumps and other equipment required to operate for the safety of major apparatus and associated control systems and alarms
- (3) Smoke control and stair pressurization systems

(4) Kitchen hood supply and/or exhaust systems, if required to operate during a fire in or under the hood

(4) Supply, return, and exhaust ventilating systems for airborne infectious isolation rooms

517.43 Connection to Critical Branch (B) Delayed Automatic or Manual Connection.

As stated in the 2011 Code, the following equipment shall be permitted to be connected to the critical branch circuit and shall be arranged for either delayed automatic or manual connection to the alternate power source:

(1) Heating equipment to provide heating for patient rooms.

Exception: Heating of general patient rooms during disruption of the normal source shall not be required under any of the following conditions:

(1) The outside design temperature is higher than -6.7°C (20°F).

(2) The outside design temperature is lower than -6.7°C (20°F) and where a selected room(s) is provided for the needs of all confined patients, only such room(s) need be heated.

(3) The facility is served by a dual source of normal power as described in 517.44(C), Informational Note.

Informational Note: The outside design temperature is based on the 97 1/2 percent design values as shown in Chapter 24 of the ASHRAE Handbook of Fundamentals (1997).

(2) Elevator service — in instances where disruption of power would result in elevators stopping between the temporary operations of any elevator for the release of passengers. For elevator cab lighting, control, and signal system requirements, see 517.42(G).

(3) Additional illumination, receptacles, and equipment shall be permitted to be connected only to the critical branch.

517.44 Sources of Power (A) Two Independent Sources of Power.

As required by the 2011 Code, the essential electrical systems shall have a minimum of two independent sources of power: a normal source generally supplying the entire electrical system and one or more alternate sources for use when the normal source is interrupted.

89) Which of the following does not have to be connected to the delayed automatic connection of the critical branch circuit?

A) Waiting rooms

B) Pharmacy dispensing areas

C) Medication preparation areas

D) Nurses' stations (unless adequately lighted by corridor luminaries)

90) Supply and return air, Kitchen hood supply, smoke control system, and sump pumps are some equipment permitted to be connected to the _____ and arranged for auto delay.

- A) Life safety
- B) Critical branch
- C) Emergency power
- D) Battery back up system

91) For either delayed automatic or manual connection to the alternate power source for heating equipment to provide heating for patient rooms as long as the temperature is higher or lower than _____.

- A) 35 F
- B) 15 F
- C) 20 F
- D) 25 F

92) Adding additional illumination, receptacles, and _____ not required by Article 517.43 of this code is allowed to be connected to the critical branch.

- A) Equipment
- B) Carts
- C) Computers
- D) Televisions

93) The essential electrical systems for health care facilities will have a _____ of two independent sources of power.

- A) No more than
- B) Maximum
- C) At least
- D) Minimum

517.44 Sources of Power (B) Alternate Source of Power.

As required by the 2011 Code, the alternate source of power shall be a generator(s) driven by some form of prime mover(s) and located on the premises.

Exception No. 1: Where the normal source consists of generating units on the premises, the alternate source shall be either another generator set or an external utility service.

Exception No. 2: Nursing homes or limited care facilities meeting the requirement of 517.40(A) and other health care facilities meeting the requirement of 517.45 shall be permitted to use a battery system or self-contained battery integral with the equipment.

517.44 Sources of Power (C) Location of Essential Electrical System Components.

As stated in the 2011 Code, careful consideration shall be given to the location of the spaces housing the components of the essential electrical system to minimize interruptions caused by natural forces common to the area (e.g., storms, floods, earthquakes, or hazards created by adjoining structures or activities). Consideration shall also be given to the possible interruption of normal electrical services resulting from similar causes as well as possible disruption of normal electrical service due to internal wiring and equipment failures.

Informational Note: Facilities in which the normal source of power is supplied by two or more separate central station-fed services experience greater than normal electrical service reliability than those with only a single feed. Such a dual source of normal power consists of two or more electrical services fed from separate generator sets or a utility distribution network that has multiple power input sources and is arranged to provide mechanical and electrical separation so that a fault between the facility and the generating sources will not likely cause an interruption of more than one of the facility service feeders.

517.45 Essential Electrical Systems for Other Health Care Facilities

The following conditions as stated in the 2011 Code for the use in other health care facilities.

- (A) Essential Electrical Distribution. The essential electrical distribution system shall be a battery or generator system.
- (B) Electrical Life Support Equipment. Where electrical life support equipment is required, the essential electrical distribution system shall be as described in 517.30 through 517.35
- (C) Critical Care Areas. Where critical care areas are present, the essential electrical distribution system shall be as described in 517.30 through 517.35.
- (D) Power Systems. Battery systems shall be installed in accordance with the requirements of Article 700, and generator systems shall be as described in 517.30 through 517.35.

517.60 Anesthetizing Location Classification (A) Hazardous (Classified) Location. The 2011 Code requires Anesthetizing Location Classifications to be classified as listed below.

- (1) Use Location: In a location where flammable anesthetics are employed, the entire area shall be considered to be a Class I, Division 1 location that extends upward to a level 1.52 m (5 ft) above the floor. The remaining volume up to the structural ceiling is considered to be above a hazardous (classified) location.
- (2) Storage Location: Any room or location in which flammable anesthetics or volatile flammable disinfecting agents are stored shall be considered to be a Class I, Division 1 location from floor to ceiling.

94) The alternate source of power with regards to health care facilities shall be a generator and located on the_____.

- A) Block
- B) Site
- C) Premises
- D) with in sight

95) According to the article 517 exceptions, if already using a generator as the normal source, you may also use another generator or an external._____.

- A) Battery
- B) Power source
- C) Inverter
- D) Utility

96) The location of essential electrical systems must be chosen to minimize the affects caused by _____ common to the area.

- A) Natural forces
- B) Short circuiting
- C) Over current suppressors
- D) Surging

97) The essential electrical systems with regards to article 517 shall be a _____ or generator set.

- A) Solar
- B) Battery
- C) Steam generation
- D) Nuclear

98) Battery systems as stated in article 517 shall be installed in accordance with the requirements of Article _____.

- A) 754
- B) 700
- C) 517
- D) 310

99) In an area where flammable anesthetics are used, the entire area shall be considered a _____ location.

- A) Class 1, Division 2
- B) Class 2, Division 2
- C) Class 2, Division 1
- D) Class 1, Division 1

517.60 Anesthetizing Location Classification (B) Other-Than-Hazardous (Classified) Location

As required by the 2011 Code, any inhalation anesthetizing location designated for the exclusive use of nonflammable anesthetizing agents shall be considered to be an other-than-hazardous (classified) location.

517.61 Wiring and Equipment (A) Within Hazardous (Classified) Anesthetizing Locations.

Where as stated in the 2011 code, the following will apply:

(1) Isolation Except as permitted in 517.160, each power circuit within, or partially within, a flammable anesthetizing location as referred to in 517.60 shall be isolated from any distribution system by the use of an isolated power system.

(2) Design and Installation.

Where an isolated power system is utilized, the isolated power equipment shall be listed as isolated power equipment and the isolated power system shall be designed and installed in accordance with 517.160.

(3) Equipment Operating at More Than 10 Volts.

In hazardous (classified) locations referred to in 517.60, all fixed wiring and equipment and all portable equipment, including lamps and other utilization equipment, operating at more than 10 volts between conductors shall comply with the requirements of 501.1 through 501.25, and 501.100 through 501.150, and 501.30(A) and 501.30(B) for Class I, Division 1 locations. All such equipment shall be specifically approved for the hazardous atmospheres involved.

(4) Extent of Location.

Where a box, fitting, or enclosure is partially, but not entirely, within a hazardous (classified) location(s), the hazardous (classified) location(s) shall be considered to be extended to include the entire box, fitting, or enclosure.

(5) Receptacles and Attachment Plugs.

Receptacles and attachment plugs in a hazardous (classified) location(s) shall be listed for use in Class I, Group C hazardous (classified) locations and shall have provision for the connection of a grounding conductor.

(6) Flexible Cord Type.

Flexible cords used in hazardous (classified) locations for connection to portable utilization equipment, including lamps operating at more than 8 volts between conductors, shall be of a type approved for extra hard usage in accordance with Table 400.4 and shall include an additional conductor for grounding.

(7) Flexible Cord Storage.

A storage device for the flexible cord shall be provided and shall not subject the cord to bending at a radius of less than 75 mm (3 in.).

517.61 Wiring and Equipment (B)(6) Above Hazardous (Classified) Anesthetizing Locations

The 2011 Code requires receptacles and attachment plugs rated 250 volts, for connection of 50-ampere and 60-ampere ac medical equipment for use above hazardous (classified) locations, to be arranged so that the 60-ampere receptacle will accept either the 50-ampere or the 60-ampere plug. Fifty ampere receptacles shall be designed so as not to accept the 60-ampere attachment plug. The attachment plugs shall be of the 2-pole, 3-wire design with a third contact connecting to the insulated (green or green with yellow stripe) equipment grounding conductor of the electrical system.

100) Any inhalation anesthetizing location used for the exclusive use of _____ anesthetizing agents shall be considered to be an other-than-hazardous (classified) location.

- A) Fast acting
- B) Bottled
- C) Nonflammable
- D) IV induced

101) Each power circuit in or partially in a flammable anesthetizing location is required to be _____ from any power distribution system.

- A) Combined
- B) Disconnected
- C) Bypassed
- D) Isolated

102) When an isolated power system is used as described in article 517, all equipment shall be _____ as isolated power equipment.

- A) Approved
- B) Stamped
- C) Labeled
- D) Listed

103) If a box, enclosure or fitting is partially within a _____ location, the location is required to be extended to include the entire box, fitting, or enclosure.

- A) Hazardous
- B) Classified
- C) Isolated
- D) Emergency

104) Receptacles and attaching plugs in a hazardous location shall be listed for use in a _____ location, and shall have a provision for a grounding conductor.

- A) Class 2, Group D
- B) Class 1, Group C
- C) Class 1, Group A
- D) Class 2, Group C

105) If a 60 amp receptacle and attachment plug are used above hazardous locations, the 60 amp plug will be allowed to receive what amps.

- A) 60 ampere only
- B) 50 ampere only
- C) Both 50 & 60 ampere
- D) Neither

517.63 Grounded Power Systems in Anesthetizing Locations (A) Battery-Powered Lighting Units.

As required by the 2011 Code, one or more battery-powered lighting units shall be provided and shall be permitted to be wired to the critical lighting circuit in the area and connected ahead of any local switches.

517.63 Grounded Power Systems in Anesthetizing Location (B) Branch-Circuit Wiring.

As stated in the 2011 Code, the branch circuits supplying only listed, fixed, therapeutic and diagnostic equipment, permanently installed above the hazardous (classified) location and in other-than-hazardous (classified) locations, shall be permitted to be supplied from a normal grounded service, single- or three-phase system, provided the following apply:

- (1) Wiring for grounded and isolated circuits does not occupy the same raceway or cable.
- (2) All conductive surfaces of the equipment are connected to an equipment grounding conductor.
- (3) Equipment (except enclosed X-ray tubes and the leads to the tubes) is located at least 2.5 m (8 ft) above the floor or outside the anesthetizing location.

(4) Switches for the grounded branch circuit are located outside the hazardous (classified) location.

Exception: Sections 517.63(B)(3) and (B)(4) shall not apply in other-than-hazardous (classified) locations.

517.63 Grounded Power Systems in Anesthetizing Location (C) Fixed Lighting Branch Circuits.

As required by the 2011 Code, the branch circuits supplying only fixed lighting shall be permitted to be supplied by a normal grounded service provided the following apply:

- (1) Such luminaries are located at least 2.5 m (8 ft) above the floor.
- (2) All conductive surfaces of luminaries are connected to an equipment grounding conductor.
- (3) Wiring for circuits supplying power to luminaries does not occupy the same raceway or cable for circuits supplying isolated power.
- (4) Switches are wall-mounted and located above hazardous (classified) locations.

517.63 Grounded Power Systems in Anesthetizing Location (D) Remote-Control Stations.

As required by the 2011 Code, wall-mounted remote-control stations for remote-control switches operating at 24 volts or less shall be permitted to be installed in any anesthetizing location.

517.63 Grounded Power Systems in Anesthetizing Location (E) Location of Isolated Power Systems.

As stated in the 2011 Code, and where an isolated power system is utilized, the isolated power equipment shall be listed as isolated power equipment. Isolated power system equipment and its supply circuit shall be permitted to be located in an anesthetizing location, provided it is installed above a hazardous (classified) location or in other-than-hazardous (classified) location.

106) How many battery powered lighting units are required in anesthetizing locations?

- A) One
- B) Three
- C) Two
- D) Five

107) Which of the following do not apply to article 517.63, the grounded power systems in anesthetizing locations.

- A) All conductive surfaces of the equipment are connected to an equipment grounding conductor
- B) Switches for the grounded branch circuit are located outside the hazardous (classified) location
- C) Equipment is located at least 3ft above the floor or outside the anesthetizing location.
- D) Wiring for grounded and isolated circuits does not occupy the same raceway or cable.

108) Fixed luminaries in anesthetizing locations powered by a normal grounded service must be at least _____ above the floor.

- A) 10ft
- B) 6ft
- C) 9ft
- D) 8ft

109) All wall-mounted remote-control stations for remote-control switches in anesthetizing locations operating at _____ or less are permitted to be installed in any location.

- A) 28 Volts
- B) 24 volts
- C) 30 Volts
- D) 36 Volts

110) When an isolated power system is used, the isolated power equipment is required to be listed as _____.

- A) Emergency equipment
- B) Safety equipment
- C) Isolated power equipment
- D) Anesthetizing equipment

517.64 Low-Voltage Equipment and Instruments. (A) Equipment Requirements.

The 2011 Code requires low-voltage equipment that is frequently in contact with the bodies of persons or has exposed current-carrying elements to comply with one of the following:

- (1) Operate on an electrical potential of 10 volts or less
- (2) Be approved as intrinsically safe or double-insulated equipment
- (3) Be moisture resistant

517.64 Low-Voltage Equipment and Instruments (B) Power Supplies.

The 2011 Code requires power that is to be supplied to low-voltage equipment to comply with one of the following:

- (1) An individual portable isolating transformer (autotransformers shall not be used) connected to an isolated power circuit receptacle by means of an appropriate cord and attachment plug
- (2) A common low-voltage isolating transformer installed in other-than-hazardous (classified) location
- (3) Individual dry-cell batteries
- (4) Common batteries made up of storage cells located in other-than-hazardous (classified) location

517.64 Low-Voltage Equipment and Instruments (C) Isolated Circuits.

In the 2011 Code, isolating-type transformers for supplying low-voltage circuits shall have both of the following:

- (1) Approved means for insulating the secondary circuit from the primary circuit
- (2) The core and case connected to an equipment grounding conductor

517.64 Low-Voltage Equipment and Instruments (D) Controls.

As stated in the 2011 Code, resistance or impedance devices shall be permitted to control low-voltage equipment but shall not be used to limit the maximum available voltage to the equipment.

517.64 Low-Voltage Equipment and Instruments (E) Battery-Powered Appliances.

As required by the 2011 NEC, battery-powered appliances shall not be capable of being charged while in operation unless their charging circuitry incorporates an integral isolating-type transformer.

517.64 Low-Voltage Equipment and Instruments (F) Receptacles or Attachment Plugs.

The 2011 Code requires any receptacle or attachment plug used on low-voltage circuits to be of a type that does not permit interchangeable connection with circuits of higher voltage.

Informational Note: Any interruption of the circuit, even circuits as low as 10 volts, either by any switch or loose or defective connections anywhere in the circuit, may produce a spark that is sufficient to ignite flammable anesthetic agents.

111) Which of the following is not a requirement for low voltage equipment in health care facilities.

- A) Be moisture resistant
- B) Operate on an electrical potential of 10 volts or less
- C) Be listed and labeled as an exposed device
- D) Be approved as intrinsically safe or double-insulated equipment

112) Article 517 requires low voltage power for instruments and equipment to not be supplied by _____.

- A) Autotransformers
- B) Dry cell batteries
- C) Batteries made up of storage cells
- D) Chord and attachment plugs

113) Isolation type transformers used for supplying low voltage circuits in health care facilities are required to have the core and _____ connected to an equipment grounding conductor.

- A) Delta
- B) Wye
- C) Line
- D) Case

114) Resistance or impedance devices used in health care facilities are permitted to control _____ equipment but not to limit their maximum allowable voltage.

- A) Line voltage
- B) Load voltage
- C) Low-voltage
- D) Control voltage

115) Battery-powered appliances cannot be capable of being charged while in operation unless their charging circuitry incorporates an integral isolating-type _____ when used in health care facilities.

- A) Transformer
- B) Inverter
- C) Converter
- D) Electrode

116) When used in health care facilities, receptacles or attachment plugs used on low voltage equipment are not permitted to interchange with _____ voltage circuits.

- A) Lower
 - B) Same
 - C) Higher
 - D) Transformed
-

V. X-Ray Installations

517.71 Connection to Supply Circuit (A) Fixed and Stationary Equipment.

As required by the 2011 Code, any fixed and stationary X-ray equipment shall be connected to the power supply by means of a wiring method complying with applicable requirements of Chapters 1 through 4 of this *Code*, as modified by this article.

Exception: Equipment properly supplied by a branch circuit rated at not over 30 amperes shall be permitted to be supplied through a suitable attachment plug and hard service cable or cord.

517.71 Connection to Supply Circuit (B) Portable, Mobile, and Transportable Equipment.

As required by the 2011 Code, individual branch circuits shall not be required for portable, mobile, and transportable medical X-ray equipment requiring a capacity of not over 60 amperes.

517.72 Disconnecting Means (A) Capacity.

As required by the 2011 Code, the disconnecting means of adequate capacity for at least 50 percent of the input required for the momentary rating or 100 percent of the input required for the long-time rating of the X-ray equipment, whichever is greater, shall be provided in the supply circuit.

517.72 Disconnecting Means (B) Location.

As stated in the 2011 Code, the disconnecting means shall be operable from a location readily accessible from the X-ray control.

517.72 Disconnecting Means (C) Portable Equipment.

As stated by the 2011 Code for equipment connected to a 120-volt branch circuit of 30 amperes or less, a grounding type attachment plug and receptacle of proper rating shall be permitted to serve as a disconnecting means.

517.73 Rating of Supply Conductors and Over current Protection (B) Therapeutic Equipment.

As required by the 2011 Code, the ampacity of conductors and rating of over current protective devices shall not be less than 100 percent of the current rating of medical X-ray therapy equipment.

Informational Note: The ampacity of the branch-circuit conductors and the ratings of disconnecting means and over current protection for X-ray equipment are usually designated by the manufacturer for the specific installation.

517.74 Control Circuit Conductors (B) Minimum Size of Conductors.

The 2011 Code allows size 18 AWG or 16 AWG fixture wires as specified in 725.49 and flexible cords shall be permitted for the control and operating circuits of X-ray and auxiliary equipment where protected by not larger than 20-ampere over current devices.

117) X ray equipment properly supplied by a circuit not over 30 amps can use an attachment plug and hard service _____ or chord.

- A) Wire
- B) Type MC cable
- C) Cable
- D) Non-metallic liquid tight

118) Individual _____ circuits shall not be required for portable x-ray equipment requiring a capacity of not over 60 amps.

- A) Safety
- B) Emergency
- C) Supplemental
- D) Branch

119) _____ or _____ percent of the input voltage will be required for the X-ray disconnecting means in a health care facility, whichever is greater according to the equipment.

- A) 50 / 100
- B) 25 / 75
- C) 100 / 125
- D) 35 / 95

120) An X-ray machine disconnect is required to be operable from a location readily _____ from the control room.

- B) Line of sight
- A) Accessible
- C) Within 25 feet
- D) Close to

121) A grounding attachment plug can be used as a disconnect for portable equipment in health care facilities if the current is _____ amps or less.

- A) 20
- B) 40
- C) 30
- D) 25

122) Over current protection for therapeutic equipment shall not be less than _____ percent of the current rating of medical X-ray machine.

- A) 125
- B) 50
- C) 95
- D) 100

123) _____ chords are permitted for the operating and control circuits of auxiliary and x-ray equipment if the circuit is no larger than 20 amps.

- A) Flexible
- B) Solid
- C) Small
- D) Heavy

517.75 Equipment Installations.

Required by the 2011 Code for new X-ray installations and all used or reconditioned X-ray equipment moved to and reinstalled at a new location shall be of an approved type.

517.76 Transformers and Capacitors.

As stated in the 2011 Code, transformers and capacitors that are part of X-ray equipment shall not be required to comply with Articles 450 and 460. Capacitors shall be mounted within enclosures of insulating material or grounded metal.

517.77 Installation of High-Tension X-Ray Cables.

The 2011 Code states that the cables with grounded shields connecting X-ray tubes and image intensifiers shall be permitted to be installed in cable trays or cable troughs along with X-ray equipment control and power supply conductors without the need for barriers to separate the wiring.

517.78 Guarding and Grounding (A) High-Voltage Parts.

As required by the 2011 Code, all high-voltage parts, including X-ray tubes, shall be mounted within grounded enclosures. Air, oil, gas, or other suitable insulating media shall be used to

insulate the high-voltage from the grounded enclosure. The connection from the high-voltage equipment to X-ray tubes and other high-voltage components shall be made with high-voltage shielded cables.

517.78 Guarding and Grounding (B) Low-Voltage Cables.

As stated in the 2011 code, the low-voltage cables connecting to oil-filled units that are not completely sealed, such as transformers, condensers, oil coolers, and high-voltage switches, shall have insulation of the oil-resistant type.

517.78 Guarding and Grounding (C) Non-Current-Carrying Metal Parts.

Required by the 2011 Code for non-current carrying metal parts of X-ray and associated equipment (controls, tables, X-ray tube supports, transformer tanks, shielded cables, X-ray tube heads, etc.) shall be connected to an equipment grounding conductor in the manner specified in Part VII of Article 250, as modified by 517.13(A) and (B).

517.160 Isolated Power Systems. (A)(6) Installations.

The 2011 Code requires wire-pulling compounds that increase the dielectric constant must not be used on the secondary conductors of the isolated power supply

124) All x-ray equipment, new or used, shall be of an _____ type.

- A) Listed
- B) Approved
- C) Labeled
- D) Line

125) Transformers that are part of x-ray equipment are not required to comply with Articles 450 and _____.

- A) 425
- B) 460
- C) 310
- D) 255

126) Cables with grounded shields connecting x-ray tubes and image intensifiers are allowed to be installed in _____ or troughs.

- A) Cable tray
- B) Raceway
- C) Rigid conduit
- D) PVC pipe

127) All _____ parts, including x-ray tubes, shall be installed within a grounded enclosures.

- A) Low-Voltage
- B) High impedance
- C) High-Voltage
- D) Electrical

128) Low-voltage cables used for equipment in health care facilities that connect to oil filled units which are not sealed completely are required to have _____ of the oil resistant type.

- A) Coating
- B) Covering
- C) Copper
- D) Insulation

129) Non current carrying metal parts of x-ray and associated equipment shall be connected to an _____ grounding conductor in the proper manner.

- A) Main
- B) Grounded
- C) Service
- D) Equipment

130) When pulling in the secondary conductors for isolated power systems used in health care facilities, the pulling compound must not _____ the conductor dielectric constant.

- A) Increase
- B) Decrease
- C) Absorbs
- D) Produces