NEC Article 517

- **Health Care Facilities**

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Learning Objectives

1. Health care facility-related definitions
2. Wiring methods and equipment for patient care areas
3. Required circuits for patient care areas
4. Required receptacles
5. Requirements for wet procedure locations
6. Requirements for the second source of power for the essential electrical system
7. Requirements for the life safety branch
8. Requirements for the critical branch
9. Requirements for the equipment branch

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Health Care Facilities


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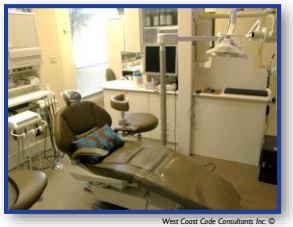
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Scope

- NEC 517.1 – Scope
  - *NEC* Article 517 applies to electrical systems in health care facilities that provide services to human beings.
  - Parts II and III of *NEC* Article 517 deal with single-function buildings but also govern individual occupancies within a multifunction building.

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Definitions

- NEC 517.2 – Definitions
  - **Ambulatory Health Care Occupancy.** "An 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:
    - (1) Treatment for patients that renders the patients incapable of taking action for self-preservation under emergency conditions without the assistance of others.
    - (2) Anesthesia that renders the patients incapable of taking action for self-preservation under emergency conditions without the assistance of others.
    - (3) 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." *NFPA 70, National Electrical Code ©*

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Definitions (cont.)

- NEC 517.2 (cont.)
- 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 and that is automatically connected to alternate power sources by one or more transfer switches during interruption of the normal power source."

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Definitions (cont.)

- NEC 517.2 (cont.)
- Electrical Life-Support Equipment. "Electrically powered equipment whose continuous operation is necessary to maintain a patient's life." *NFPA 70, National Electrical Code ©*

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Definitions (cont.)

- NEC 517.2 (cont.)
- 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."

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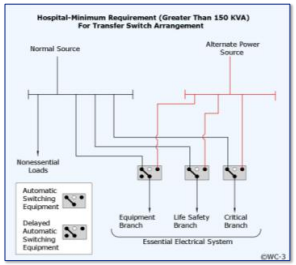
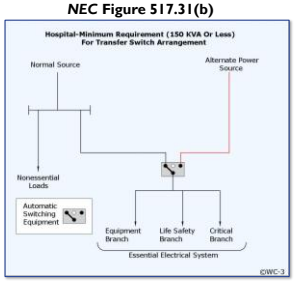
Essential Electrical Systems for Hospitals

NEC Figure 517.31(a)



NEC Figure 517.31(b)



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Definitions (cont.)

- NEC 517.2 (cont.)
- 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 3-phase power equipment."

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Definitions

- **NEC 517.2 (cont.)**
- Health Care Facility's Governing Body. "The person or persons who have the overall legal responsibility for the operation of a health care facility."

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Definitions (cont.)

- **NEC 517.2 (cont.)**

  Health Care Facilities. "Buildings, portions of buildings, or mobile enclosures in which human medical, dental, psychiatric, nursing, obstetrical, or surgical care are provided."

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  - The Informational Note says: "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."

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Definitions (cont.)

- NEC 517.2 (cont.)
- 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." *NFPA 70, National Electrical Code ©*

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Definitions (cont.)

- **NEC 517.2 (cont.)**
- Invasive Procedure. "Any procedure that penetrates the protective surfaces of a patient's body (i.e., skin, mucous membrane, cornea) and that is performed with an aseptic field (procedural site). [Not included in this category are placement of peripheral intravenous needles or catheters used to administer fluids and/or medications, gastrointestinal endoscopies (i.e., sigmoidoscopies), insertion of urethral catheters, and other similar procedures.]"

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Definitions (cont.)

- NEC 517.2 (cont.)
- Isolated Power System. "A system comprising an isolating transformer or its equivalent, a line isolation monitor, and its ungrounded circuit conductors."

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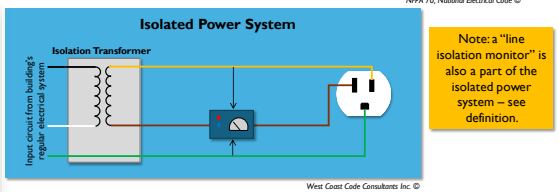

Note: a "line isolation monitor" is also a part of the isolated power system – see definition.

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Definitions (cont.)

- NEC 517.2 (cont.)
- 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." *NFPA 70, National Electrical Code ©*

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Definitions (cont.)

- NEC 517.2 (cont.)
- Limited Care Facility. “A building or portion thereof used on a 24-hour basis for the housing of four or more persons who are incapable of self-preservation because of age; physical limitation due to accident or illness; or limitations such as intellectual disability/developmental disability, mental illness, or chemical dependency.” *NFPA 70, National Electrical Code ©*

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Definitions (cont.)

- **NEC 517.2 (cont.)**

  Medical Office (Dental Office). A building or part thereof in which all of the following occur:
  - (1) “Examinations and minor treatments or procedures are performed under the continuous supervision of a dental professional;
  - (2) Use of limited sedation and treatment or procedures that do not render the patient incapable of self-preservation under emergency conditions; and
  - (3) No overnight stays for patients or 24-hour operations.”

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Definitions (cont.)

- **NEC 517.2 (cont.)**
- Nursing Home. “A building or portion of a building used on a 24-hour basis for the housing and nursing care of four or more persons who, because of mental or physical incapacity, might be unable to provide for their own needs and safety without the assistance of another person.” *NFPA 70, National Electrical Code ©*

Thomas Bjorkan, Wikipedia.com

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Definitions (cont.)

- NEC 517.2 (cont.)
- Patient Bed Location. “The location of a patient sleeping bed, or the bed or procedure table of a Category 1 (critical care) space.”

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Definitions (cont.)

- NEC 517.2 (cont.)

  Patient Care Space. "Any space of a health care facility wherein patients are intended to be examined or treated."

  - **"Critical Care (Category 1) Space.** Space in which failure of equipment or a system is likely to cause major injury or death of patients, staff, or visitors." *NFPA 70, National Electrical Code ©*
    - Examples could include: intensive care rooms, delivery rooms, operating rooms, trauma rooms, and similar. See also informational note.

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Definitions (cont.)

- NEC 517.2 (cont.)

  Patient Care Space (continued):

  - **"General Care (Category 2) Space.** Space in which failure of equipment or a system is likely to cause minor injury to patients, staff, or visitors." *NFPA 70, National Electrical Code ©*
    - Example could include: inpatient bedrooms, procedural rooms, dialysis rooms, and similar. See also informational note.

Wikipedia.com

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Definitions (cont.)

- NEC 517.2 (cont.)

  Patient Care Space (continued):

  - **"Basic Care(Category 3) Space.** Space in which failure of equipment or a system is **not** likely to cause injury to the patients or caregivers but may cause patient discomfort."
    - Examples could include: Rooms for basic medical or dental treatment occur, examination or treatment rooms in medical or dental offices, or exam and treatment rooms in nursing homes and limited care facilities. See also informational note.

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Definitions (cont.)

- NEC 517.2 (cont.)

  Patient Care Space (continued):

  - **"Support (Category 4) Space.** Space in which failure of equipment or a system is **not** likely to have a physical impact on patient care." *NFPA 70, National Electrical Code ©*
    - Examples could include: Offices, corridors, lounges, dining rooms, or similar. See also informational note.


Asa Wilson, Wikipedia.com

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517.2 Definitions

- NEC 517.2 (cont.)

Patient Care Space (continued):

- **"Support (Category 4) Space.** Space in which failure of equipment or a system is **not** likely to have a physical impact on patient care." *NFPA 70, National Electrical Code ©*
  - Examples could include: Offices, corridors, lounges, dining rooms, or similar. See also informational note.

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Definitions (cont.)

- NEC 517.2 (cont.)
- Patient Care Vicinity. "A space, within a location intended for the examination and treatment of patients, extending 6 feet 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 ft 6 in. above the floor." *NFPA 70, National Electrical Code ©*

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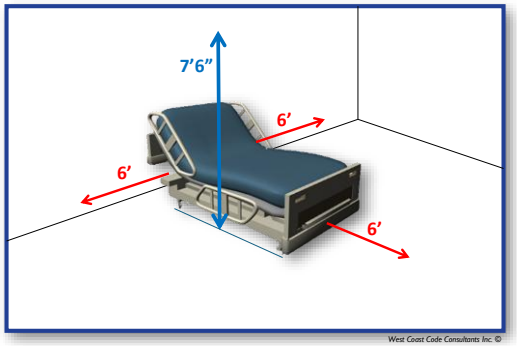
Patient Care Vicinity



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Definitions (cont.)

- NEC 517.2 (cont.)
- Selected Receptacles. "A minimal number of receptacles selected by the health care facility's governing body as necessary to provide essential patient care and facility services during loss of normal power." *NFPA 70, National Electrical Code ©*

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Definitions (cont.)

- NEC 517.2 (cont.)
- Task Illumination. "Provision for the minimum lighting required to carry out necessary tasks in the areas described in 517.34, including safe access to supplies and equipment, and access to exits." *NFPA 70, National Electrical Code ©*

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Definitions (cont.)

- NEC 517.2 (cont.)
- Wet Procedure Location. "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." *NFPA 70, National Electrical Code ©*

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Purpose of Part II

- **NEC 517.10**

  (A) Part II of *NEC* Article 517 is applicable for patient care spaces for all health care facilities.

  (B) Part II does **not** apply to:

  - Business offices, corridors, waiting rooms, and similar areas of clinics, medical and dental offices, and outpatient facilities.
  - Rooms or areas used only for sleeping rooms in nursing homes or limited care facilities. Wiring in such areas still must meet the requirements of Chapters 1-4 of the *NEC*.
  - Areas used exclusively for immunizations, phychiatry/phychotherapy, alternative medicine, & optometry.

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Matt Buck – Wikipedia.com

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Grounding Receptacles and Fixed Electrical Equipment in Patient Care Areas

- NEC 517.13 – Grounding Receptacles…

  Wiring in **patient care spaces** is required to comply with *NEC* 517.13(A) and (B).

  - **(A)** All branch circuits serving patient care spaces (and not just patient care *vicinity*) are required to have an effective ground-fault current path by installing the wiring within in a metal raceway system, or as part of a cable assembly having a metallic armor or sheath.
  - The metal raceway system, or metallic cable armor, or sheath assembly itself must be in accordance with *NEC* 250.118 (for equipment grounding conductors).

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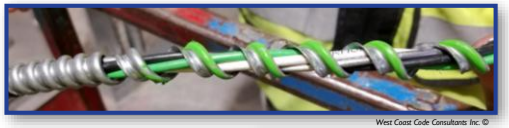
Metal Conduit or Metal Clad Cables



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Grounding Receptacles & Equip. in Patient Care Areas (cont.)

- NEC 517.13 (cont.)
  - **(B) Insulated Equipment Grounding Conductors/Bonding Jumpers.**
  - **(B)(1)** An insulated equipment grounding conductor (of the wire type) is required to be installed with the circuit wiring noted in *NEC* 517.13(A) and such must be connected to the following:
    - The grounding terminals of all receptacles (but <u>not</u> connected to isolated ground receptacles).
    - To any metal outlet boxes, medical device boxes, or metal enclosures.
    - To any non-current-carrying conductive surfaces of fixed electrical equipment which are likely to become energized that are subject to personal contact (and operating at over 100 volts).
    - Metal faceplates bonded to a metal box or to the yoke strap of a receptacle (and connected to the insulated equipment grounding conductor).

(See exceptions on next slide)

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Grounding Receptacles & Equip. in Patient Care Areas (cont.)

- NEC 517.13 (cont.)
  - **Exceptions to *NEC* 517.13(B):**
    - **Exception #1**: An insulated equipment bonding jumper that directly connects to the equipment grounding conductor noted in *NEC* 517.13(B)(1) is permitted to connect the metal box and receptacle(s) to the equipment grounding conductor. However, any isolated ground receptacles are required to be connected per *NEC* 517.16.
    - **Exception #2**: Metal faceplates are allowed to be bonded to the equipment grounding conductor through the use of the metal mounting screws which secure the faceplate to a grounded outlet box or grounded wiring device.
    - **Exception #3**: Luminaires which are located more than 7 ½ feet above the floor and any switches located outside of the patient care *vicinity* are allowed to be connected to an equipment grounding conductor per *NEC* 517.13(A) **<u>or</u>** (B).

(note: regular MC cable could be used for exception #3)

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Panelboard Bonding

- NEC 517.14
  - There must be provided a **#10 AWG** insulated copper conductor (of the wire type) to connect the equipment grounding terminal buses of multiple panelboards serving the same individual patient care vicinity.
  - The above noted grounding conductor is allowed to be broken at the panelboards in order to terminate the wire (but must be continuous otherwise).

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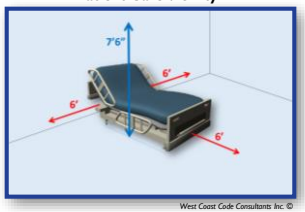
Use of Isolated Ground Receptacles

- NEC 517.16 – Use of Isolated Ground Receptacles
- **(A)** Isolated ground receptacles are **NOT** allowed to be installed within a patient care *vicinity*.

Also, per 517.16 the isolated ground receptacle is not allowed to defeat the purpose of the requirements of 517.13.

Patient Care Vicinity



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Use of Isolated Ground Receptacles (cont.)

- NEC 517.16 (cont.)
- **(B)** Isolated ground receptacles are permitted to be installed outside of a patient care *vicinity* as long as *NEC* 517.16(B)(1) and (B)(2) are complied with.

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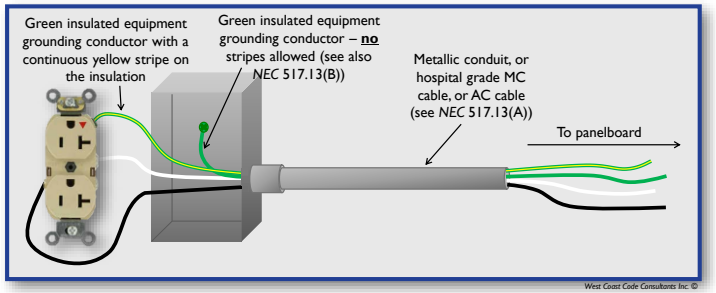
NEC 517.16(B)(1) and (B)(2):



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Ground-Fault Protection of Equipment

- NEC 517.17 – Ground-Fault Protection of Equipment
- **(A)** The requirements of *NEC* 517.17 apply to any hospitals or buildings which have critical care spaces (Category 1) and also any other buildings which provide the essential utilities or services for the operation of critical care (Category 1) spaces or any electrical life-support equipment.

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Ground-Fault Protection of Equipment (cont.)

- NEC 517.17 (cont.)
  - **(B)** Whenever the service disconnect for the building is required to have ground-fault protection of equipment (GFPE), as required per *NEC* 230.95 or 215.10, an additional step of ground-fault protection shall be provided in **all next level feeder disconnecting means** downstream of the service (ie. toward the load).
  - The above noted additional levels of ground-fault protection (GFPE) **CANNOT** be installed on the **load side** of an essential electrical system transfer switch.

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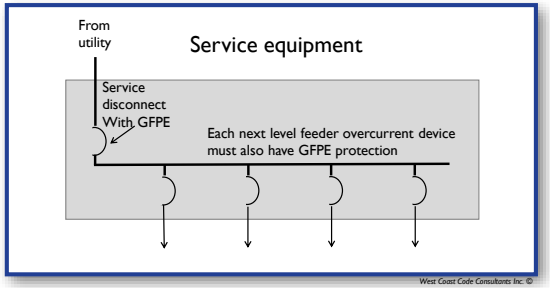
Ground-Fault Protection of Equipment (cont.)



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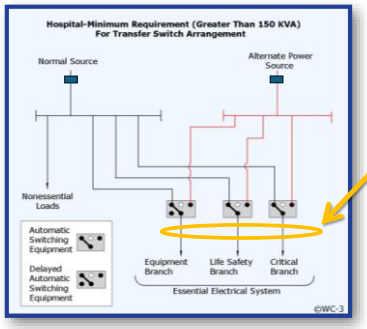
Ground-Fault Protection of Equipment (cont.)

***NEC* Figure 517.31(a)**



GFPE protection CANNOT be installed on the load side of an essential electrical system transfer switch

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Ground-Fault Protection of Equipment (cont.)

- NEC 517.17 (cont.)
  - **(C)** The ground-fault protection (GFPE,) for the service and feeder disconnecting means is required to be **fully selective** (ie. Selectively Coordinated) so that the feeder overcurrent protection device, but not the service overprotection device, will open on ground faults on the load side of the feeder device.
  - The coordination must be as required per manufacturer's recommendations and must achieve 100% selectivity.
  - **(D)** All GFPEs must be each be performance tested to ensure compliance with *NEC* 517.17(C).

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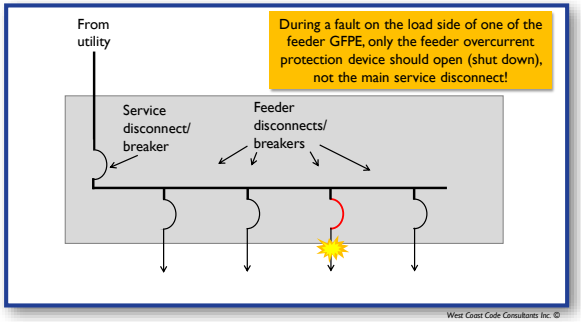
Selective Coordination



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General Care Areas (Category 2 spaces)

- NEC 517.18 – General Care Areas (Category 2 spaces)
  - **(A)** Every patient bed location is required to have at least **two branch circuits**, one fed from the critical branch and the other one fed from the normal system.
  - All branch circuits from the normal system are required to originate in the same panelboard.
  - The cover plates for the receptacles or the receptacles themselves must have a **distinctive color or marking** so as to be readily distinguishable from other receptacles.
    - The receptacles or cover plates must also indicate the panelboard and branch-circuit number supplying them.
  - Branch circuits serving patient bed locations CANNOT be part of a multiwire branch circuit.

See similar requirements for Critical Care (Category 1 Areas) [*NEC* 517.19(A)]

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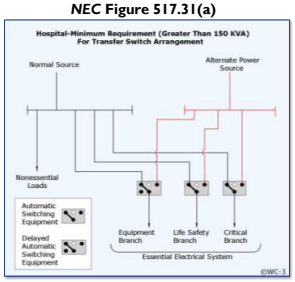
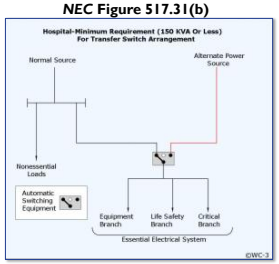
Essential Electrical Systems for Hospitals

***NEC* Figure 517.31(a)**



***NEC* Figure 517.31(b)**



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General Care Areas (Category 2 spaces, cont.)

- NEC 517.18 (cont.)

Exceptions to *NEC* 517.18(A):

- **Exception #1:** Branch circuits which only serve special purpose outlets or receptacles and are not required to be fed from the same panelboard as for the general care space.
  - An example of a special purpose outlet could be for x-ray equipment.
- **Exception #2:** The requirements of 517.18(A) do not apply to patient bed locations in clinics, medical and dental offices, outpatient facilities, psychiatric, substance abuse, rehabilitation hospitals, sleeping rooms of nursing homes, and limited care facilities (which meet the requirements of *NEC* 517.10(B)(2)).
- **Exception #3:** When a general care (Category 2) patient bed location is served from the critical branch by two separate transfer switches, the bed location is not required to have any circuits from the normal system.
- **Exception #4:** When the circuit(s) is part of a Type 2 essential electrical system then the branch circuit is permitted to be served by the equipment branch and not the critical branch.

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General Care Areas (cont.)

- NEC 517.18 (cont.)
  - **(B)(1)** Each patient bed location is required to be provided with a minimum of **eight receptacles**. Such receptacles can be the single, duplex, or quadruplex type.
  - **(B)(2)** All receptacles are required to be listed as "hospital grade" and be identified as such.
  - There must be provided an insulated copper equipment grounding conductor (sized per *NEC* Table 250.122) and be connected to the grounding terminal of the receptacle.

See exceptions

Hospital grade receptacle

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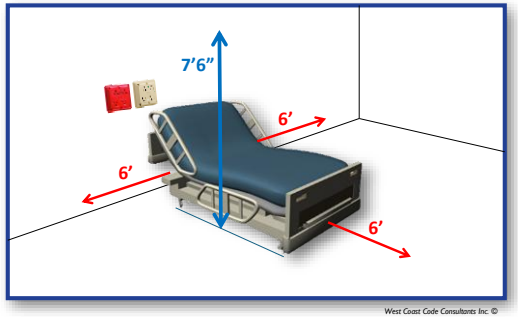
Receptacles in Patient Care Vicinity – General Care (Category 2) Spaces



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General Care Areas (cont.)

- NEC 517.18 (cont.)

  (C) Each receptacle within the following pediatric related locations must be the **tamper-resistant type** (or have a listed tamper-resistant cover):
  - Patient rooms, bathrooms, playrooms, activity rooms, or rooms with similar risks (as determined by the governing body based on a risk assessment).
  - Infant nurseries are not included in the above noted areas.

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Critical Care (Category 1) Spaces

- NEC 517.19 – Critical Care (Category I) Spaces

  (B) Patient Bed Location Receptacles.
  - **(B)(1)** Each patient bed location is required to be provided with a minimum of **14 receptacles**. At least one such receptacle must be fed by either the normal system branch circuit [noted in *NEC* 517.19(A)], or by a critical branch circuit which is supplied by a different transfer switch than the other receptacles at the same patient bed location.

Receptacles must also be "hospital grade" [see 517.19(B)(2)]

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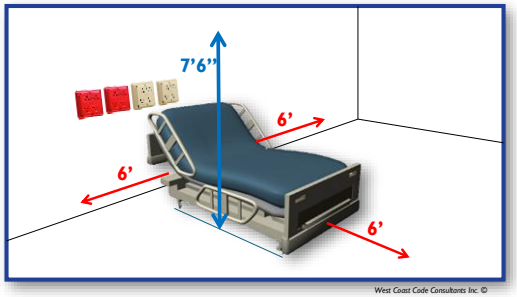
Receptacles in Patient Care Vicinity – Critical Care (Category 1) Spaces



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Critical Care (Category 1 Spaces, cont.)

- NEC 517.19 (cont.)

  (C) Operating Room Receptacles.

  - **(1)** Every operating room is required to have at least **36 receptacles divided between at least two branch circuits.**
  - At least 12 but not more than 24 of the above noted receptacles are required to be connected to either the normal system branch circuit [noted in *NEC* 517.19(A)] or a critical branch circuit which is supplied by a different transfer switch than the other receptacles at the same location.

All NON-locking type receptacles must also be "hospital grade" unless they're the locking type [see 517.19(C)(2)]

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Equipment Grounding and Bonding (for Critical Care Spaces)

- NEC 517.19(E) – Equipment Grounding and Bonding

  When feeders are installed in metal raceways or Type MC or MI cable are used (and the conduit or metal sheath qualifies as an equipment grounding conductor per *NEC* 250.118), all enclosures and equipment (such as panelboards, switchboards, and switchgear) are required to be properly bonded to an equipment grounding conductor per one of the following bonding means:

  - A grounding bushing with a properly sized bonding jumper, with the bonding jumper either connected to the enclosure or to the grounding busbar of the panel.
  - The metal conduit or MC or MI cable is connected to the enclosure via threaded hubs or bosses.
  - Or other approved devices such as bonding-type locknuts or bushings. Standard locknuts are NOT allowed to be used for bonding.

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Equipment Grounding and Bonding (cont.)

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Wet Procedure Locations

- *NEC* 517.20 – Wet Procedure Locations

  (A) Circuit wiring in any "**wet procedure location**" (see definitions at beginning of *NEC* Article 517) is/are required to have special protection against electric shock per one of the following:
  - An isolated power distribution system. Such system must limit a possible ground-fault current (for a first fault) to a low value, without shutting off the power supply.
  - Or a distribution system which shuts off the power supply if a ground-fault current happens and exceeds **6 mA** (such as is the case with Class A GFCI devices)

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Wet Procedure Location (cont.)

- *NEC* 517.20 (cont.)

  Exception to 517.20(A): Branch circuits supplying only listed, fixed, therapeutic and diagnostic equipment do not have to meet the requirements specified in *NEC* 517.20(A), provided that:
  - The wiring for grounded and isolated circuits does not occupy the same raceway, and
  - All conductive surfaces of the equipment are connected to an insulated copper equipment grounding conductor.

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Wet Procedure Locations (cont.)

- *NEC* 517.20 (cont.)
- **(B)** Where an isolated power system is installed, such equipment is required to be listed as isolated power equipment, and such system must meet the requirements of *NEC* 517.160.

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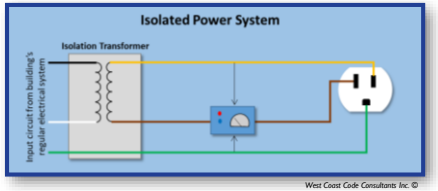
Isolated Power System (definition)

- "A system comprising an isolating transformer or its equivalent, a line isolation monitor, and its ungrounded circuit conductors." *NFPA 70, National Electrical Code ©*

As the general rule, an isolated power system can only serve one operating room [*NEC* 517.160(A)(4)].

The conductors must be orange and brown, having stripes that are NOT while, green, or gray [*NEC* 517.160(A)(5)].



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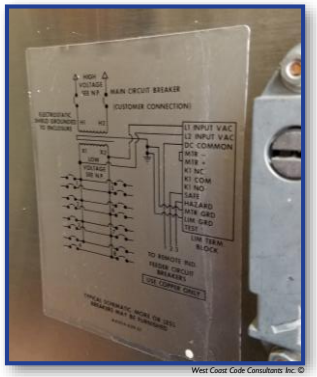

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Ground-Fault Circuit-Interrupter Protection for Personnel

- NEC 517.21 – GFCI for Critical Care (Cat 1) and General Care (Cat 2) Spaces
- Receptacles are not required in bathrooms or toilet rooms.
- Ground-fault circuit-interrupter (GFCI) protection for personnel is NOT required for receptacles located in a Critical Care (Category 1) and General Care (Category 2) spaces where the toilet and basin (sink) are installed at a patient bed location.

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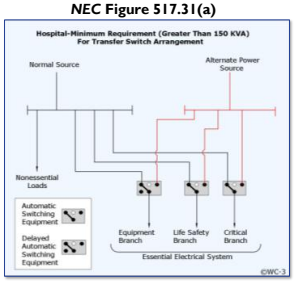
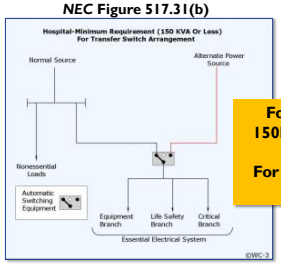
Part III of *NEC* Article 517 deals with the Essential Electrical System.

***NEC* Figure 517.31(a)**



***NEC* Figure 517.31(b)**



See also *NEC* 517.42 for essential electrical systems for nursing homes and limited health care facilities.

For a 480V system, 150kVA is about 180A.

For a 208V system, it's about 416A.

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Other Articles

- NEC 517.26
- Unless amended by NEC Article 517, the life safety branch of an essential electrical system must comply with the requirements of NEC Article 700 (which deals with emergency backup systems).
  - But 700.4 does not apply (capacity and rating).
  - 700.10(D) does not apply (fire protection).
  - 700.32 does not apply (selective coordination).
  - And 700.17 (circuits for emergency lighting) is required to be replaced with: "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."

2020

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Type 1 Essential Electrical Systems

- NEC 517.29
- (A) For Type 1 Essential Electrical Systems the requirements of Part III of Article 517 and 517.29 through 517.35 apply.
- A Type 1 Essential Electrical System is required for Critical Care (Category 1) spaces.
- But a Type I system is permitted to service General Care (Cat 2), Basic Care (Cat 3), and Support (Cat 4) spaces.

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Sources of Power

- **NEC 517.30 – Sources of Power**
  (A) The essential electrical system (for a hospital) is required to have at least two independent sources of power.
  - The first source must be a normal source generally supplying the entire electrical system.
  - The second source must be one or more alternate source(s) for use when the normal source is interrupted.

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Sources of Power

- **NEC 517.30**
  - **(B)(2)** Fuel cell systems [meeting the requirements of *NEC* 517.30(B)(2) items 1 through 5] are permitted as the alternate source (see also Article 700 in the *NEC*).

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Sources of Power

- **NEC 517.30 – Sources of Power**
  - **(B)(3)** Certain battery systems are permitted as the alternate source (see also Article 700 in the *NEC*).
    - Typically, NFPA 111 (Standard on Stored Electrical Energy Emergency and Standby Power Systems) will also apply for the system.

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Locations of Essential Electrical System Equipment

- NEC 517.30(C)
  - Equipment for the essential electrical system is required to be installed in locations to minimize the adverse effects of local natural forces that are common to the area.
    - This could include storms, floods, earthquakes, or other potential hazards such as adjoining structures.
  - Location of the electrical service equipment also applies to this requirement.
  - In addition to the above noted requirements, the feeders from the normal source of power must be kept separate from the feeders of the alternate source of power to help minimize simultaneous disruption of both sets of feeders.

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Essential Electrical System

- **NEC 517.31 – Essential Electrical System (EES)**
  - **(B)** The number of how many transfer switches are needed must be based on reliability and design (but a minimum of 3 for a Type 1 EES).
  - **(B)(1)** Any loads not specifically mentioned in *NEC* Article 517 that will be served by the generating equipment (alternate source) must have their own transfer switch and must meet either of the following:
    - Not be transferred if the loads will overload the alternate source of power.
    - Or the loads must be shed when the alternate source will be overloaded.

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Essential Electrical System (cont.)

- NEC 517.31 (cont.)
  - **(C)(1)** The circuit wiring for the **life safety branch and also the critical branch** of the essential electrical system cannot be in the same raceways, boxes, or cabinets with each other or other wiring (ie. the life safety wiring and critical branch wiring must be kept separate from each other and from other types of wiring).

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Essential Electrical System (cont.)

- NEC 517.31 (cont.)
- **(C)(1) continued:**
  - HOWEVER, under the following conditions wiring of the life safety branch and the critical branch are allowed to be in the same raceways, boxes, or cabinets as other circuit wiring:
    - Inside transfer equipment enclosures
    - In exit or emergency luminaires which are supplied from two separate sources
    - In a common junction box which is attached to exit or emergency luminaires (that are supplied from two sources)
    - The wiring is for two or more circuits supplied from the same transfer switch and are for the same branch.
  - Also, the wiring of the equipment branch is allowed to be in the same raceways, boxes, or cabinets of any other circuits that are not part of the essential electrical system.

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Essential Electrical System (cont.)

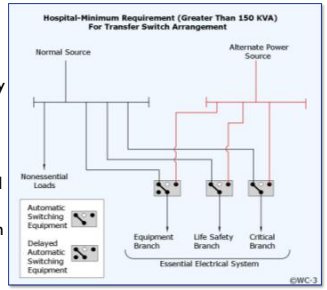
- NEC 517.31 (cont.)

(C)(I) continued:

2020 • Raceway, cables, boxes, and enclosures of the Life Safety and Critical Branches must be readily identifiable. This includes transfer switches, generator(s), power panels etc.

2020 • Raceways and cables are required to be field-marked every **25 feet** along the raceway or cable.

• Whenever the critical care locations are served from two separate transfer switches, the two separate systems are required to be kept in different raceways, boxes, or cabinets from each other.



73

Essential Electrical System (cont.)

NEC 517.31 (cont.)

(C)(3) Allowable wiring methods for life safety and critical branches must be per the following:

- Metal raceways (non-flexible), MI cable, RTRC conduit with the marking –XW, or schedule 80 PVC.
- Nonmetallic conduit cannot be used for wiring supplying patient care areas (see also *NEC* 517.13).
- Schedule 40 PVC, or flexible conduit or cables which are allowed to be encased in concrete are permitted if encased in not less than 2" of concrete.

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Essential Electrical System (cont.)

NEC 517.31 (cont.)

(C)(3) continued:

- Listed flexible metal conduit or listed metal sheathed cables are allowed per the following:
  - Where part of a listed prefab medical headwall.
  - Where used in listed furniture.
  - Where fished in walls or ceilings where not accessible.
  - Where necessary for equipment that requires a flexible connection.
  - For luminaires that are installed in a rigid ceiling and there isn't any access to the space above the ceiling after the light is installed.
- Flexible power cords of appliances or equipment is allowed.
- Class 2 or Class 3 system wiring (with or without raceways).

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Essential Electrical System (cont.)

- **NEC 517.31 (cont.)**

(D) The essential electrical system is required to have the capacity (and also rating) per the maximum demand that is likely to be produced by the loads.

- Feeders need to still be sized per *NEC* 215.2 and Part III of Article 220.

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Essential Electrical System (cont.)

517.31(D) continued:

The calculations for determining the maximum demand of the loads must be per any of the following:

- Per "prudent demand factors" in conjunction with historical data.
- The actual connected load.
- Feeder calculations per *NEC* Article 220.
- Or any combination of the above noted items.

Also, the requirements of *NEC* 700.4 or 701.4 (capacity and rating) do not apply. See *NEC* 517.31(D) and 517.26.

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Essential Electrical System (cont.)

- **NEC 517.31 (cont.)**
- (E) The cover plates (or receptacles themselves) for any receptacles supplied by the life safety and critical branches of an essential electrical system must have a distinctive color or marking to make them readily identifiable.

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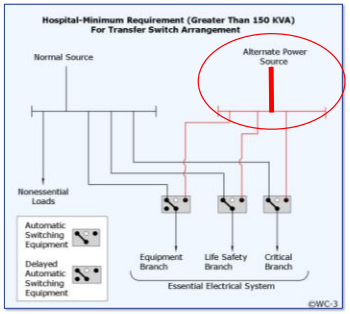
Essential Electrical System (cont.)

- **NEC 517.31 (cont.)**
- (F) Only a single feeder is required from the alternate source to the point of where the equipment branch, life safety branch, and equipment branch are separated.



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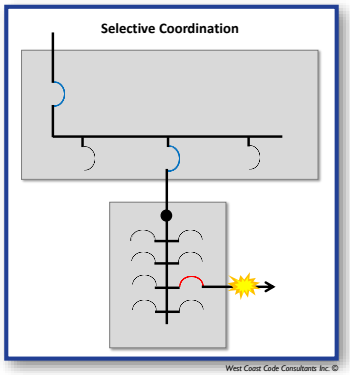
Essential Electrical System (cont.)

- **NEC 517.31 (cont.)**
- (F) All overcurrent protection devices for the essential electrical system are required to be selectively coordinated for faults having a duration exceeding 0.1 seconds.

(see exceptions)



80

Branch Circuits Requiring Automatic Connection

- **NEC 517.32**
- (B) For the life safety and critical branches (of a Type 2 essential electrical system), whenever the normal source of power is disrupted, connection to the alternate source of power must occur within 10 seconds.
- Note: previous editions of the NEC (2017 and older) for 517.32 did not appear to distinguish what type of essential electrical system the 10 seconds maximum time limit applied to.

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Life Safety Branch

- NEC 517.33 – Life Safety Branch
  - Only the items listed per *NEC* 517.33(A) through (H) are allowed to be connected to the **life safety** branch:
    - Illumination for the means of egress.
    - Exit signage.
    - Alarms and alerting systems.
    - Communication systems (for emergencies).
    - Power for illumination, battery charger, and receptacles for the generator set.
    - And generator set accessories (which are required for the generator).
    - Elevators.
    - Automatic doors.

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Critical Branch

NEC 517.34 – Critical Branch

- **(A)** The critical branch (of the essential electrical system) is required to provide power to the following:
  - For critical care (Category 1) spaces where deep sedation or general anesthesia is administered, task illumination, specific receptacles, and fixed equipment. Included in this could be an isolated power system.
  - For any patient care spaces, task illumination, and selected receptacles in the following:
    - Nurseries for infants
    - Ares for preparation of medication
    - Areas for pharmacy dispensing
    - Select nursing areas (determined by the governing body)
    - Psychiatric bed areas (not counting receptacles)
    - Treatment rooms in a ward
    - Nurses' stations (not needed for lights if corridor luminaires properly light the station)

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Critical Branch (cont.)

NEC 517.34 (cont.)

- **(A) continued:**
  - Any receptacles and/or illumination for specialized patient care
  - Call systems for nurses
  - Blood, bone, and tissue banks
  - Telecommunications facility/rooms and associated equipment


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Critical Branch (cont.)

NEC 517.34 (cont.)

- **(A) continued:**
  - For Task illumination, specific receptacles, and specific circuits for the following:
    - Beds in general care (Category 2) locations (every patient bedroom must have at least one duplex receptacle) and task illumination as required per the governing body.
    - Angiographic labs
    - Cardiac catheterization labs
    - Coronary care units
    - Hemodialysis rooms/areas
    - Specific emergency room treatment areas (selected per the governing body)
    - Physiology labs
    - Intensive care units
    - Postoperative recovery rooms (selected per the governing body)
  - 2020 Clinical IT network equipment.
  - 2020 Wireless phone & paging equipment.
  - And any other task illumination, receptacles, and specific circuits needed in order to effectively operate the facility.

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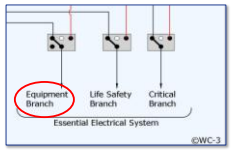
Equipment Branch

- NEC 517.35
  - The equipment branch is required to be connected to the alternate source of power so that the equipment specified in *NEC* 517.35(A) is automatically connected at the "appropriate time-lag intervals" when loss or disruption of the normal power source.
    - The exception to the above noted requirements is an essential electrical system which is under 150kVA.
  - See also *NEC* 517.35(B) which includes equipment automatically and manually connected to the alternate power source.



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Equipment Branch (cont.)

NEC 517.35 (cont.)

- **(A)** The following equipment is permitted to be automatically delayed when connecting to the alternate source of power:
  - Any central suction systems that serve medical and surgical functions. But suction systems could also be added to the critical branch.
  - Sump pumps (where required for safe operation of a major apparatus).
  - Any compressed air systems that serve medical and surgical functions. But such systems could also be added to the critical branch.
  - Smoke control and stair pressurization systems (or both).
  - Kitchen hoods (including its supply and/or exhaust systems).

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Equipment Branch (cont.)

NEC 517.35(A)(cont.)

- The overall supply, return, and exhaust ventilating systems for rooms requiring ventilation and exhaust. Such could include: airborne infectious or isolation rooms, protective environment rooms, exhaust for laboratory hoods, any exhaust for nuclear medicine areas, ethylene oxide exhaust, and any anesthesia exhaust.
  - When there cannot be a delay in power, such systems can instead be on the critical branch.
- Ventilating and exhaust systems for operating and delivery rooms.
- Ventilating and exhaust systems and including any air-conditioning systems serving telephone/data equipment rooms/closets.

Lab Exhaust Hood

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Equipment Branch (cont.)

NEC 517.35 (cont.)

- **(B)** The following equipment is permitted to be automatically delayed or be manually transferred when connecting to the alternate source of power:
- Heating equipment for: operation rooms, delivery rooms, recovery rooms, intensive care rooms, coronary care rooms, nurseries, infection/isolation rooms, emergency treatment areas, patient rooms. Also allowed is pressure maintenance systems for pump(s) for water-based fire protection systems.

See exceptions for buildings located in warm climates or if there's provided two sources of normal power.

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Equipment Branch (cont.)

NEC 517.35(B)(cont.)

- Specific elevator(s) to be used for patient, surgical, and obstetrical purposes when the normal source of power is interrupted. If there's a potential for elevators to stop between floors (during interruption of the normal power source), then "throw-over facilities" are required to be provided for temporary operation of an elevator to release the people therein.
- Hyperbaric facilities.
- Hypobaric facilities.
- Automatic doors.
- Minimal amounts of electrically heated autoclaving (sterilizing) equipment.
- Any controls for equipment that are listed in *NEC* 517.35.
- Any other selected equipment (ie. selected by the governing body) is allowed to connected to the equipment system.

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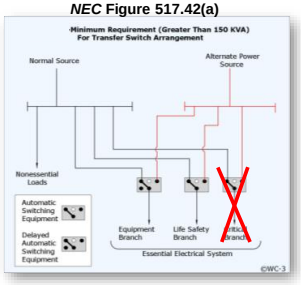
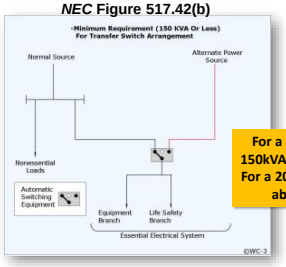
Type 2 essential electrical systems for nursing homes and limited health care facilities

***NEC* Figure 517.42(a)**



***NEC* Figure 517.42(b)**



For a 480V system, 150kVA is about 180A. For a 208V system, it's about 416A.

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Type 2 essential electrical systems for nursing homes and limited health care facilities (continued)

NEC 517.40

(A) 517.40(C) through 517.44 apply to General Care (Cat 2) locations [2017 *NEC* referred to nursing homes or limited care facilities].

- Exception: 517.40(C) through 517.44 do not apply to any freestanding nursing homes and limited care facilities when all of the following applies:
  - The facility's policies do not allow any persons to be put on life-support equipment;
  - The facility does not perform surgical treatment which requires general anesthesia;
  - Automatic backup power (or battery supply) is provided for not less than 1.5 hours to lighting for exits, at any exit pathways/corridors or stairways, nursing stations, medical prep rooms, boiler rooms, and communication areas. All alarm systems must also be provided with backup power.

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Type 2 essential electrical systems for nursing homes and limited health care facilities (continued)

NEC 517.40

- (B) If a nursing home or limited care facility allows a person to be admitted and such person requires to be placed on life support equipment, then the essential electrical system must comply with the requirements of NEC 517.29 through 517.35 (for Type 1 essential electrical systems).

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Classification of Anesthetizing Locations

- **NEC 517.60 – Classification of Anesthetizing Locations**
  - **(A)** Wherever flammable anesthetics are **used** (employed), the entire area is required to be considered a Class I, Division 1 location.
  - Such location is to extend upward 5 feet above the floor.
  - Any areas above the 5 foot area (and up to the structural ceiling) are to be considered to be above a hazardous (classified) location.

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Classification of Anesthetizing Locations (cont.)

- **NEC 517.60 (cont.)**
- (B) Wherever flammable anesthetics are stored, the entire room from floor to the ceiling is required to be considered a Class I, Division 1 location.
- Note: the use of flammable anesthetics is becoming less and less common.

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NEC Article 517

- Part IV deals with inhalation anesthetizing locations.
- Part V deals with X-ray equipment.
- Part VI deals with communication, signaling, data, fire alarm, and other systems that operate less than 120V.
- Part VII has specific rules for isolated power systems.

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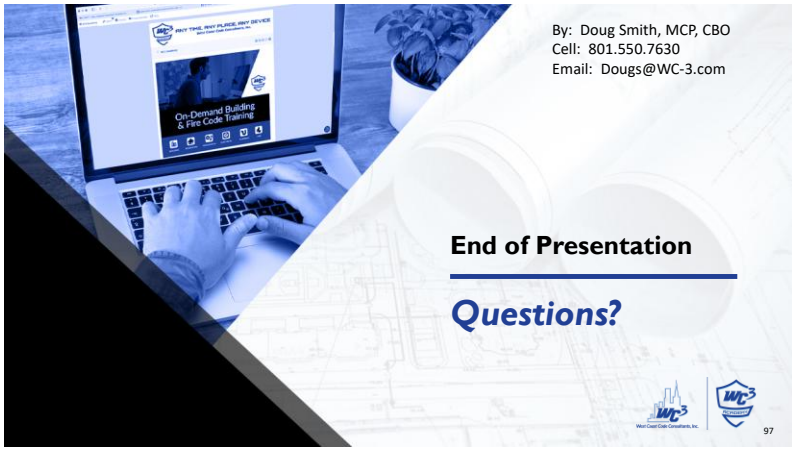
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