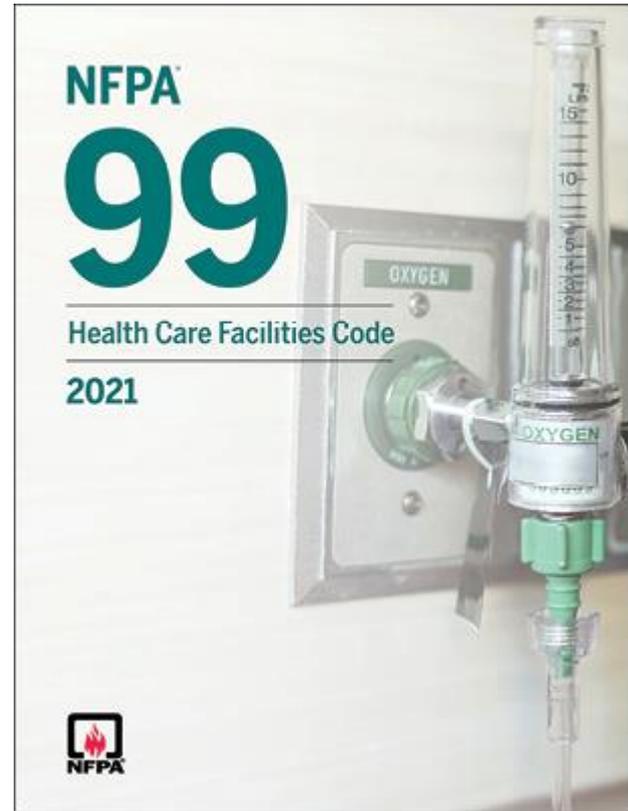
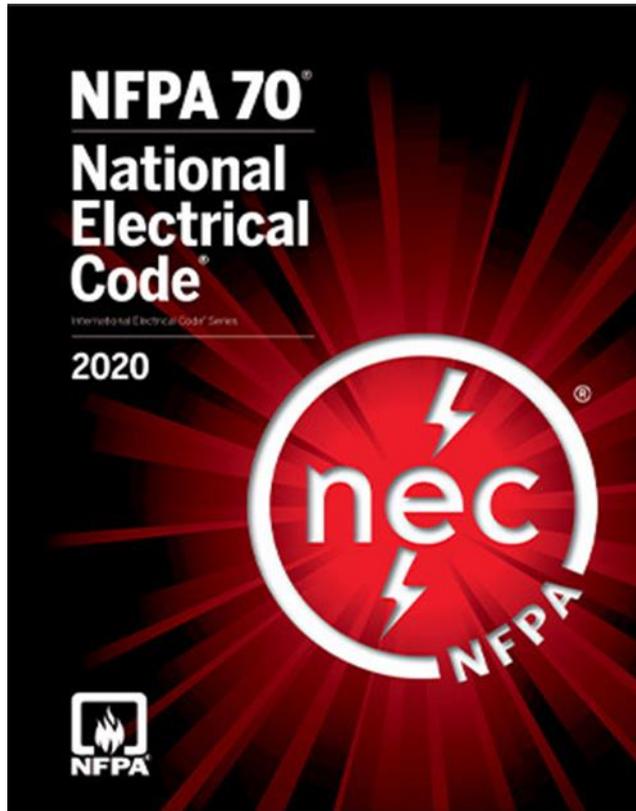


NEC Article 517 Health Care Facilities

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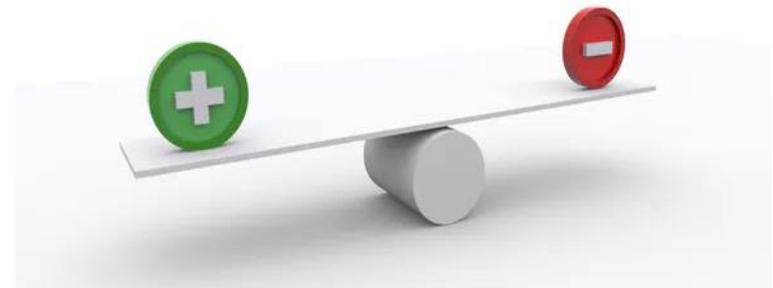
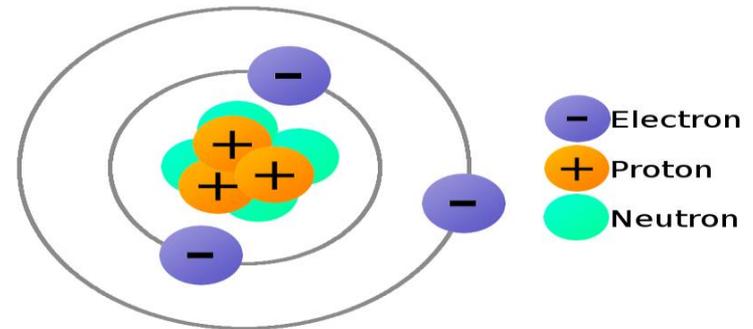
NEC Article 517 Health Care Facilities

- Theory
- Definitions
- Life Safety Branch
- Critical Branch
- Equipment Branch
- Essential Electrical Systems
- Isolated Power Systems



517.11 General Installations- Construction Criteria

The purpose of this article is to specify the installation criteria and wiring methods that minimize electrical hazards by the maintenance of adequately low potential differences only between exposed conductive surfaces that are likely to become energized and could be contacted by a patient



IN & Handbook Comments

- Sensitivity to electric shock may be increased for patients whose body resistance is compromised by a medical procedure
- It is difficult to prevent the occurrence of a conductive or capacitive path from the patients body to some grounded object
- A special problem is presented by the patient with an externalized direct conductive path to the heart muscle
- The patient may be electrocuted at current levels so low that additional protection in the design of appliances, insulation of the catheter, and control of medical practice is required

Working in Health Care World - Electrically

Electricity & human physiology

- How one cell becomes 100 trillion cells
- Cells and response to electricity (macro-micro)
- Outside current
- Inside current
- The frequency factor



How can you get 1 milliamp to flow?

How can you get 10 microamps to flow (.01 milliamps)?

$$V / R = I$$

$$120 \text{ V} / 120 \text{ ohms} = 1 \text{ amp}$$

$$120 \text{ V} / 120,000 \text{ ohms} = .001 \text{ amps or } 1 \text{ milliamps}$$

$$12 \text{ V} / 12,000 \text{ ohms} = .001 \text{ amps or } 1 \text{ milliamps}$$

$$1.2 \text{ V} / 1200 \text{ ohms} = .001 \text{ amps or } 1 \text{ milliamps}$$

$$120 \text{ V} / 1200 \text{ ohms} = .1 \text{ amps or } 100 \text{ milliamps}$$

It's the current that kills; not the voltage, however, the voltage forces the current through the resistance of the body

$$V=I \times R = 20 \text{ microamps} \times 1200 \text{ ohms} = 24 \text{ millivolts}$$



A. EXTERNAL CURRENT—60 Hz—APPLIED FOR 1 SECOND

Current Range	Effect
.001 amp (1 milliamp)*	Threshold of perception; tingling sensation
.016 amp (16 milliamps)	'Let-go' current; level at which a person would be quite willing to 'let-go' of the probe, only muscle control is inhibited and the opposite occurs—he can not 'let go'
.02 to .05 amp (20 to 50 milliamps)	Pain very real; fainting may occur; mechanical injury possible; heart and respiratory functions will continue however
.1 to 3 amps (100 to 3000 milliamps)	Ventricular fibrillation will occur; respiratory system will not be injured
6 to about 12 amps **	Heart will go into a sustained contraction but will revert to normal rhythm when probe is removed; burns may occur if current density is excessive where probe is applied

B. INTERNAL CURRENT— 60 Hz—APPLIED FOR 1 SECOND DIRECTLY ON HEART

.000020 to .000800 amp (20 to 800 microamps)	Ventricular fibrillation in dogs; catheter in heart used
.000150 to .001500 amp (150 to 1500 microamps)	Ventricular fibrillation in humans; 0.25 cm diameter electrode used
.001500 to .006000 amp (1500 to 6000 microamps)	Ventricular fibrillation in humans; 12.5 cm diameter electrode used

In part, from Dalziel "Electric Shock Hazards," IEEE Spectrum, Feb. 1972

* This author has reports of nurses and patients feeling currents as low as .0006 amps (.6 milliamps) externally. This was confirmed with a microammeter check of the equipment involved

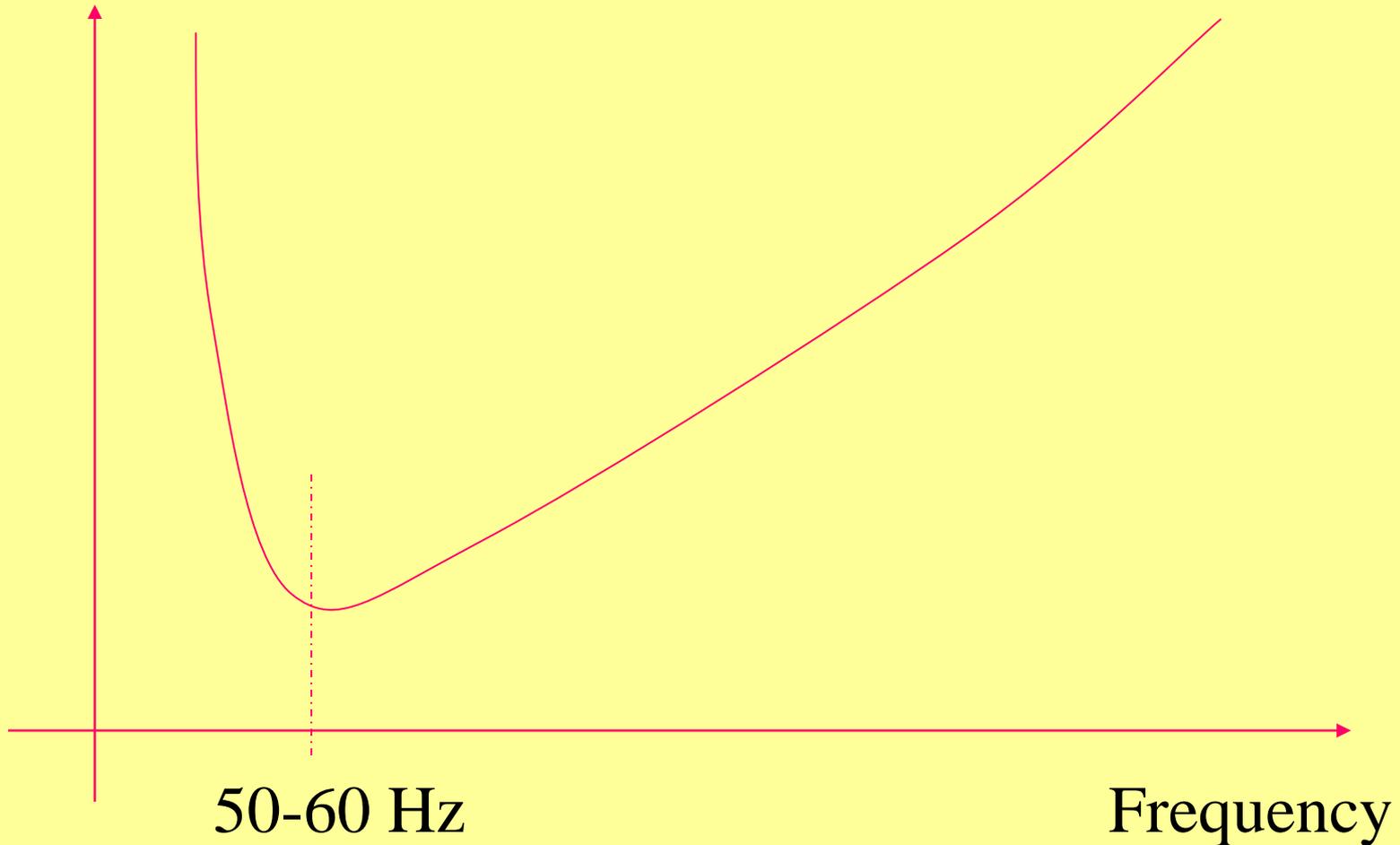
** Principle of the defibrillator is the shocking of the heart with a high energy pulse to start normal rhythm. This will be discussed in Chapter 4

Table 3-3. Experiments with electrical currents in adults.



Frequency vs. current: Impact on response

Current



50-60 Hz

Frequency



Definitions: Health Care Facilities

Buildings, portions of buildings, or mobile enclosures in which human medical, dental, psychiatric, nursing, obstetrical, or surgical care is provided
(99:3.3.71)

Informational Note: Examples of health care facilities include, but are not limited to, hospitals, nursing homes, limited care facilities, clinics, medical and dental offices, and ambulatory care centers, whether permanent or movable.







PHYSICAL THERAPY & SPORTS REHABILITATION

SmithKline Beecham

Clinical Laboratories

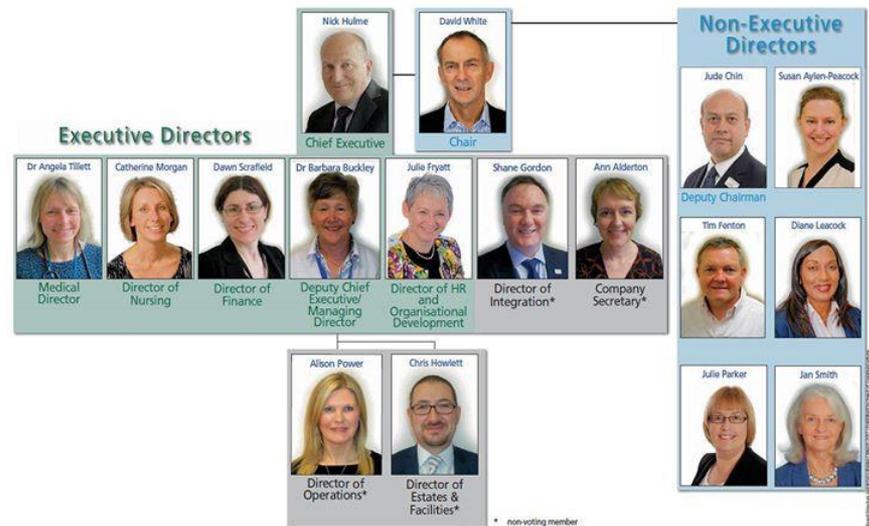


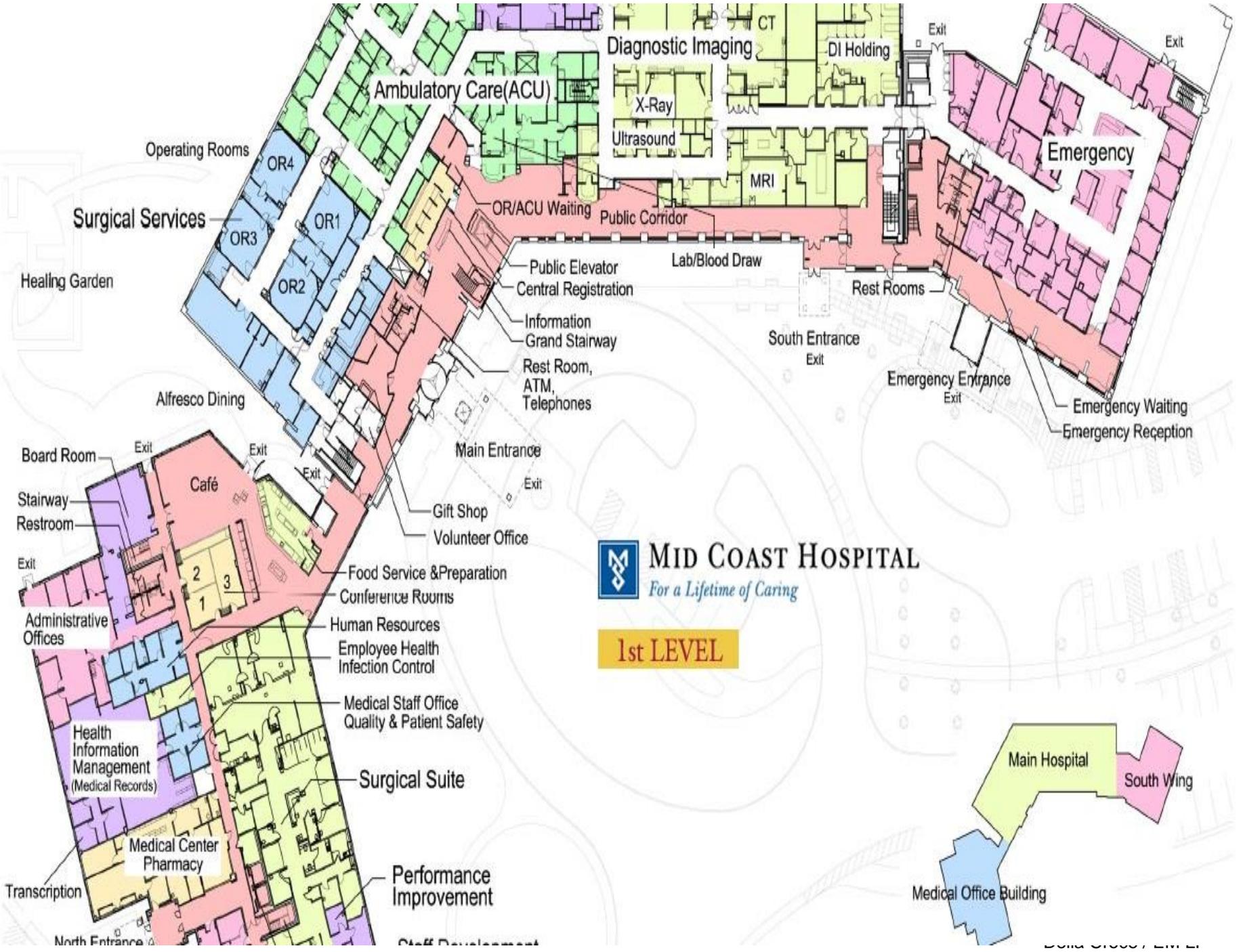
N Definitions: Health Care Facilities Governing Body

The person or persons who have the overall legal responsibility for the operation of a health care facility
(99:3.3.72)

Board of Directors

Colchester Hospital University NHS Foundation Trust





Definitions: Hospital

A building or portion thereof used on a 24-hour basis for the medical, psychiatric, obstetrical, or surgical care of four or more inpatients (**101:3.3.150**)



Definitions: Ambulatory Health Care Occupancy



- Used to provide services or treatment simultaneously to four or more patients that provides, on an outpatient basis, one or more of the following:
- ✓ Treatment for patients that renders the patients incapable of taking action for self-preservation under emergency conditions without assistance of others
- ✓ Anesthesia that renders the patients incapable of taking action for self-preservation under emergency conditions without the assistance of others
- ✓ Treatment for patients who, due to the nature of their injury or illness, are incapable of taking action for self-preservation under emergency conditions without the assistance of others



(101:3.3.196.1)



Definitions: Medical Office

- A building or part thereof in which all the following occur:
- ✓ Examinations and minor treatments or procedures are performed under the continuous supervision of a medical or dental professional
- ✓ Limited to minimal sedation or procedures that do not render the patient incapable of self-preservation under emergency conditions
- ✓ No overnight stays for patients or 24-hour operation



Professional Building

10919

**ORTHODONTICS
GENERAL DENTISTRY**

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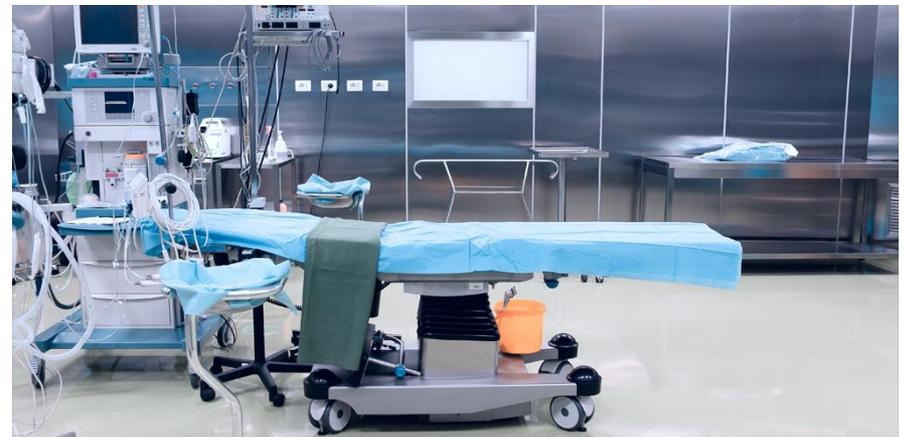
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Definitions: Patient Bed Location

The location of a patient sleeping bed, or the bed or procedure table of a Category 1 (critical care) space
(99:3.3.135)



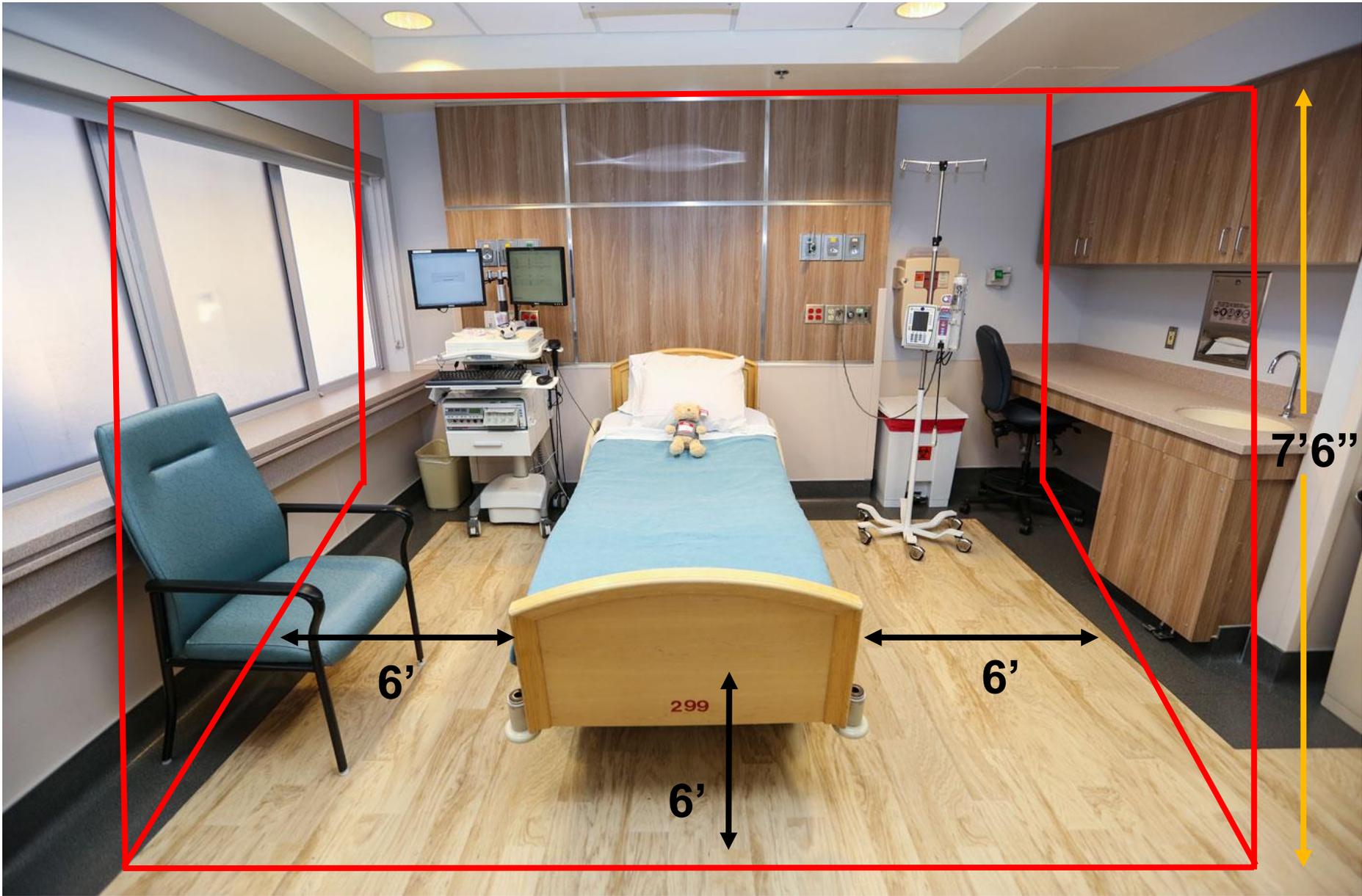




Definitions: Patient Care Vicinity

A space, within a location intended for the examination and treatment of patients, extending 6' beyond the normal location of the patient bed, chair, table, treadmill, or other device that supports the patient during examination and treatment and extending vertically to 7' 6" above the floor
(99:3.3.139)





Definitions: Patient Care Space

Any space of a health care facility wherein patients are intended to be examined or treated (**99:3.3.136**)

Informational Note No. 1: The health care facility's governing body designates patient care space in accordance with the type of patient care anticipated

Informational Note No. 2: Business offices, corridors, lounges, day rooms, dining rooms, or similar areas typically are not classified as patient care spaces

- ✓ Category 4 (Support)
- ✓ Category 3 (Basic Care)
- ✓ Category 2 (General Care)
- ✓ Category 1 (Critical Care)

Definitions: Category 4 (Support)

Space in which failure of equipment or a system is not likely to have a physical impact on patient care
(99:3.3.136)

Informational Note: Category 4 spaces were formerly known as support rooms. Examples of support spaces include, but are not limited to, anesthesia work rooms, sterile supply, laboratories, morgues, waiting rooms, utility rooms, and lounges

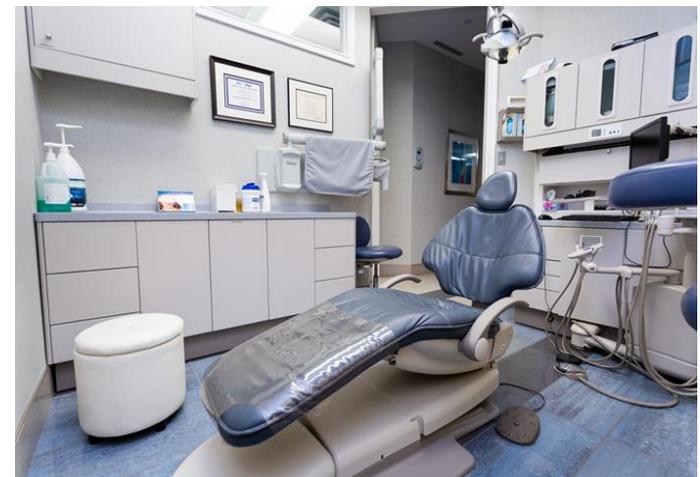




Definitions: Category 3 (Basic Care)

Space in which failure of equipment or a system is not likely to cause injury to the patients, staff, or visitors but can cause patient discomfort (**99:3.3.136**)

Informational Note: Category 3 spaces, formerly known as basic care rooms, are typically where basic medical or dental care, treatment, or examinations are performed. Examples include, but are not limited to, examination or treatment rooms in clinics, medical and dental offices, nursing homes, and limited care facilities.





Definitions: Category 2 (General Care)

Space in which failure of equipment or a system is likely to cause minor injury to patients, staff, or visitors (**99:3.3.136**)

Informational Note: Category 2 spaces were formerly known as general care rooms. Examples include, but are not limited to, inpatient bedrooms, dialysis rooms, in vitro fertilization rooms, procedural rooms, and similar rooms.



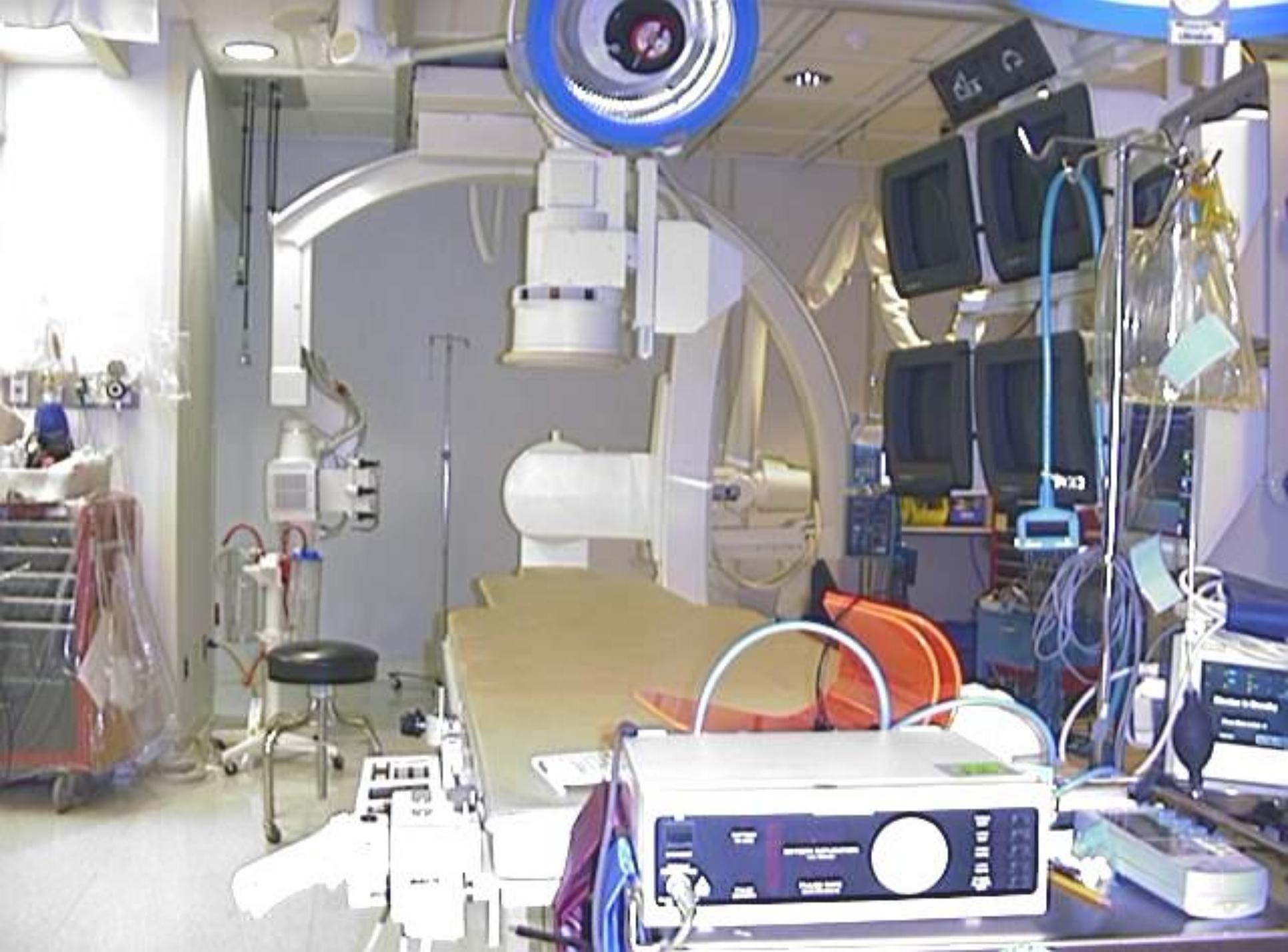
Definitions: Category 1 (Critical Care)

Space in which failure of equipment or a system is likely to cause major injury or death of patients, staff, or visitors (**99:3.3.136**)

Informational Note: Category 1 spaces, formerly known as critical care rooms, are typically where patients are intended to be subjected to invasive procedures and connected to line-operated, patient care–related appliances. Examples include, but are not limited to, special care patient rooms used for critical care, intensive care, and special care treatment rooms such as angiography laboratories, cardiac catheterization laboratories, delivery rooms, operating rooms, post-anesthesia care units, trauma rooms, and other similar rooms.

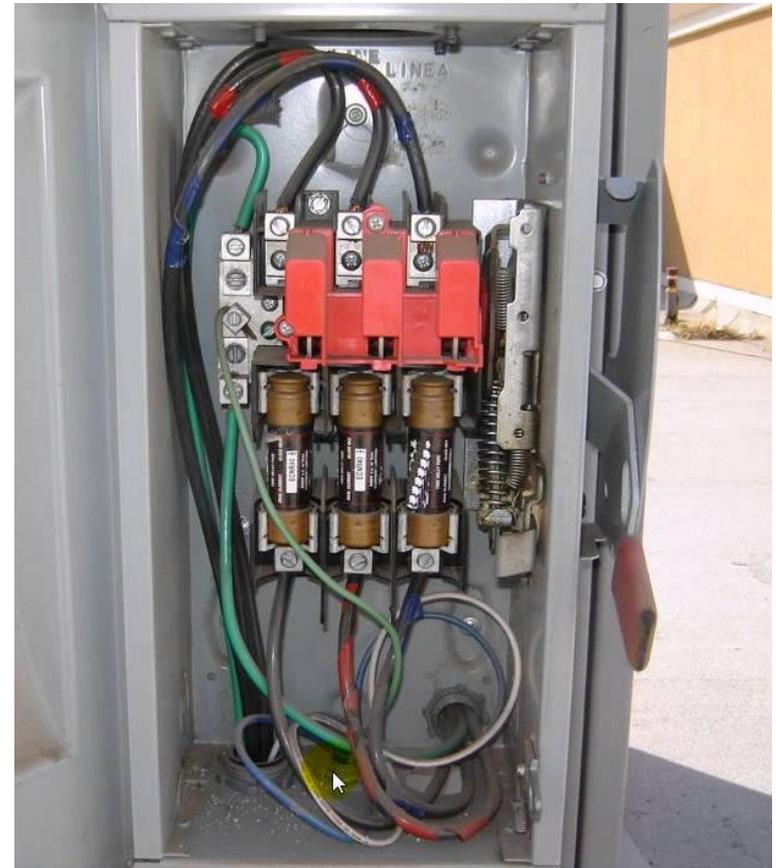






Definitions: Equipment Branch

A system of feeders and branch circuits arranged for delayed, automatic, or manual connection to the alternate power source and that serves primarily three phase power equipment (**99:3.3.49**)



Type I EES

517.35 Equipment Branch

The equipment branch shall be installed and connected to the alternate power source such that the equipment described in 517.35(A) is automatically restored to operation at appropriate time-lag intervals following the energizing of the life safety and critical branches. [99:6.7.5.1.4.2(A)]

The arrangement of the connection to the alternate power source shall also provide for the subsequent connection of equipment described in 517.35(B). [99:6.7.5.1.4.2(B)]

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



Type I EES

517.35 Equipment Branch

517.35(A) Equipment for Delayed Automatic Connection

(1) Central suction systems serving medical and surgical functions, including controls, with such suction systems permitted to be placed 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

(con't)



Type I EES

517.35 Equipment Branch

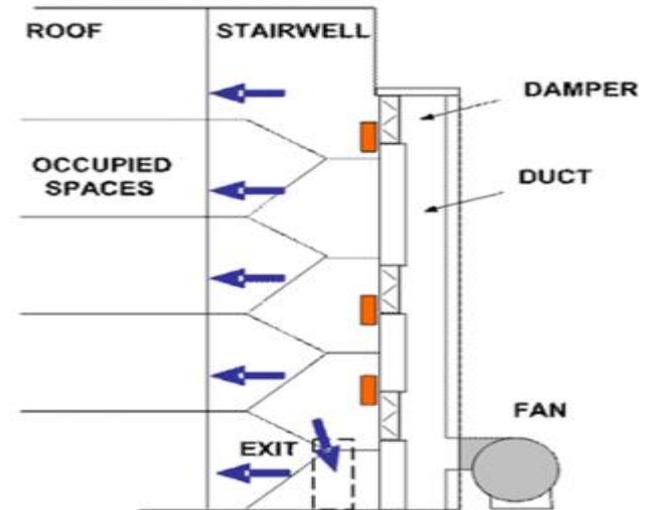
517.35(A) Equipment for Delayed Automatic Connection

(3) Compressed air systems serving medical and surgical functions, including controls with such air systems permitted to be placed on the critical branch

(4) Smoke control and stair pressurization systems

(5) Kitchen hood supply or exhaust systems, or both, if required to operate during a fire in or under the hood

(con't)



Type I EES

517.35 Equipment Branch

517.35(A) Equipment for Delayed Automatic Connection

- (6) Supply, return, and exhaust ventilating systems for the following:
- a. Airborne infectious/isolation rooms
 - b. Protective environment rooms
 - c. Exhaust fans for laboratory fume hoods
 - d. Nuclear medicine areas where radioactive material is used
 - e. Ethylene oxide evacuation
 - f. Anesthetic evacuation

Where delayed automatic connection is not appropriate, the ventilation systems shall be permitted to be placed on the critical branch
[99:6.7.5.1.4.3 (A) & (B)]



Type I EES

517.35 Equipment Branch

517.35(A) Equipment for Delayed Automatic Connection

(7) Supply, return, and exhaust ventilating systems for operating and delivery rooms

(8) Supply, return, exhaust ventilating systems and/or a/c systems serving telephone equipment rooms/closets and data equipment rooms/closets

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.

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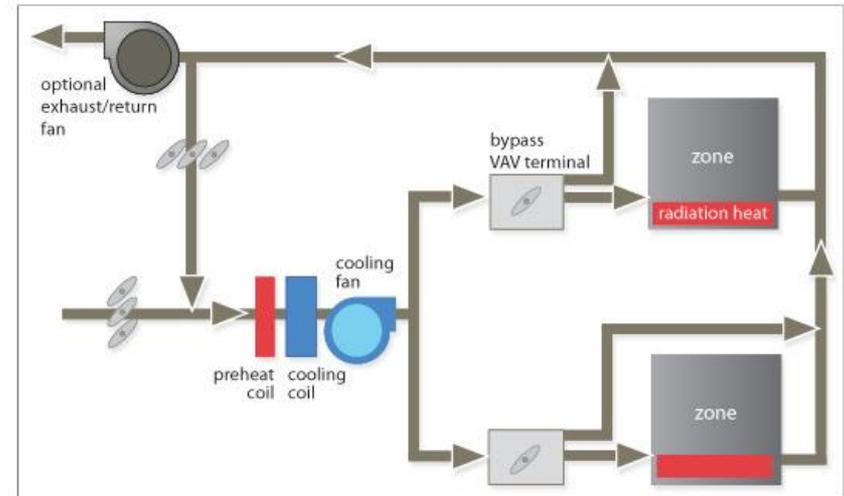


Type I EES

517.35 Equipment Branch

517.35(B) Equipment for Delayed Automatic or Manual Connection

(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



One Exception

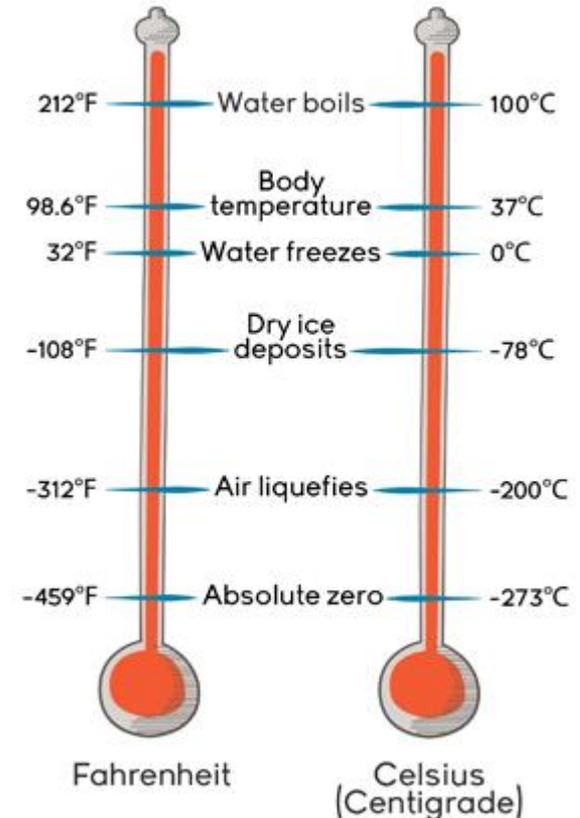
Type I EES

517.35 Equipment Branch

517.35(B) Equipment for Delayed Automatic or Manual Connection

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*



Type I EES

517.35 Equipment Branch

517.35(B) Equipment for Delayed Automatic or Manual Connection

(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.



Type I EES

517.35 Equipment Branch

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517.35(B) Equipment for Delayed Automatic or Manual Connection

- (3) Hyperbaric facilities
- (4) Hypobaric facilities
- (5) Automatically operated doors



Hyperbaric Chamber

- ✓ The pressure is increased anywhere between 2-25 times over the standard atmospheric pressure, and the patient is given an air supply of 100% oxygen in this environment
- ✓ This type of treatment is called hyperbaric oxygen therapy (HBOT)
- ✓ Our lungs are able to bring in 22 times more oxygen than they normally would be able to at sea level
- ✓ HBOT is commonly used for decompression sickness and to speed up wound healing.
- ✓ HBOT also treats and controls necrotizing infections and infections with an acute resistance to antibiotics
- ✓ Another typical application is found in scuba diving, in which diving chambers are used as personal transportation capsules that maintain internal pressure to allow for training or rapid decompression

Hypobaric Chamber

- ✓ Hypobaric pressure chambers simulate high altitude conditions by using a vacuum pump to evacuate the air out of the sealed chamber at a constant rate
- ✓ In a high-altitude environment the body struggles to get enough oxygen in to the bloodstream, which causes a condition known as hypoxia
- ✓ Chambers are used to determine the manifestation of hypoxia symptoms in individuals who operate in altitude environments above 10K feet
- ✓ Some elite athletes use the chamber to create a very mild case of hypoxia during sleep. As a result of the body's natural response to hypoxia, the circulation oxygen is increased, especially during strenuous activity.
- ✓ Chamber is also used to simulate the effects of hypobaria in high altitude training for commercial and fighter pilots. The simulation covers rapid decompression profiles for quick ascends from 25K feet to 40K feet within a few minutes. As the individuals train in these chambers, they are able to overcome their own limitations and fully adapt to their work environment.

Type I EES

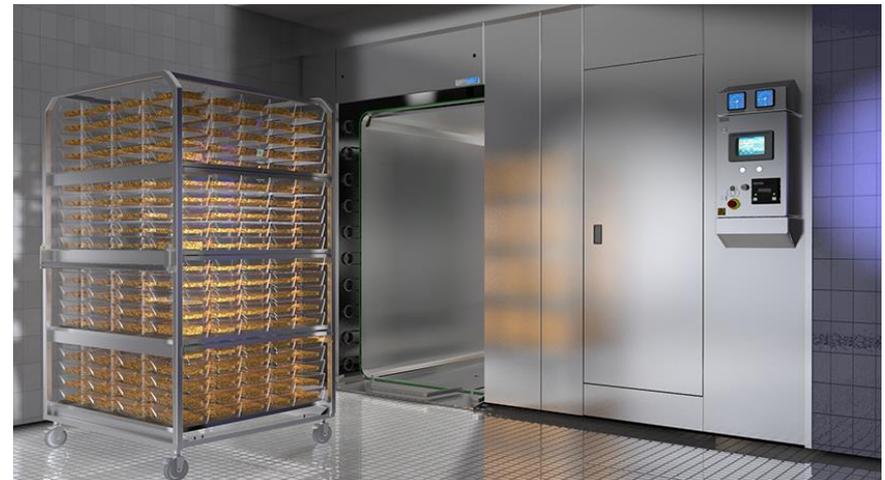
517.35 Equipment Branch

517.35(B) Equipment for Delayed Automatic or Manual Connection

(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 517.35

(8) Other selected equipment shall be permitted to be served by the equipment system. [99:6.7.5.1.4.4]



Definitions: Critical Branch

A system of feeders and branch circuits supplying power for task illumination, fixed equipment, select receptacles, and select power circuits serving areas and functions related to patient care that are automatically connected to alternate power sources by one or more transfer switches during interruption of the normal power source (**99:3.3.30**)



Type I EES

517.34 Critical Branch

517.34(A) Task Illumination, Fixed Equipment and Selected Receptacles

The critical branch shall supply power for task illumination, fixed equipment, select receptacles, and select power circuits serving the following spaces and functions related to patient care:

(1) Category 1 (critical care) spaces where deep sedation or general anesthesia is administered, task illumination, selected receptacles, and fixed equipment

(con't)



Type I EES

517.34 Critical Branch

517.34(A) Task Illumination, Fixed Equipment and Selected Receptacles

(2) Task illumination and select receptacles in the following:

- a. Patient care spaces, including infant nurseries, select acute nursing areas, psychiatric bed areas (omit receptacles) and ward treatment rooms
- b. Medication preparation spaces
- c. Pharmacy dispensing spaces
- d. Nurses' stations — unless adequately lighted by corridor luminaires
(con't)



Type I EES

517.34 Critical Branch

517.34(A) Task Illumination, Fixed Equipment and Selected Receptacles

(3) Additional specialized patient care task illumination and receptacles, where needed

(4) Nurse call systems

(5) Blood, bone, and tissue banks

(6) Telecommunications entrance facility, telecom equipment rooms, and telecom rooms and equipment in these rooms

(con't)



Type I EES

517.34 Critical Branch

517.34(A) Task Illumination, Fixed Equipment and Selected Receptacles

(7) Task illumination, select receptacles, and select power circuits for the following areas:

- a. Category 1 (critical care) or 2 (general care) spaces with at least one duplex receptacle per patient bed location, and task illumination as required by the governing body of the health care facility
- b. Angiographic labs
- c. Cardiac catheterization labs
- d. Coronary care units
- e. Hemodialysis rooms or areas
- f. Emergency room treatment areas (select)
- g. Human physiology labs
- h. Intensive care units
- i. Postoperative recovery rooms (select)



Type I EES

517.34 Critical Branch

517.34(A) Task Illumination, Fixed Equipment and Selected Receptacles

(8) Clinical IT-network equipment

(9) Wireless phone and paging equipment for clinical staff communications

(10) Additional task illumination, receptacles, and select power circuits needed for effective facility operation, including single-phase fractional HP motors, which are permitted to be connected to the critical branch



Type I EES

517.34 Critical Branch

517.34(B) Switching

It shall be permitted to control task illumination on the critical branch



Type I EES

517.34 Critical Branch

517.34(C) Subdivision of the Critical Branch

The critical branch shall be permitted to be subdivided into two or more branches. [99:6.7.5.1.3.1]

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.



Definitions: Life Safety Branch

A system of feeders and branch circuits supplying power for lighting, receptacles, and equipment essential for life safety that is automatically connected to alternate power sources by one or more transfer switches during interruption of the normal power source
(99:3.3.93)



Type I EES

517.33 Life Safety Branch



The life safety branch shall be limited to circuits essential to life safety.

[99:6.7.5.1.2.3]

No functions other than those listed in 517.33(A) through (H) shall be connected to the life safety branch



Type I EES

517.33 Life Safety Branch

517.33(A) Illumination of Means of Egress

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 two circuits can be selected and both circuits cannot be extinguished at the same time



Type I EES

517.33 Life Safety Branch



517.33(B) Exit Signs

Exit signs and exit directional signs



Type I EES

517.33 Life Safety Branch

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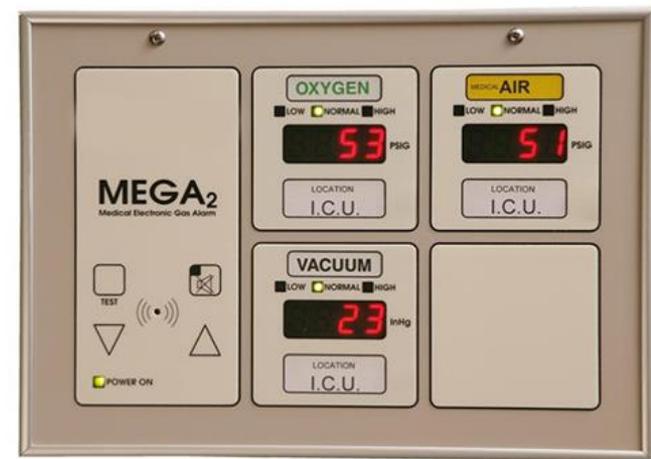
517.33(C) Alarm & Alerting Systems

(1) Fire alarm systems

(2) Alarm and alerting systems (other than fire alarm systems) shall be connected to the life safety branch or critical branch. [99:6.7.5.1.2.5]

(3) Alarms for systems used for the piping of nonflammable medical gases

(4) Mechanical, control, and other accessories required for effective life safety systems operation shall be permitted to be connected to the life safety branch



Type I EES

517.33 Life Safety Branch



517.33(D) Communications Systems

Hospital communications systems, where used for issuing instructions during emergency conditions.

[99:6.7.5.1.2.4(3)]



Type I EES

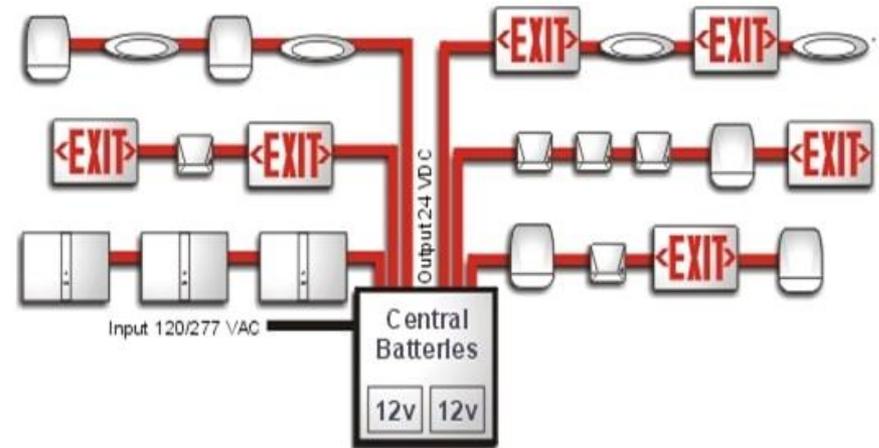
517.33 Life Safety Branch

517.33(E) Generator Set Locations

Generator set locations as follows:

- (1) Task illumination
- (2) Battery charger for emergency battery-powered lighting unit(s)
- (3) Select receptacles at the generator set location and essential electrical system transfer switch locations

[99:6.7.5.1.2.4(4)]



Type I EES

517.33 Life Safety Branch

517.33(F) Generator Set Accessories

Loads dedicated to a specific generator, including the fuel transfer pump(s), ventilation fans, electrically operated louvers, controls, cooling system, and other generator accessories essential for generator operation, shall be connected to the life safety branch or to the output terminals of the generator with overcurrent protective devices

[99:6.7.5.1.2.6]



Type I EES

517.33 Life Safety Branch



517.33(H) Automatic Doors

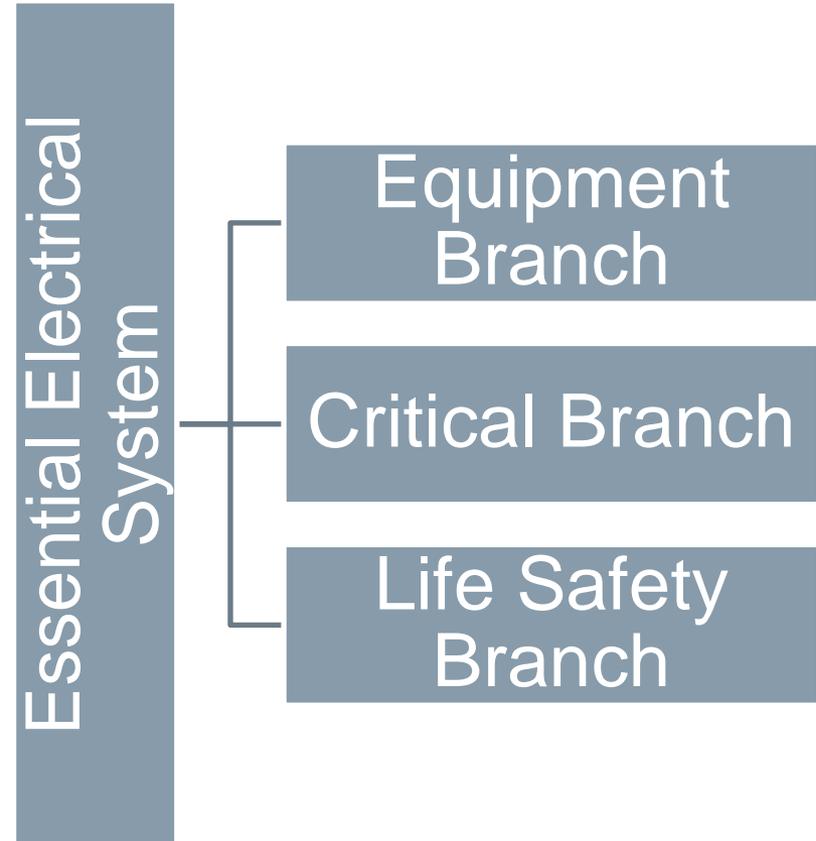
Electrically powered doors used for building egress

[99:6.7.5.1.2.4(6)]



Definitions: Essential Electrical System

A system comprised of alternate sources of power and all connected distribution systems and ancillary equipment, designed to ensure continuity of electrical power to designated areas and functions of a health care facility during disruption of normal power sources, and also to minimize disruption within the internal wiring system
(99:3.3.51)



Part III Essential Electrical System (EES)

517.26 Application of Other Articles

The life safety branch of the essential electrical system shall meet the requirements of Article 700, except:

- (1) Section 700.4 shall not apply
- (2) Section 700.10(D) shall not apply
- (3) Section 700.17 shall be replaced with the following: Branch circuits that supply emergency lighting shall be installed to provide service from a source complying with 700.12 when normal supply for lighting is interrupted or where single circuits supply luminaires containing secondary batteries
- (4) Section 700.32 shall not apply

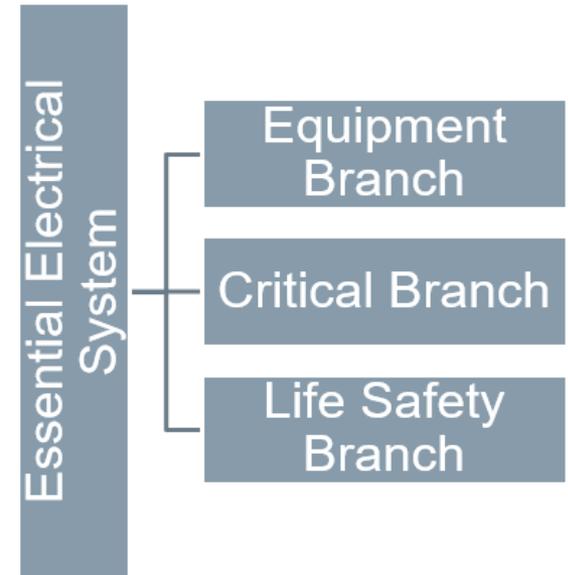


Part III Essential Electrical System (EES)

517.25 Essential Electrical Systems for Health Care Facilities

Type 1 and Type 2 EES for health care facilities shall comprise separate branches 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

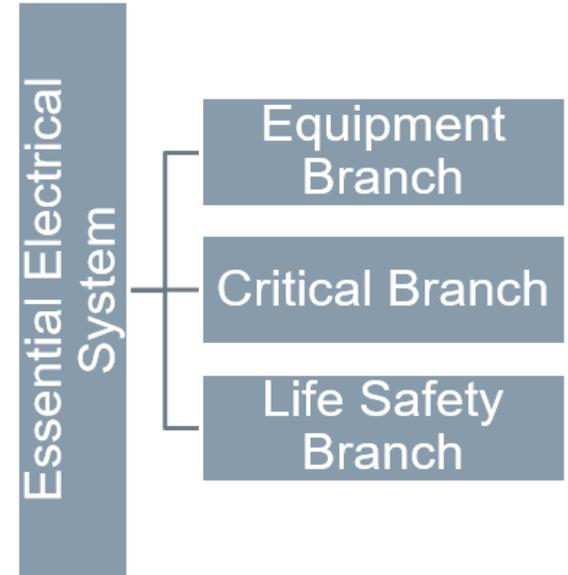
Informational Note: For information on the need for an essential electrical system see NFPA 99-2018



Part III Essential Electrical System (EES)

517.29 Type EES

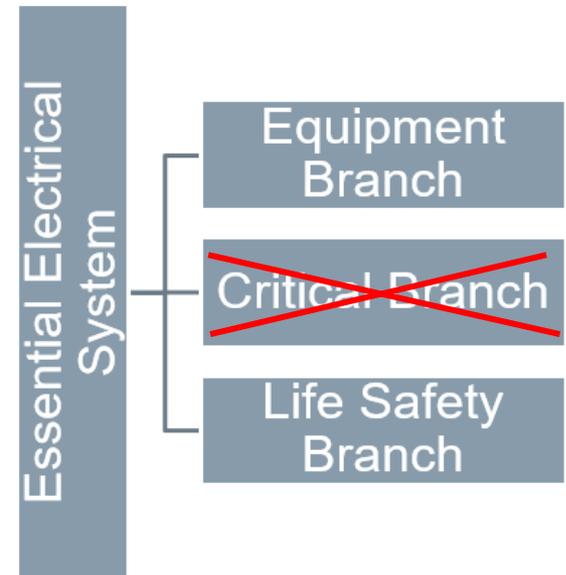
IN: Type 1 EES are comprised of three separate branches capable of supplying a limited amount of lighting and power service that is considered essential for life safety and effective facility operation during the time the normal electrical service is interrupted for any reason. These three separate branches are the life safety, critical, and equipment branches. [99:A.6.7.2.3]



Part III Essential Electrical System (EES)

517.40 Type 2 EES

IN No. 2: Type 2 ESS are comprised of two separate branches capable of supplying a limited amount of lighting and power service that is considered essential for the protection of life and safety and effective operation of the institution during the time normal electrical service is interrupted for any reason: the life safety and equipment branches. The number of transfer switches to be used should be based upon reliability, design, and load considerations. Each branch of the ESS should have one or more transfer switches. One transfer switch should be permitted to serve one or more branches in a facility with a maximum demand on the EES of 150 kVA (120 kW). [99:A.6.7.6.2.1]



Part III EES

517.29 Type I EES

517.29(A) Applicability

The requirements of 517.29 through 517.35 shall apply to Type 1 EES

Type 1 systems shall be required for Category 1 (critical care) spaces

Type 1 systems shall be permitted to serve Category 2 (general care), Category 3 (basic care), and Category 4 (support) spaces



Type I EES

517.31 Requirements

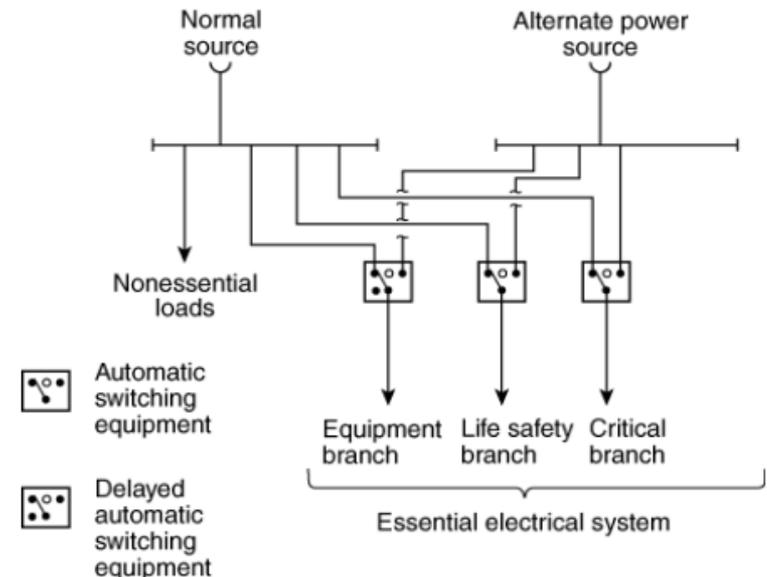
(A) Separate Branches

Type 1 ESS shall be comprised of three separate branches 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. The three branches are life safety, critical, and equipment.

The division between the branches shall occur at transfer switches where more than one transfer switch is required.

[99:6.7.2.3.1]

IN Figure 517.31(a) Type 1 EES- Minimum Requirement (greater than 150 kVA) for Transfer Switch Arrangement



Type I EES

517.31 Requirements

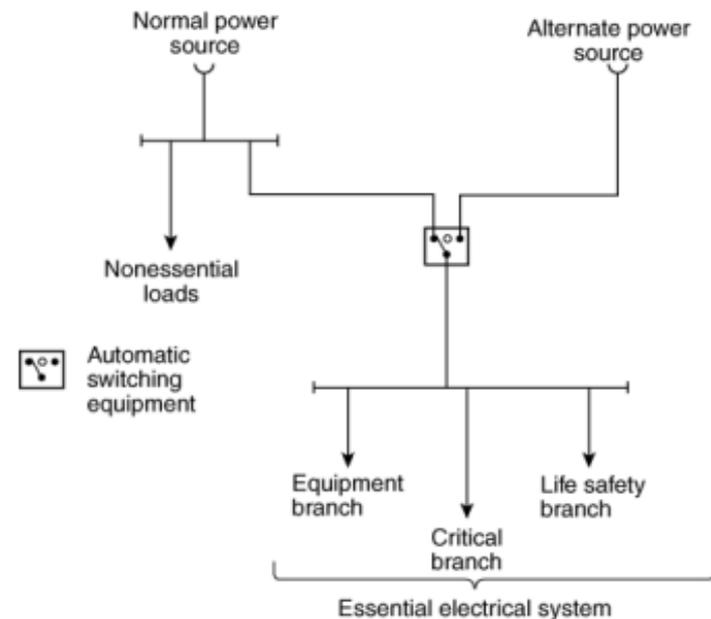
(B) Transfer Switches

Shall be in accordance with one of the following:

(1) The number of transfer switches to be used shall be based on reliability and design. Each branch of the essential electrical system shall have one or more transfer switches

(2) One transfer switch shall be permitted to serve one or more branches in a facility with a continuous load on the switch of 150 kVA (120 kW) or less. [99:6.7.6.2.1.4]

IN Figure 517.31(b) Type 1 EES- Minimum Requirement (150 kVA or less) for Transfer Switch Arrangement



Type I EES

SIEMENS

517.32 Branches Requiring Automatic Connection *Ingenuity for life*

517.32(A) Life Safety and Critical Branch Used in a Type 1 EES

Those functions of patient care depending on lighting or appliances that are connected to the EES shall be divided into the life safety branch and the critical branch, as described in 517.33 and 517.34

517.32(B) Life Safety and Critical Branch Used in a Type 2 EES

The life safety and critical branches shall be installed and connected to the alternate power source specified in 517.41(A) and 517.41(B) so that all functions specified herein for the life safety and critical branches are automatically restored to operation within 10 seconds after interruption of the normal source. [99:6.7.5.3.1]

Type II EES

517.40

IN No. 1: Nursing homes and other limited care facilities can contain Category 1 (critical care) spaces and/or Category 2 (general care) spaces depending on the design and type of care administered in the facility. For Category 1 spaces, see 517.29 through 517.35. For Category 2 spaces not served by Type 1 EES, see 517.40 through 517.44.

IN No. 2: Type 2 EES are comprised of two separate branches capable of supplying a limited amount of lighting and power service that is considered essential for the protection of life and safety and effective operation of the institution during the time normal electrical service is interrupted for any reason. These two separate branches are the life safety and equipment branches. The number of transfer switches to be used should be based upon reliability, design, and load considerations. Each branch of the EES should have one or more transfer switches. One transfer switch should be permitted to serve one or more branches in a facility with a maximum demand on the EES of 150 kVA (120 kW). [99:A.6.7.6.2.1]

Type II EES

517.40(A) Applicability

The requirements of Part III, 517.40(C) through 517.44, shall apply to Category 2 (general care) spaces.

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:

- (1) 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*
- (2) No surgical treatment requiring general anesthesia is offered*
- (3) An automatic battery-operated system(s) or equipment 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.*

Type II EES

517.43 Automatic Connections to Life Safety & Equipment Branch

The life safety and equipment branches shall be installed and connected to the alternate source of power specified in 517.41 so that all functions specified herein for the life safety and equipment branches are automatically restored to operation within 10 seconds after interruption of the normal source.
[99:6.7.6.4.1]

No functions other than those listed in 517.43(A) through (G) shall be connected to the life safety branch.
[99:6.7.6.2.1.5(D)]



Definition of Wet Procedure Locations.

- **The area in a patient care space where a procedure is performed that is normally subject to wet conditions while patients are present, including standing fluids on the floor or drenching of the work area, either of which condition is intimate to the patient or staff. [99:3.3.171]**
- **Informational Note: Routine housekeeping procedures and incidental spillage of liquids do not define a wet procedure location. [99:A.3.3.171]**



517.20 Wet Procedure Locations

(A) Receptacles and Fixed Equipment

Wet procedure locations shall be provided with special protection against electric shock as follows:

- (1) Power distribution system that inherently limits the possible ground-fault current due to a 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 the trip value of a Class A GFCI
(1 exception)



517.20 Wet Procedure Locations

Exception: Branch circuits supplying only listed, fixed, therapeutic and diagnostic equipment shall be permitted to be supplied from a grounded service, single- or 3-phase system, provided that

(a) Wiring for grounded and isolated circuits does not occupy the same raceway, and

(b) All conductive surfaces of the equipment are connected to an insulated copper EGC

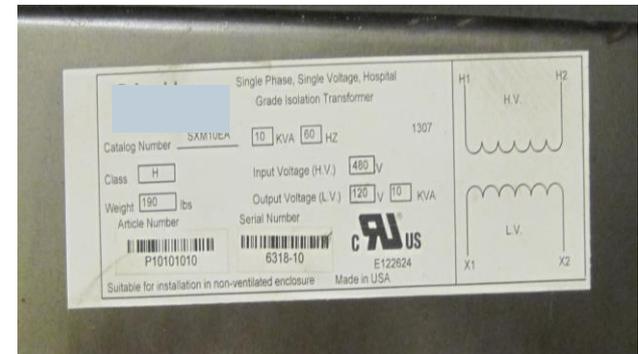


517.20 Wet Procedure Locations



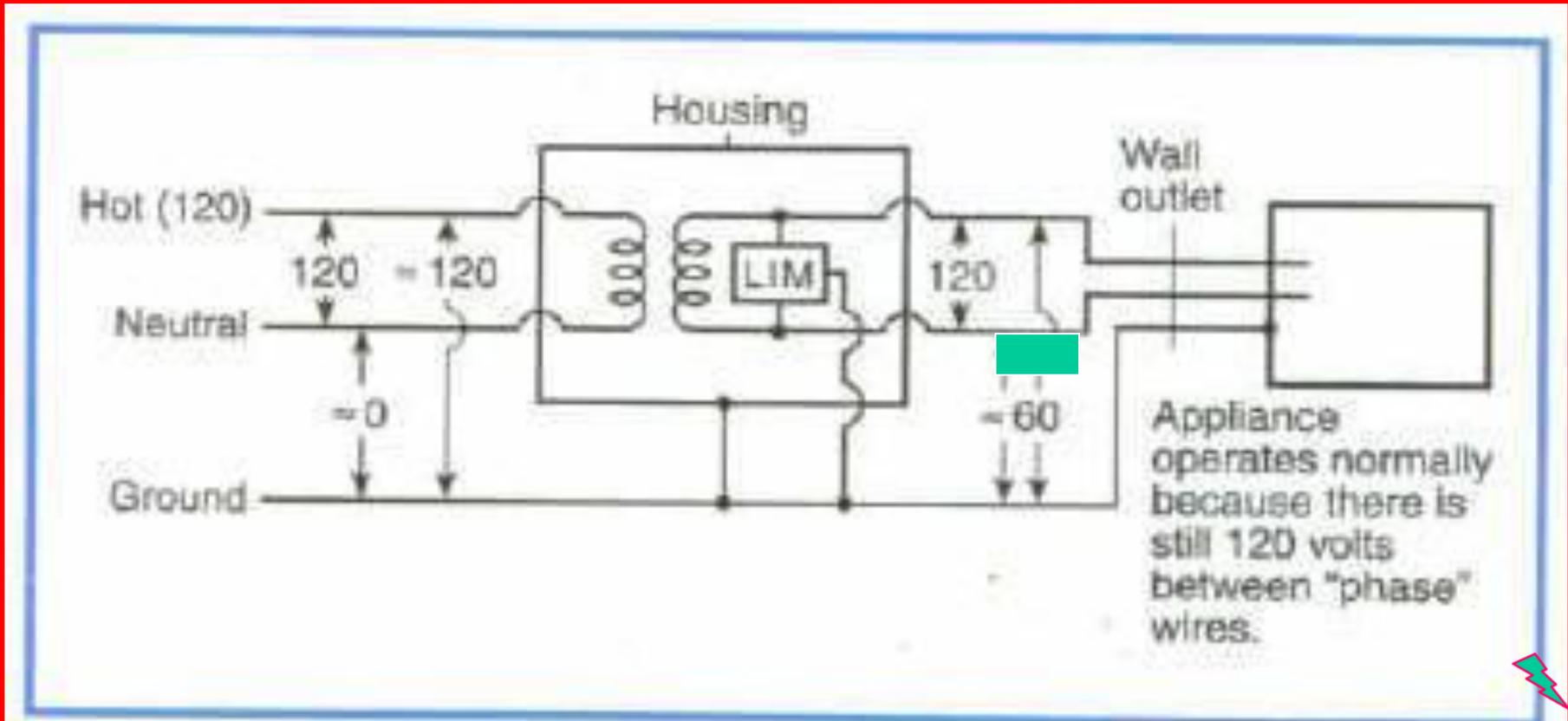
(B) Isolated Power Systems

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



Electrical Distribution System-6.3.2.6 Isolated Power Systems.

- What is 'isolated power'?
- Isolation performance
- Grounding continuous: from input side to output side
- Simplified schematic diagram



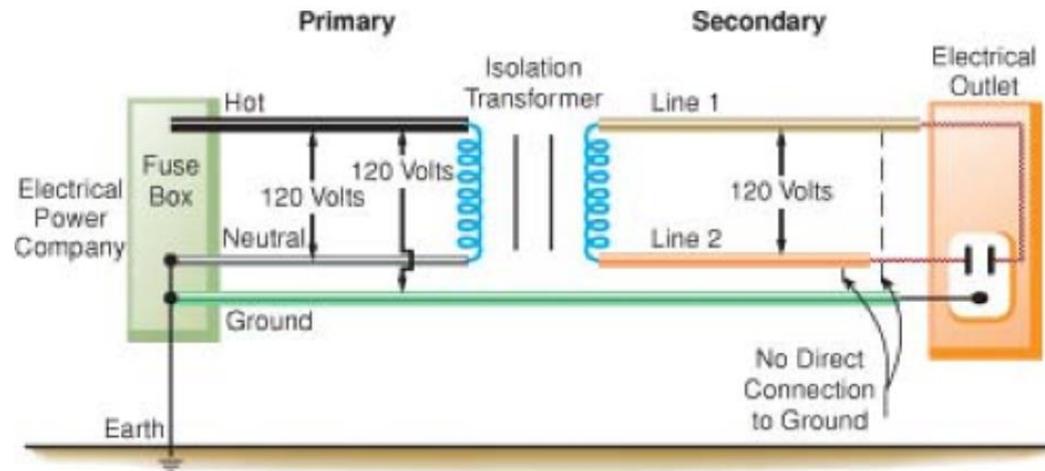


Figure 8-3. In an operating room, the isolation transformer converts the grounded power on the primary side to an ungrounded power system on the secondary side of the transformer. There is no direct connection from the power on the secondary side to ground. The equipment ground wire, however, is still present.

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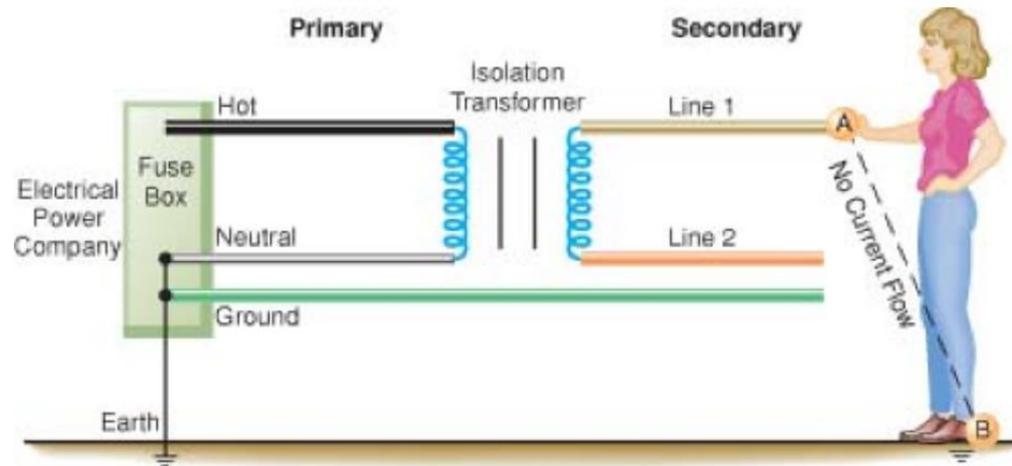


Figure 8-4. A safety feature of the isolated power system is illustrated. An individual contacting one side of the isolated power system (**A**) and standing on the ground (**B**) will not receive a shock. In this instance, the individual is not contacting the circuit at two points and thus is not completing the circuit.

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Part VII

517.160 Isolated Power System

(A)(1) Installation

Each isolated power circuit shall be controlled by a switch or circuit breaker that has a disconnecting pole in each isolated circuit conductor to simultaneously disconnect all power

Such isolation shall be accomplished by means of one or more isolation transformers, by means of generator sets, or by means of electrically isolated batteries

Conductors of isolated power circuits shall not be installed in cables, raceways, or other enclosures containing conductors of another system



517.160 Isolated Power System

(A)(2) Circuit Characteristics

Circuits supplying primaries of isolating transformers shall operate at not more than 600V between conductors

The secondary voltage of such transformers shall not exceed 600V between conductors of each circuit

All circuits supplied from such secondaries shall be ungrounded and shall have an approved OC device of proper ratings in each conductor

(con't)



517.160 Isolated Power System

(A)(2) Circuit Characteristics

Circuits supplied directly from batteries or from motor generator sets shall be ungrounded and shall be protected against overcurrent in the same manner as transformer-fed secondary circuits

If an electrostatic shield is present, it shall be connected to the reference grounding point



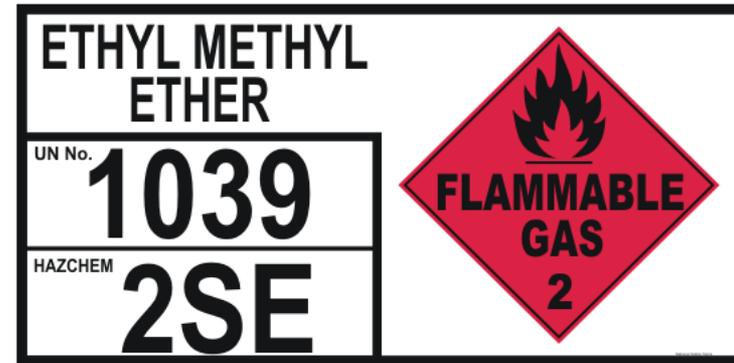
517.160 Isolated Power System

(A)(3) Equipment Location

The isolating transformers and associated primary or secondary overcurrent devices shall not be installed in hazardous (classified) locations

The isolated secondary circuit wiring extending into a hazardous anesthetizing location shall be installed in accordance with 501.10

(501.10 Wiring Methods in Class I Locations)



517.160 Isolated Power System

(A)(4) Isolation Transformer

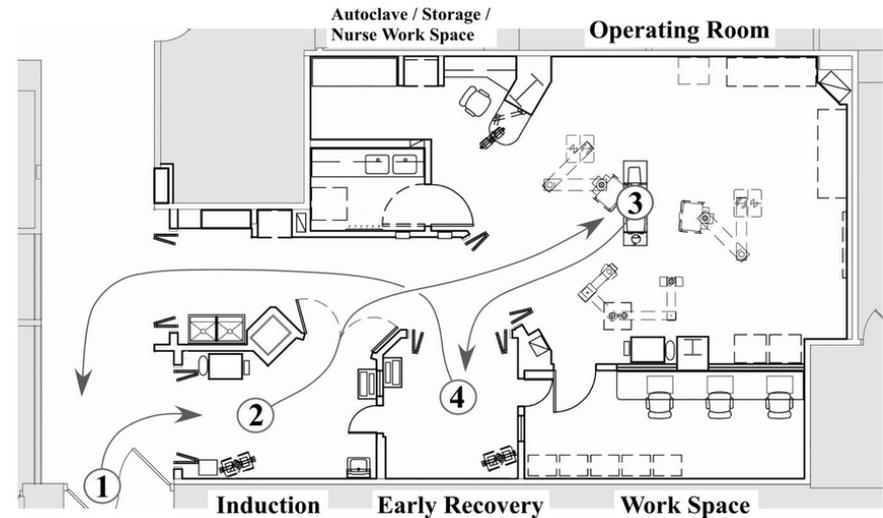
An isolation transformer shall not serve more than one operating room except as covered in (A)(4)(a) and (A)(4)(b)

For purposes of this section, anesthetic induction rooms are considered part of the operating room or rooms served by the induction rooms



517.160 Isolated Power System

(A)(4)(a) *Induction Rooms.* Where an induction room serves more than one operating room, the isolated circuits of the induction room shall be permitted to be supplied from the isolation transformer of any one of the operating rooms served by that induction room



517.160 Isolated Power System

(A)(4)(b) *Higher Voltages*. Isolation transformers shall be permitted to serve single receptacles in several patient areas where the following apply:

(1) The receptacles are reserved for supplying power to equipment requiring 150 volts or higher, such as portable X-ray units

(2) The receptacles and mating plugs are not interchangeable with the receptacles on the local isolated power system

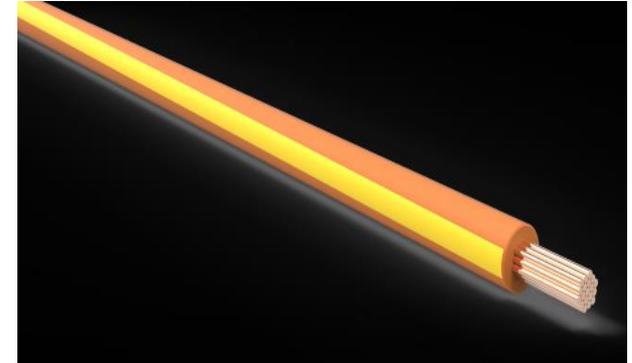


517.160 Isolated Power System

(A)(5) Conductor Identification

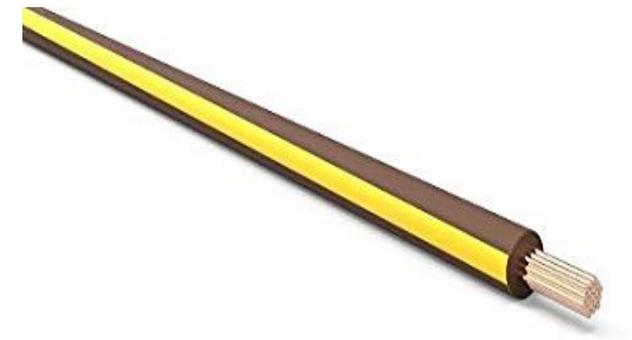
Isolated Conductor No. 1

Orange with at least one distinctive colored stripe other than white, green, or gray along the entire length of the conductor



Isolated Conductor No. 2

Brown with at least one distinctive colored stripe other than white, green, or gray along the entire length of the conductor



(con't)

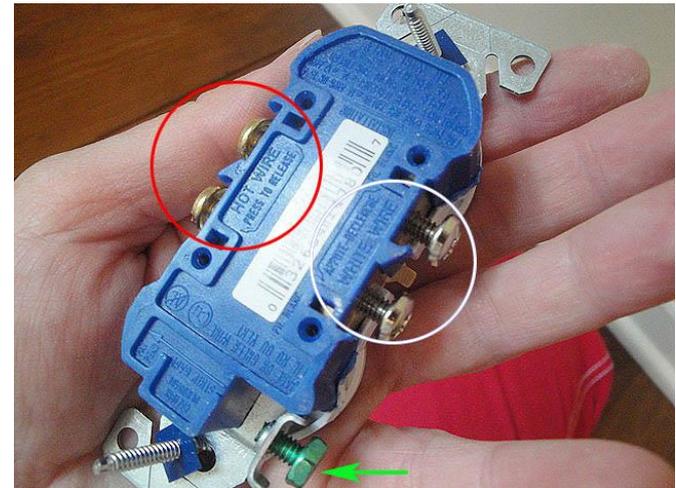
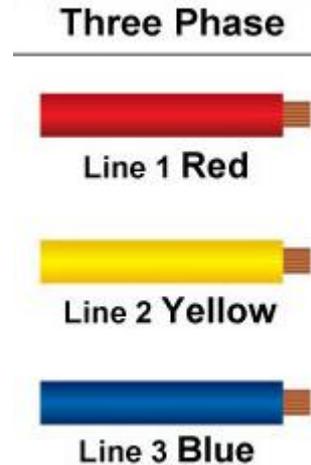


517.160 Isolated Power System

(A)(5) Conductor Identification

For 3-phase systems, the third conductor shall be identified as yellow with at least one distinctive colored stripe other than white, green, or gray along the entire length of the conductor

Where isolated circuit conductors supply 125-volt, single phase, 15- and 20-ampere receptacles, the striped orange conductors shall be connected to the terminals on the receptacles that are identified in accordance with 200.10(B) for connection to the grounded circuit conductor





FOR USE WITH SQUARE D COMPANY BACKBOX
CONTOUR (FLUSH OR BUSHING SURFACE)
PLANT 85 42194-000-02

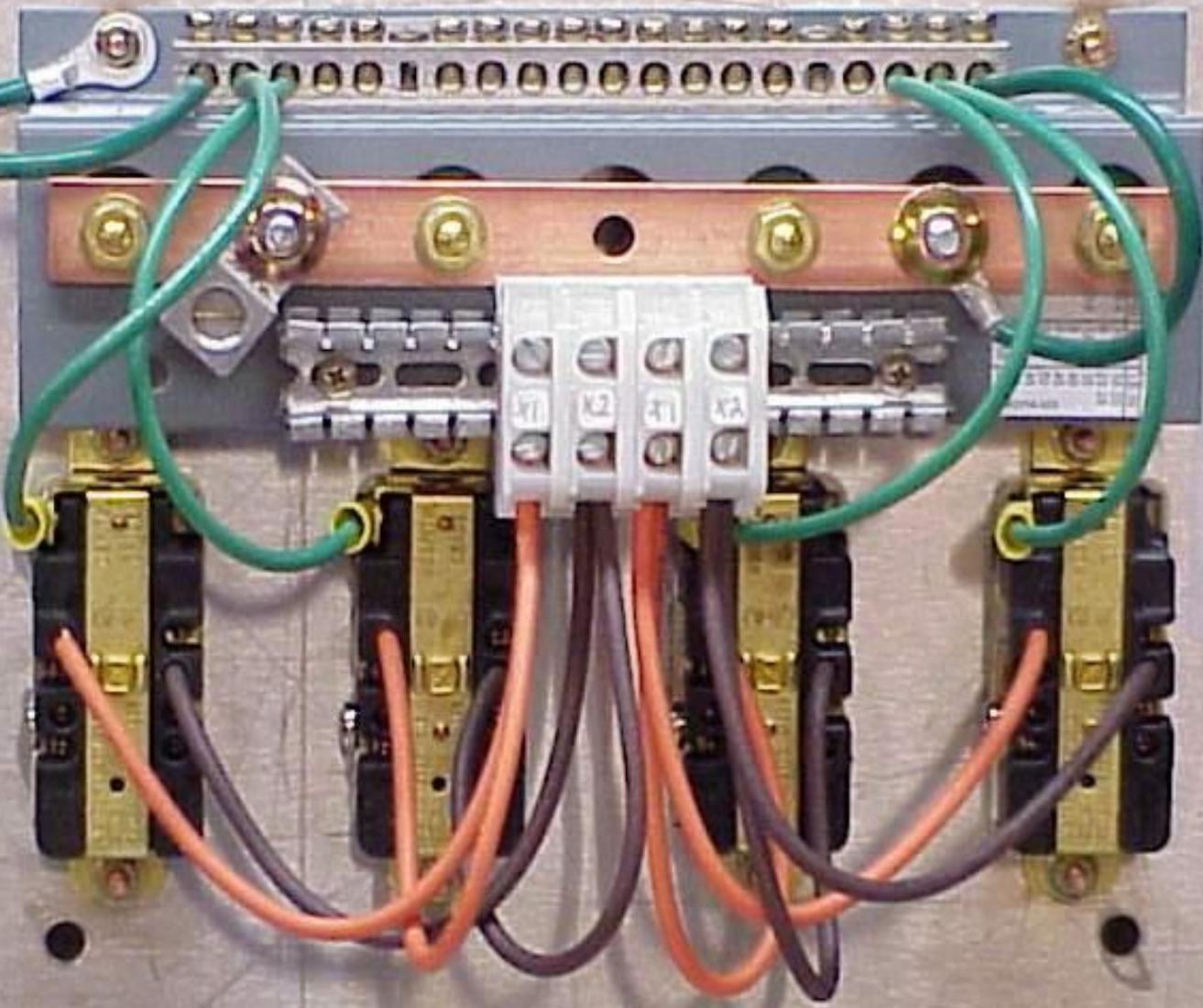
ATTACH COVER TO FLANGE OF
BACK BOX DURING INSTALLATION

A41114000-01

DRW DRMS DRW
 DRW DRMS DRW

USE COPPER ONLY

SQUARE D COMPANY



517.160 Isolated Power System

(A)(6) Wire Pulling Compounds

Wire-pulling compounds that increase the dielectric constant shall not be used on the secondary conductors of the isolated power supply

