

(B) Line Isolation Monitor.

(1) Characteristics. In addition to the usual control and over-current protective devices, each isolated power system shall be provided with a listed continually operating line isolation monitor that indicates total hazard current. The monitor shall be designed such that a green signal lamp, conspicuously visible to persons in each area served by the isolated power system, remains lighted when the system is adequately isolated from ground. An adjacent red signal lamp and an audible warning signal (remote if desired) shall be energized when the total hazard current (consisting of possible resistive and capacitive leakage currents) from either isolated conductor to ground reaches a threshold value of 5 mA under nominal line voltage conditions. The line monitor shall not alarm for a fault hazard of less than 3.7 mA or for a total hazard current of less than 5 mA.

Exception: A system shall be permitted to be designed to operate at a lower threshold value of total hazard current. A line isolation monitor for such a system shall be permitted to be approved, with the provision that the fault hazard current shall be permitted to be reduced but not to less than 35 percent of the corresponding threshold value of the total hazard current, and the monitor hazard current is to be correspondingly reduced to not more than 50 percent of the alarm threshold value of the total hazard current.

See Exhibit 517.6 for an example of a hospital isolated power system panel.

(2) Impedance. The line isolation monitor shall be designed to have sufficient internal impedance such that, when properly connected to the isolated system, the maximum internal current that can flow through the line isolation monitor, when any point of the isolated system is grounded, shall be 1 mA.

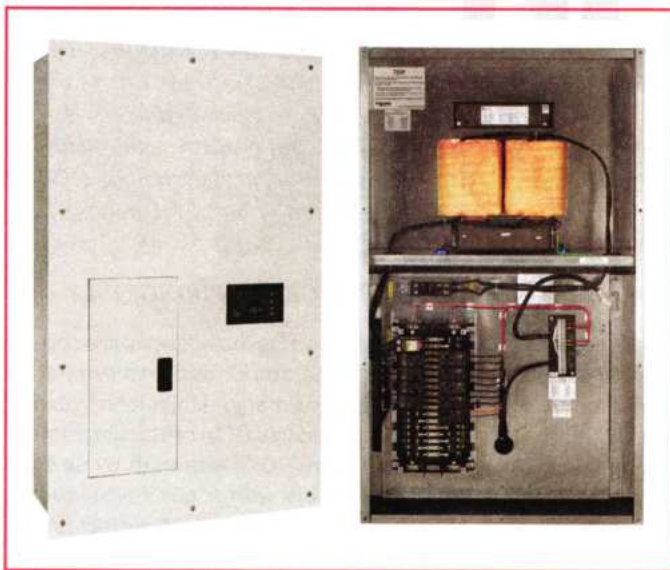


EXHIBIT 517.6 An example of a hospital isolated power system panel with built-in isolation transformer, line isolation monitor, load center, and grounded busbar. (Courtesy of Schneider Electric)

Exception: The line isolation monitor shall be permitted to be of the low-impedance type such that the current through the line isolation monitor, when any point of the isolated system is grounded, will not exceed twice the alarm threshold value for a period not exceeding 5 milliseconds.

Informational Note: Reduction of the monitor hazard current, provided this reduction results in an increased “not alarm” threshold value for the fault hazard current, will increase circuit capacity.

(3) Ammeter. An ammeter calibrated in the total hazard current of the system (contribution of the fault hazard current plus monitor hazard current) shall be mounted in a plainly visible place on the line isolation monitor with the “alarm on” zone at approximately the center of the scale.

Exception: The line isolation monitor shall be permitted to be a composite unit, with a sensing section cabled to a separate display panel section on which the alarm or test functions are located.

Informational Note: It is desirable to locate the ammeter so that it is conspicuously visible to persons in the anesthetizing location.

ARTICLE 518

Assembly Occupancies

518.1 Scope. Except for the assembly occupancies explicitly covered by 520.1, this article covers all buildings or portions of buildings or structures designed or intended for the gathering together of 100 or more persons for such purposes as deliberation, worship, entertainment, eating, drinking, amusement, awaiting transportation, or similar purposes.

Informational Note: See NFPA 101-2021, *Life Safety Code*, or the local building code for methods of determining population capacity.

Article 518 applies to assembly occupancies designed or intended for 100 or more persons with the population capacity determined by methods utilized in NFPA 101®, *Life Safety Code*®. Article 518 would apply, for example, to a church chapel or an auditorium for occupancy of 100 or more persons but not to a supermarket. Even though a supermarket might contain 100 or more persons at any given time, it is not specifically designed or intended for the assembly of persons. Article 518 does not apply to office buildings or schools, even though such buildings, as a rule, are designed for occupancy by 100 or more persons. The article does, however, apply to assembly halls, restaurants, and assembly areas such as large meeting or conference rooms, cafeterias, gymnasiums, and auditoriums within an office or school building if these parts of the building are designed or intended for the assembly of 100 or more persons. Note that the production and audience areas of theaters within a building are subject to the requirements of Article 520.

The following information for determining new assembly occupancy capacity is extracted from NFPA 101:

12.1.7 Occupant Load.

12.1.7.1 General. The occupant load, in number of persons for whom means of egress and other provisions are required, shall be determined on the basis of the occupant load factors of Table 7.3.1.2 [Commentary Table 518.1] that are characteristic of the use of the space or shall be determined as the maximum probable population of the space under consideration, whichever is greater.

7.3.1.1.2 For other than existing means of egress, where more than one means of egress is required, the means of egress shall be of such width and capacity that the loss of any one means of egress leaves available not less than 50 percent of the required capacity.

7.3.1.2 Occupant Load Factor. The occupant load in any building or portion thereof shall be not less than the number of persons determined by dividing the floor area assigned to that use by the occupant load factor for that use as specified in Table 7.3.1.2 [Commentary Table 518.1]. Where both gross and net area figures are given for the same occupancy, calculations shall be made by applying the gross area figure to the gross area of the portion of the building devoted to the use for which the gross area figure is specified and by applying the net area figure to the net area of the portion of the building devoted to the use for which the net area figure is specified.

518.2 General Classification.

(A) Examples. Assembly occupancies shall include, but not be limited to, the following:

- (1) Armories
- (2) Assembly halls
- (3) Auditoriums
- (4) Bowling lanes
- (5) Casinos and gaming facilities
- (6) Club rooms
- (7) Conference rooms
- (8) Courtrooms
- (9) Dance halls
- (10) Dining and drinking facilities
- (11) Exhibition halls
- (12) Gymnasiums
- (13) Mortuary chapels
- (14) Multipurpose rooms
- (15) Museums
- (16) Places of awaiting transportation
- (17) Places of religious worship
- (18) Pool rooms
- (19) Restaurants
- (20) Skating rinks

(B) Multiple Occupancies. Where an assembly occupancy forms a portion of a building containing other occupancies, Article 518 applies only to that portion of the building considered an assembly occupancy. Occupancy of any room or space

for assembly purposes by less than 100 persons in a building of other occupancy, and incidental to such other occupancy, shall be classified as part of the other occupancy.

(C) Theatrical Areas. Where any such building or structure, or portion of a building or structure, contains a projection booth or stage platform or area for the presentation of theatrical or musical productions, either fixed or portable, the wiring for that area, including associated audience seating areas, and all equipment that is used in the referenced area, and portable equipment and wiring for use in the production that will not be connected to permanently installed wiring, shall comply with Article 520.

Informational Note: See NFPA 101-2021, *Life Safety Code*, or the local building code for methods of determining population capacity.

The requirements in Article 520 apply to theatrical areas within assembly occupancies. See the commentary following 520.1.

518.3 Temporary Wiring. In exhibition halls used for display booths, as in trade shows, the temporary wiring shall be permitted to be installed in accordance with Article 590. Flexible cables and cords approved for hard or extra-hard usage shall be permitted to be laid on floors where protected from contact by the general public. The ground-fault circuit-interrupter requirements of 590.6 shall not apply. All other ground-fault circuit-interrupter requirements of this *Code* shall apply.

Where ground-fault circuit-interrupter protection for personnel is cord-and-plug-connected to the branch circuit or to the feeder, the ground-fault circuit-interrupter protection shall be listed as portable ground-fault circuit-interrupter protection or provide a level of protection equivalent to a portable ground-fault circuit interrupter, whether assembled in the field or at the factory.

Exception: Where conditions of supervision and maintenance ensure that only qualified persons will service the installation, flexible cords or cables identified in Table 400.4 for hard usage or extra-hard usage shall be permitted in cable trays used only for temporary wiring. All cords or cables shall be installed in a single layer. A permanent sign shall be attached to the cable tray at intervals not to exceed 7.5 m (25 ft) and read as follows:

CABLE TRAY FOR TEMPORARY WIRING ONLY

GFCI requirements for temporary wiring installations are covered in 590.6, but those requirements do not apply to temporary installations under Article 518. Temporary installations in exhibition halls must meet all other applicable GFCI protection requirements such as those specified in 210.8. Although trade show booths are connected to temporary wiring, GFCI protection is required for water features at garden shows, receptacles near sinks for food vendors, and other, similar installations.

Permanent GFCI protection differs from portable GFCI protection. Product standards for GFCI equipment require portable

COMMENTARY TABLE 518.1 Occupant Load Factor

Use	(ft ² /person) ^a	(m ² /person) ^a
Assembly Use		
Concentrated use, without fixed seating	7 net	0.65 net
Less concentrated use, without fixed seating	15 net	1.4 net
Bench-type seating	1 person/18 linear in.	1 person/455 linear mm
Fixed seating	Use number of fixed seats	Use number of fixed seats
Waiting spaces	See 12.1.7.2 and 13.1.7.2 [of NFPA 101].	See 12.1.7.2 and 13.1.7.2 [of NFPA 101].
Kitchens	100	9.3
Library stack areas	100	9.3
Library reading rooms	50 net	4.6 net
Swimming pools	50 (water surface)	4.6 (water surface)
Swimming pool decks	30	2.8
Exercise rooms with equipment	50	4.6
Exercise rooms without equipment	15	1.4
Stages	15 net	1.4 net
Lighting and access catwalks, galleries, gridirons	100 net	9.3 net
Casinos and similar gaming areas	11	1
Skating rinks	50	4.6
Business Use (other than below)	150	14
Concentrated business use ^f	50	4.6
Airport traffic control tower observation levels	40	3.7
Collaboration rooms/spaces ≤450 ft ² (41.8 m ²) in area ^f	30	2.8
Collaboration rooms/spaces >450 ft ² (41.8 m ²) in area ^f	15	1.4
Day-Care Use	35 net	3.3 net
Detention and Correctional Use	120	11.1
Educational Use		
Classrooms	20 net	1.9 net
Shops, laboratories, vocational rooms	50 net	4.6 net
Health Care Use		
Inpatient treatment departments	240	22.3
Sleeping departments	120	11.1
Ambulatory health care	150	14
Industrial Use		
General and high hazard industrial	100	9.3
Special-purpose industrial	NA	NA
Mercantile Use		
Sales area on street floor ^{b,c}	30	2.8
Sales area on two or more street floors ^c	40	3.7
Sales area on floor below street floor ^c	30	2.8
Sales area on floors above street floor ^c	60	5.6
Floors or portions of floors used only for offices	See business use.	See business use.
Floors or portions of floors used only for storage, receiving, and shipping, and not open to general public	300	27.9
Mall structures ^d	Per factors applicable to use of space ^e	
Residential Use		
Hotels and dormitories	200	18.6
Apartment buildings	200	18.6
Board and care, large	200	18.6
Storage Use		
In storage occupancies	NA	NA
In mercantile occupancies	300	27.9
In other than storage and mercantile occupancies	500	46.5

Note: NA = not applicable. The occupant load is the maximum probable number of occupants present at any time.

^aAll factors are expressed in gross area unless marked "net."

Notes b through f contain specific load or egress considerations, such as when no direct egress to a street is available, for the occupancies referenced. Refer to NFPA 101 for further information.



EXHIBIT 518.1 Protective cover for flexible cords and cables laid on floors or on the ground. (Courtesy of Electriduct)

devices to de-energize the contacts when the grounded conductor is open, a grounded conductor is transposed (miswired), and/or an ungrounded conductor is open. For that reason, GFCI protection for temporary wiring must be listed as portable or provide equivalent protection to a portable GFCI device.

Exhibit 518.1 is an example of a protective cover used where cords are subject to physical damage, such as pedestrian walkways or light vehicle pathways.

518.4 Wiring Methods.

- Δ (A) **General.** The wiring method shall qualify as an equipment grounding conductor in accordance with 250.118 or shall contain an equipment grounding conductor sized in accordance with Table 250.122, and shall be any of the following:

- (1) Metal raceways
- (2) Flexible metal raceways
- (3) Nonmetallic raceways encased in not less than 50 mm (2 in.) of concrete
- (4) Type MI, Type MC, or Type AC cable

- Δ (B) **Communications, Signaling Systems, Data Systems, Fire Alarm Systems, and Systems Less Than 120 Volts, Nominal.** Fixed wiring methods for specific installations shall be as follows:

- (1) Audio signal processing, amplification, and reproduction equipment — 640.9
- (2) Communications systems — Part IV of Article 805 and Part VI of Article 840
- (3) Class 2 and Class 3 remote control and signaling circuits — Article 725, Part III
- (4) Class 2 circuits that transmit power, data, or both to a powered device

Informational Note: See ANSI/NEMA C137.3-2017, *American National Standard for Lighting Systems — Minimum Requirements for Installation of Energy Efficient Power over Ethernet (PoE) Lighting Systems*, for information on installation of cables for PoE lighting systems. See Part III of Article 760 for information on fire alarm circuits.

- (C) **Nonrated Construction.** In addition to the wiring methods permitted by 518.4(A), nonmetallic-sheathed cable, electrical nonmetallic tubing, and rigid nonmetallic conduit shall be permitted to be installed in those buildings or portions of those buildings that are not required to be of fire-rated construction by the applicable building code.

Informational Note: Fire-rated construction is the fire-resistive classification used in building codes.

- Δ (D) **Spaces with Finish Rating.** Electrical nonmetallic tubing and rigid nonmetallic conduit shall be permitted to be installed in club rooms, conference and meeting rooms in hotels or motels, courtrooms, dining facilities, restaurants, mortuary chapels, museums, libraries, and places of religious worship where the following apply:

- (1) The tubing or conduit is installed concealed within walls, floors, and ceilings where the walls, floors, and ceilings provide a thermal barrier of material that has at least a 15-minute finish rating as identified in listings of fire-rated assemblies.
- (2) The tubing or conduit is installed above suspended ceilings where the suspended ceilings provide a thermal barrier of material that has at least a 15-minute finish rating as identified in listings of fire-rated assemblies.

Electrical nonmetallic tubing and rigid nonmetallic conduit are not recognized for use in other space used for environmental air in accordance with 300.22(C).

Informational Note: A finish rating is established for assemblies containing combustible (wood) supports. The finish rating is defined as the time at which the wood stud or wood joist reaches an average temperature rise of 121°C (250°F) or an individual temperature rise of 163°C (325°F) as measured on the plane of the wood nearest the fire. A finish rating is not intended to represent a rating for a membrane ceiling.

The wiring methods identified in 518.4(A) and (B) apply to any wall, floor, or ceiling within an assembly occupancy, as classified in 518.2. The requirements of 518.4(C) apply to those portions of the building and those assembly occupancies not required to be fire rated. Determination of whether a building or portions of a building are required to be constructed using fire-rated construction methods is a function of the building code in effect in a jurisdiction. Under certain height, area, and occupancy type parameters, a building intended for the assembly of 100 or more persons could be constructed using methods that are not fire-rated. The use of electrical nonmetallic tubing and rigid nonmetallic conduit as permitted in 518.4(D) applies only to the specific occupancies described, provided the wiring methods are installed concealed behind a surface that has a 15-minute finish rating.

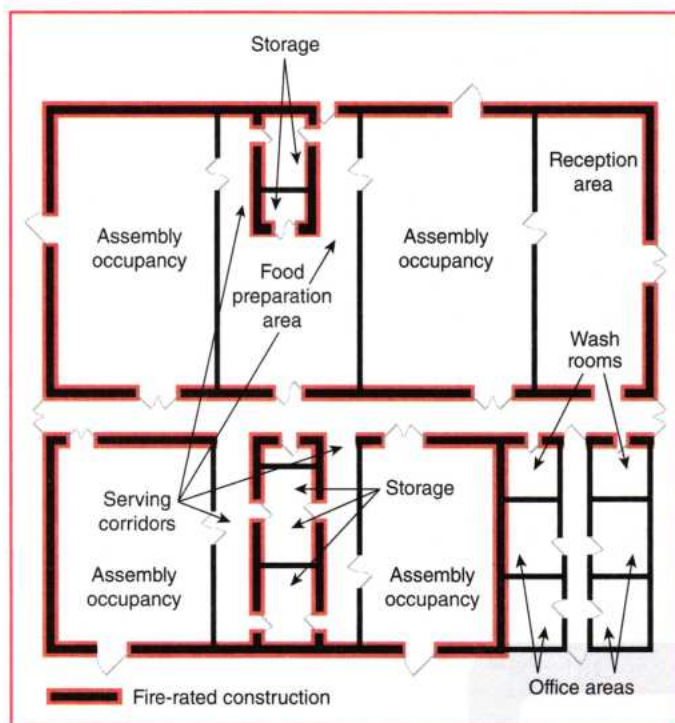


EXHIBIT 518.2 Floor plan of a single-story facility. The walls required by the local building code to be of fire-rated construction are represented by the red highlighted lines; the thin black lines represent walls not required by the local building code to be of fire-rated construction.

Exhibit 518.2 illustrates a single-story facility in which the washrooms and office area are not assembly occupancies, as defined in 518.2, and therefore require no special wiring methods. Ordinary wiring methods may be used on the inside surface of the storage area walls and on or in the partitions between storage areas, because those areas are not assembly occupancies. However, the main requirements of 518.4 apply inside any hollow spaces of the fire-rated storage area walls, because the serving corridors are part of the assembly occupancies as a result of the particular building design. If the hollow spaces of fire-rated walls or ceiling also provide a 15-minute finish rating and are not "other spaces used for environmental air" as described in 300.22(C), electrical nonmetallic tubing as well as rigid nonmetallic conduit is permitted for specifically described occupancies, as specified in 362.10. Also, wiring in ceilings or floors that are required to be of fire-rated construction in the assembly occupancy must also comply with 518.4.

Assembly occupancies frequently require emergency wiring, particularly for emergency illumination and exit lighting.

See also

700.10(D) for special fire protection requirements for emergency circuits in assembly occupancies with an occupant capacity of 1000 or more

- Δ **518.5 Supply.** Portable switchboards, portable power distribution equipment, and commercial appliance outlet centers shall be installed in accordance with 518.5(A) through (C).

N (A) Power Outlets and Commercial Appliance Outlet Centers.

N (1) **Overcurrent Protection.** Power outlets and commercial appliance outlet centers shall provide overcurrent protection or shall be protected by overcurrent devices.

N (2) **Accessibility.** Overcurrent devices, power outlets, and commercial appliance outlet centers shall not be accessible to the general public.

N (3) **Equipment Grounding Conductor Connections.** Connecting means for an equipment grounding conductor shall be provided.

N (4) **Markings.** Power outlets and commercial appliance outlet centers shall be marked as follows:

FOR USE BY QUALIFIED PERSONS ONLY.

RISK OF ELECTRIC SHOCK.

Disconnect all power before servicing.

Disconnecting means location:

N (5) **Panelboard Orientation.** A panelboard installed in a listed commercial appliance outlet center designed for in-floor mounting shall be permitted to be orientated in the face-up position, if such orientation is part of the listing, and 408.43 shall not apply.

N (B) **Portable Switchboards and Portable Power Distribution Equipment.** Portable switchboards and portable power distribution equipment shall be supplied only from listed power outlets or listed commercial appliance outlet centers, each having sufficient voltage and ampere ratings.

N (C) **Neutral Conductor of Feeders Supplying Solid State Dimmer Systems.** The neutral conductor of feeders supplying solid-state phase control, 3-phase, 4-wire dimmer systems shall be considered a current-carrying conductor for purposes of ampacity adjustment.

The neutral conductor of feeders supplying solid-state sine wave, 3-phase, 4-wire dimming systems shall not be considered a current-carrying conductor for purposes of ampacity adjustment.

Exception: The neutral conductor of feeders supplying systems that use or are capable of using both phase-control and sine-wave dimmers shall be considered as current-carrying for purposes of ampacity adjustment.

Informational Note: See Article 100 for definitions of solid-state dimmer types.

Portable switchboards and portable power distribution equipment must be supplied from listed power outlets, such as the one shown in Exhibit 518.3, or from listed commercial appliance outlet centers. This equipment must be rated for the voltage and current for which they are used. Power outlets, commercial appliance outlet centers, and their associated overcurrent protective devices must not be accessible to the general public.

Some professional performance lighting systems use solid-state, sine wave, 3-phase, 4-wire dimming systems. These dimmers

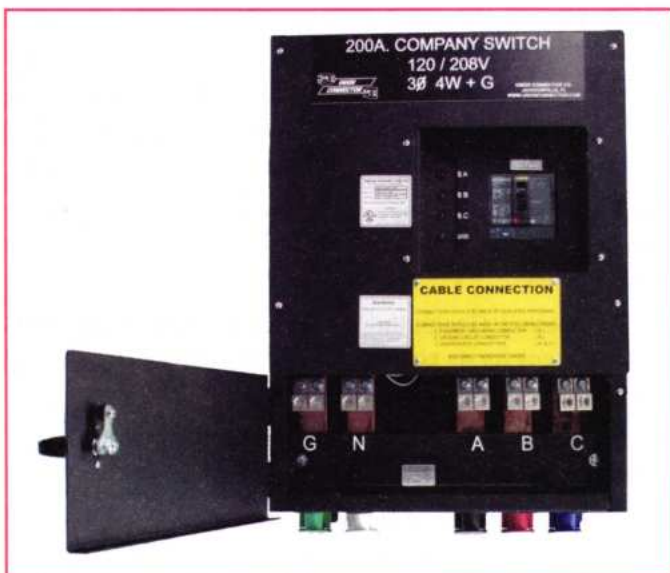


EXHIBIT 518.3 A listed power outlet for connection of portable switchboards in an assembly occupancy. (Courtesy of Union Connector Co., Inc.)

vary with the amplitude of the applied voltage waveform, without any of the nonlinear switching found in phase-control solid-state dimmers. Because solid-state sine wave dimmers are linear loads, they do not require the neutral to be considered a current-carrying conductor. This characteristic impacts the number of current-carrying conductors in a raceway or cable and the need to apply ampacity adjustment factors.

518.6 Illumination. Illumination shall be provided for all working spaces about fixed service equipment, switchboards, switchgear, panelboards, or motor control centers installed outdoors that serve assembly occupancies. Control by automatic means only shall not be permitted. Additional lighting outlets shall not be required where the workspace is illuminated by an adjacent light source.

In some assembly occupancies, fixed service equipment is installed outdoors. Illumination of indoor service equipment is required by 110.26(D). Section 518.6 requires illumination of outdoor service equipment supplying assembly occupancies.

ARTICLE

520

Theaters, Audience Areas of Motion Picture and Television Studios, Performance Areas, and Similar Locations

Part I. General

520.1 Scope. This article covers all buildings or that part of a building or structure, indoor or outdoor, designed or used for

presentation, dramatic, musical, motion picture projection, or similar purposes and to specific audience seating areas within motion picture or television studios.

The special requirements of Article 520 apply only to that part of a building used as a theater or for a similar purpose and do not necessarily apply to the entire building. In a school building, for example, the requirements of Article 520 apply to an auditorium used for dramatic or other performances. The special requirements of this article apply to the stage, auditorium, dressing rooms, and main corridors leading to the auditorium but not to other parts of the building not involved in the use of the auditorium for performances or entertainment. Audience areas of motion picture and television studios, as defined and covered in Article 530, and stage areas of concert and festival venues are also covered by the requirements of Article 520.

520.5 Wiring Methods.

(A) General. The fixed wiring method shall be any of the following:

- (1) Metal raceways
- (2) Nonmetallic raceways encased in at least 50 mm (2 in.) of concrete
- (3) Type MI cable, Type MC cable, or Type AC cable containing an insulated equipment grounding conductor sized in accordance with Table 250.122

(B) Communications, Signaling Systems, Data Systems, Fire Alarm Systems, and Systems Less Than 120 Volts, Nominal. Fixed wiring methods for specific installations shall be as follows:

- (1) Audio signal processing, amplification, and reproduction equipment — 640.9
- (2) Communications systems — Parts I and IV of Article 800, Part IV of Article 805, and Part VI of Article 840
- (3) Class 2 and Class 3 remote control and signaling circuits — Part III of Article 725
- (4) Class 2 circuits that transmit power, data, or both to a powered device

Informational Note: See ANSI/NEMA C137.3-2017, *American National Standard for Lighting Systems — Minimum Requirements for Installation of Energy Efficient Power over Ethernet (PoE) Lighting Systems*, for information on installation of cables for PoE lighting systems. See Part III of Article 760 for information on fire alarm circuits.

(C) Portable Equipment. The wiring for portable switchboards, stage set lighting, stage effects, and other wiring not fixed as to location shall be permitted with approved flexible cords and cables as provided elsewhere in Article 520. Fastening such cables and cords by uninsulated staples or nailing shall not be permitted.

(D) Nonrated Construction. Nonmetallic-sheathed cable, Type AC cable, electrical nonmetallic tubing, and rigid nonmetallic conduit shall be permitted to be installed in those buildings or portions of buildings that are not required to be of fire-rated construction by the applicable building code.