so that the bottom of the enclosure is not less than 150 mm (6 in.) above the ground.

Requiring equipment to be mounted so that the bottom of the enclosure is at least 6 inches above the ground prevents excessive moisture from entering the equipment and allows for proper radius of bend on conductors entering and exiting the equipment from below.

(B) Busbars and Terminals. Busbars shall have an ampere rating not less than the overcurrent device supplying the feeder supplying the box. Where conductors terminate directly on busbars, busbar connectors shall be provided.

(C) Receptacles and Overcurrent Protection. Receptacles shall have overcurrent protection installed within the box. The overcurrent protection shall not exceed the ampere rating of the receptacle, except as permitted in Article 430 for motor loads.

(D) Single-Pole Connectors. Where single-pole connectors are used, they shall comply with 530.10.

525.23 Ground-Fault Circuit-Interrupter (GFCI) Protection.

Section 525.23 provides three categories: where GFCIs are required, where GFCIs are not required, and where GFCIs are not permitted to be installed. The application where GFCI protection is not required is very specific. The receptacles must be locking, must be quick disconnect/reconnect, and must not be accessible from grade. GFCI protection is not allowed on circuits that supply means-of-egress illumination. GFCI receptacles that are supplied by branch circuits that utilize flexible cord are required to be listed for portable use. This requirement ensures that the GFCI devices will have open neutral protection.

(A) Where GFCI Protection Is Required. In addition to the requirements of 210.8(B), GFCI protection for personnel shall be provided for the following:

(1) All 125-volt, single-phase, 15- and 20-ampere non-locking-type receptacles used for disassembly and reassembly or readily accessible to the general public
(2) Equipment that is readily accessible to the general public and supplied from a 125-volt, single-phase, 15- or 20-ampere branch circuit

The GFCI shall be permitted to be an integral part of the attachment plug or located in the power-supply cord within 300 mm (12 in.) of the attachment plug. Listed cord sets incorporating GFCI for personnel shall be permitted.

(B) Where GFCI Protection Is Not Required. Receptacles that are not accessible from grade level and that only facilitate quick disconnecting and reconnecting of electrical equipment shall not be required to be provided with GFCI protection. These receptacles shall be of the locking type.

(C) Where GFCI Protection Is Not Permitted. Egress lighting shall not be protected by a GFCI.

(D) Receptacles Supplied by Portable Cords. Where GFCI protection is provided through the use of GFCI receptacles, and the branch circuits supplying receptacles use flexible cord, the GFCI protection shall be listed, labeled, and identified for portable use.

Part IV. Equipment Grounding and Bonding

525.30 Equipment Bonding. The following equipment connected to the same source shall be bonded:

(1) Metal raceways and metal-sheathed cable
(2) Metal enclosures of electrical equipment
(3) Metal frames and metal parts of portable structures, trailers, trucks, or other equipment that contain or support electrical equipment

Where the metal frames or parts of the equipment in 525.30(1), (2), or (3) are likely to become energized in the event of a fault, the equipment grounding conductor of the supply circuit shall be permitted to serve as the bonding means.

Δ **525.31 Equipment Grounding.** The equipment grounding conductor shall be connected to the system grounded conductor at the service disconnecting means or, in the case of a separately derived system such as a generator, at the generator or first disconnecting means supplied by the generator.

525.32 Equipment Grounding Conductor Continuity Assurance. The continuity of the equipment grounding conductors shall be verified each time that portable electrical equipment is connected.

The transient nature of the events covered under Article 525 and, in some cases, the entire associated electrical distribution system increases the possibility that continuity of the equipment grounding conductor (EGC) system could be interrupted. Verification of the grounding system continuity each time equipment is reconnected helps ensure the safety of workers and members of the general public who may come in contact with electrical equipment.

ARTICLE 530 Motion Picture and Television Studios and Remote Locations

Part I. General

Δ **530.1 Scope.** The requirements of this article shall apply to motion picture and television studios in facilities and locations staffed by qualified persons, except as provided in 520.1. Such occupancies shall include those using either electronic or film cameras for image capture.

Informational Note: See NFPA 40-2019, *Standard for the Storage and Handling of Cellulose Nitrate Film*, for methods of protecting against cellulose nitrate film hazards.

The requirements for motion picture studios and those for television studios are virtually the same and are intended to apply only to those locations presenting special hazards, for example, where film is handled or for temporary structures constructed of wood or other combustible material. It is important to note that Article 530 considers these occupancies specialized workplaces, not assembly occupancies, unless an audience is present. If an audience is present, the requirements of Article 520 apply to audience seating areas. Equipment listed for use under Article 520 is often listed for use under Article 530.

See also

NFPA 140, *Standard on Motion Picture and Television Production Studio Soundstages, Approved Production Facilities, and Production Locations,* which addresses additional aspects of these facilities

• N **530.3 Restricted Public Access.**

N **(A) Studios.** The electrical equipment covered in this article shall be used in motion picture or television studios with restricted public access.

N **(B) Remote Locations.** Where the equipment is deployed on remote locations, restricted public access shall be provided in the form of physical barriers or other access control measures.

N **530.4 Supervision by Qualified Personnel.** Portable electrical equipment, including distribution systems, generators, battery systems, and other power sources, shall be deployed, energized, and, while energized, operated and continuously supervised by trained, qualified, and employer-authorized personnel.

Δ **530.5 Wiring Methods.** Wiring methods for permanent installations shall be in accordance with 530.5(A) or (B).

N **(A) General.** The permanent wiring shall be permitted to be any of the following:

(1) Metal raceways
(2) Nonmetallic raceways encased in not less than 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

N **(B) Communications, Signaling Systems, Data Systems, Fire Alarm Systems, and Systems Less than 120 Volts, Nominal.** Permanent wiring methods for communications, signaling, data, fire alarm systems, and systems operating at less than 120 volts, nominal, shall be in accordance with the following:

(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 IV 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.

530.7 Sizing of Feeder Conductors for Motion Picture and/or Television Studio Sets. Applying the demand factors listed in Table 530.7 to the portion of the maximum possible connected load for studio or stage set lighting for all permanently installed feeders between substations and stages and to all permanently installed feeders between the main stage switchboard and stage distribution centers shall be permitted.

TABLE 530.7 Demand Factors for Stage Set Lighting

Portion of Stage Set Lighting Load to Which Demand Factor Applied (volt-amperes)	Feeder Demand Factor (percent)
First 50,000 or less at	100
From 50,001 to 100,000 at	75
From 100,001 to 200,000 at	60
Remaining over 200,000 at	50

• Δ **530.8 Equipment Grounding Conductor.** Permanent wiring systems shall include an equipment grounding conductor of a type in accordance with 250.118 installed with the supply conductors and connected to the building or structure disconnecting means and the grounding electrode(s). The grounding electrode(s) shall also be connected to the building or structure disconnecting means. Equipment grounding conductors shall be sized in accordance with 250.122. This shall not apply to pendant and portable stage lighting, stage sound equipment, or other special stage equipment operating at not over 150 volts dc to ground.

530.9 Plugs and Receptacles. Plugs and receptacles shall be in accordance with 530.9(A), (B), and (C).

(A) Rating. Plugs and receptacles, including cord connectors and flanged surface devices, shall be rated in amperes. The voltage rating of the plugs and receptacles shall not be less than the nominal circuit voltage. Plug and receptacle ampere ratings for ac circuits shall not be less than the feeder or branch-circuit overcurrent device ampere rating. Table 210.21(B)(2) shall not apply.

The occupancies referenced in Article 530 are excluded from all the general requirements relating to connector rating and branch-circuit loading found elsewhere in the *NEC*®, such as in Table 210.21(B)(2). Connectors must be rated for the parameters involved, thus permitting connectors with voltage and current ratings higher than the branch-circuit rating to be used.

N **(B) Construction.** Plugs and receptacles shall be constructed so that differently rated devices cannot be connected together. Alternating-current multipole connectors shall be polarized and comply with the requirements of 406.7 and 406.10.

Exception: 125-volt, 20-ampere, nonlocking (T-slot) receptacles shall be permitted to accept a 15-ampere attachment plug of the same voltage rating.

Δ **(C) Interchangeability.** Plugs and receptacles used in portable professional motion picture and television equipment shall be permitted to be interchangeable for ac or dc use if they are on the same premises, listed for ac and dc use, and clearly marked to identify the system to which they are connected.

The studio set lighting and associated equipment, both fixed and portable, must be as flexible as possible. Connectors are often used for different purposes and are therefore marked on a show-by-show basis to designate the voltage, current, and type of current actually employed. The receptacle loads on studio set lighting are known and are not casually connected as they might be at a typical general-use wall receptacle. Care is taken to ensure that circuits are not overloaded, thereby avoiding nuisance tripping.

530.10 Single-Pole Separable Connectors.

Δ **(A) General.** Single-pole separable connectors shall comply with the requirements of 406.13. Sections 400.14, 406.7, and 406.8 shall not apply to listed single-pole separable connectors.

N **(B) Paralleled Input Devices.** Where paralleled sets of current-carrying single-pole separable connectors are provided as input devices, they shall be prominently labeled with a warning indicating the presence of internal parallel connections. All paralleled input devices other than primary input devices shall be guarded against accidental contact.

N **(C) Supply Feed-Through Outlets.** Where portable equipment contains a feed-through outlet of the same rating as its supply inlet, the feed-through outlet shall not require overcurrent protection in the equipment.

530.11 Branch Circuits.

A branch circuit of any size supplying one or more receptacles shall be permitted to supply stage set lighting loads.

The GFCI requirements of 210.8(B), excluding 210.8(B)(6), shall apply.

Branch circuits supplying egress lighting, life-critical stunts, life-critical special effects, or any other condition where a nonorderly shutdown might introduce additional or increased hazards shall not be protected by GFCIs.

Outdoor circuits are often dimmed and are exempt from the GFCI requirement of 210.8(B)(6) because dimmer-rated GFCI devices are not readily available. Due to the unique requirements of motion picture production, the use of GFCIs for outdoor circuits must be evaluated on a case-by-case basis. For example, one popular way to perform a high fall stunt from a building is for the stunt performer to land onto an air bag. The air bag must be constantly inflated by a high power fan which is supplied by a dedicated generator; that circuit is thus a life-critical circuit and should not be protected by a GFCI, even if a rain effect is part of the stunt.

530.12 Enclosing and Guarding Live Parts.

(A) Live Parts. Parts of electrical equipment that are live or are likely to become energized shall be enclosed, guarded, or located so persons cannot accidentally come in contact with them or bring conductive material into contact with them.

(B) Switches. All switches shall be of the externally operable type.

Part II. Portable Equipment In Production Areas of Studios and Remote Locations

Δ 530.21 Portable Equipment.

N **(A) Listing.** Portable stage and studio electrical equipment shall be listed or approved. Field-assembled extension cords and multiconductor cable assemblies consisting of listed connectors and cable shall be permitted in production areas.

N **(B) Outdoor Use.** Portable stage and studio equipment and portable power distribution equipment not identified for outdoor use shall be permitted for temporary use if the equipment is supervised by qualified personnel while energized and barriered from the general public.

Informational Note No. 1: See ANSI/ESTA E1.58, *Electrical Safety Standard for Portable Stage and Studio Equipment Used Outdoors*, for requirements covering temporary outdoor use of equipment not identified for outdoor use.

Informational Note No. 2: See ANSI/ESTA E1.19-2015, *Recommended Practice for the use of Class A Ground-Fault Circuit Interrupters (GFCIs) intended for personnel protection in the Entertainment Industry*, for guidance on the use of GFCIs in wet locations.

Portable indoor stage or studio equipment is permitted to be *temporarily* used outdoors, provided it is supervised by a qualified person and not accessible to the general public. If it rains, the equipment is typically de-energized and covered. At the end of the day, the equipment is either de-energized and protected or dismantled and stored.

530.22 Portable Wiring.

(A) Stage Set Wiring. The wiring for stage set lighting and other supply wiring not fixed in place shall use listed hard usage flexible cords and cables. Where subject to physical damage, such wiring shall use listed extra-hard usage flexible cords and cables. Splices and taps in cables shall be permitted if the total connected load does not exceed the maximum ampacity of the cable.

Δ **(B) Stage or Special Effects and Electrical Equipment Used as Stage Properties.** The wiring for stage effects and electrical equipment used as stage properties shall be permitted to be wired with single- or multiconductor listed flexible cords or cables if the conductors are protected from physical damage and secured to the scenery by approved cable ties or insulated staples. Splices or taps shall be permitted where such are made with listed devices and the circuit is protected at not more than 20 amperes.

(C) Other Electrical Equipment. Cords and cables other than extra-hard usage, where supplied as a part of a listed assembly, shall be permitted.

• *N* **(D) Portable Feeder Cable Penetration of Walls, Floors, or Ceilings.** Portable feeder cables shall be permitted to temporarily penetrate fire-rated walls, floors, or ceilings where all of the following apply:

(1) The opening is of noncombustible material.
(2) When in use, the penetration is sealed with a temporary seal of a listed firestop material.
(3) When not in use, the opening shall be capped with a material of equivalent fire rating.

Δ **(E) Cable Protection.** Cables shall be protected by bushings where they pass through enclosures and shall be arranged so that tension on the cable is not transmitted to the connections. Where power conductors pass through metal, the requirements of 300.20 shall apply.

• *N* **(F) Special-Purpose Multicircuit Cable Systems.** Special-purpose multicircuit cable systems shall comply with 520.68(D).

Δ **530.23 Overcurrent Protection.** Overcurrent protective devices in production areas shall comply with 530.23(A) through (D).

Δ **(A) Portable Stage Cables.** Overcurrent protection for portable stage cables shall comply with the requirements of 240.5.

• *N* **(B) Portable Single Conductor Feeder Cables Using Single-Pole Separable Connectors.** Portable feeder cables in production areas shall be protected by means of overcurrent devices set at not more than 400 percent of the ampacity of the cable listed in Table 400.5(A)(2). The maximum load on a single conductor portable feeder cable shall not exceed the cable ampacity in Table 400.5(A)(2).

Δ **(C) DC Plugging Boxes.** Cables and cords supplied through plugging boxes shall include only copper conductors. Cables and cords smaller than 8 AWG shall be attached to a plugging box by means of a plug containing two cartridge fuses or a 2-pole circuit breaker. Plugging boxes shall not be permitted on ac systems. Receptacles in dc plugging boxes shall be rated at not less than 30 amperes.

(D) Alternating-Current Power Distribution Boxes. Alternating-current power distribution boxes used in production areas shall contain receptacles of a polarized, grounding type. A feed-through outlet of the same rating as its supply inlet shall not require overcurrent protection in the equipment. Alternating-current power distribution boxes shall be listed.

Informational Note: See ANSI/UL 1640-2016, *Standard for Portable Power-Distribution Equipment*, for information on alternating-current power distribution boxes.

• *N* **530.24 Purpose-Built Luminaires, Lighting, and Effects Equipment.** Purpose-built luminaires, lighting, and effects equipment shall not be required to be listed but shall be required to be approved.

Δ **530.26 Portable Luminaires.**

N **(A) Listing.** Portable luminaires shall be listed.

Exception: Portable luminaires used as properties on a motion picture set or television stage set, on a studio stage or lot, or on location shall not be considered portable luminaires for the purpose of this section.

(B) Portable Enclosed-Arc Luminaires. Portable enclosed-arc lamps, and associated ballasts shall be listed. Interconnecting cord sets and interconnecting cords and cables for enclosed-arc luminaires shall be of extra-hard usage type and listed.

Informational Note: See ANSI/ESTA E1.16-2007, *Entertainment Technology — Configuration Standard for Metal-Halide Power Cables*, for information on enclosed-arc luminaire interconnecting cord sets and cables.

• *N* Part III. Portable Equipment in Support Areas

N **530.41 Restricted Public Access.** The electrical equipment used in non-production areas shall be restricted from access by the general public.

N **530.42 Overcurrent Protection for Portable Cable.** Overcurrent protection of conductors for portable cables shall comply with the requirements of 240.5(A).

N **530.43 Portable Generators.**

N **(A) Location.** Portable and vehicle-mounted generators shall be located away from flammable materials, and exhaust shall be vented away from structures and other areas where people might congregate.

N **(B) Ventilation.** Portable and vehicle-mounted generators shall not be operated in areas without natural or provided ventilation to prevent the buildup of exhaust.

N **530.44 Ground-Fault Circuit-Interrupter (GFCI) Protection.**

N **(A) Where GFCI Protection is Required.** In addition to the requirements of 210.8(B), GFCI protection for personnel shall be provided for the following:

(1) All 125-volt, single-phase, 15- and 20-ampere receptacles that are readily accessible to unqualified personnel and that are used for other than motion picture and television production equipment
(2) Equipment, other than motion picture and television production equipment, that is readily accessible to unqualified personnel and supplied from a 125-volt, single-phase, 15- or 20-ampere branch circuit

Listed GFCI protection for personnel that is identified for portable use shall be permitted to be an integral part of the attachment plug or be located in the power-supply cord within 300 mm (12 in.) of the attachment plug. Listed cord sets incorporating GFCI for personnel shall be permitted.

N **(B) Where GFCI Protection is Not Permitted.** Egress lighting shall not be protected by a GFCI.

N **(C) Receptacles Supplied by Portable Cords.** GFCI protection shall be listed, labeled, and identified for portable use where it is provided using GFCI receptacles and the branch circuits supplying receptacles use flexible cord.

N **530.45 Production Vehicles and Trailers.** Where the wiring of production vehicles and trailers are supplied by a grounded ac service or by a grounded separately derived ac source, they shall comply with 530.45(A) through (F) of this section.

N **(A) Internal Panelboards (Where Used).** A listed and appropriately rated panelboard or other equipment specifically listed for this purpose shall be used. The grounded conductor termination bar shall be insulated from the enclosure.

N **(B) Grounding.** The panelboard shall have an equipment grounding bus with terminals for all equipment grounding conductors or other approved equipment grounding means.

N **(C) Power-Supply Grounding.** The equipment grounding conductor in the supply cord or feeder shall be connected to the equipment grounding bus or other approved equipment ground means in the panelboard.

N **(D) Insulated Grounded Conductor (Neutral Conductor).** The grounded circuit conductor (neutral conductor) shall be insulated from the equipment grounding conductors and from equipment enclosures and other grounded parts.

N **(E) Required Bonding.** All exposed non–current-carrying metal parts that are likely to become energized shall be effectively bonded to the grounding terminal or enclosure of the panelboard. A bonding conductor shall be connected between any panelboard and an accessible terminal on the chassis of the portable trailer or vehicle.

N **(F) Production Vehicles and Trailers with Onboard Generators.** Production vehicles and trailers with onboard generators shall comply with the requirements of 551.30.

N **530.46 Protection.** Flexible cords and cables accessible to personnel shall be arranged to minimize tripping hazard potential, and shall be permitted to be covered with a nonconductive matting secured to the walkway surface or protected with another approved cable protection method if the matting or other protection method does not constitute a greater tripping hazard than the uncovered cables.

Part IV. Dressing Rooms

Δ **530.61 Fixed Wiring in Dressing Rooms.** Fixed wiring in dressing rooms shall be installed in accordance with the wiring methods covered in Chapter 3.

Part V. Portable Substations

530.71 General. Wiring and equipment in portable substations rated 50 to 1000 volts, nominal, shall conform to the requirements of the sections applying to installations in permanently fixed substations. Where limited space is available, when approved, working spaces shall be permitted to be reduced where the following conditions apply:

(1) The equipment is arranged so that the qualified operator can work safely.
(2) The equipment is guarded so that other persons in the vicinity cannot accidentally come into contact with current-carrying parts or bring conducting objects into contact with them while they are energized.

530.72 Over 1000 Volts, Nominal. Wiring and equipment of portable substations rated over 1000 volts, nominal, shall comply with the requirements of Part IV of Article 490.

ARTICLE 540

Motion Picture Projection Rooms

Part I. General

540.1 Scope. This article applies to motion picture projection rooms, motion picture projectors, and associated equipment of the professional and nonprofessional types using incandescent, carbon arc, xenon, or other light source equipment that develops hazardous gases, dust, or radiation.

Informational Note: See NFPA 40-2019, *Standard for the Storage and Handling of Cellulose Nitrate Film*, for further information.

Motion picture projection rooms are not hazardous locations as classified in Article 500. Some older types of film, such as cellulose nitrate film, are highly flammable and rarely used today. The more commonly used cellulose acetate film is not volatile at ordinary temperatures and does not emit flammable gases. Therefore, wiring methods for projection rooms are not required to be suitable for hazardous locations.