

QCIT.Guide Info - Metallic Outlet Boxes

GENERAL

This category covers metallic mud rings, flush device boxes, conduit bodies, conduit boxes, floor boxes, outlet boxes, outlet box hoods, special-purpose boxes, extension rings, covers, and cover plates for flush-mounted wiring devices, intended for installation in accordance with Article 314 of ANSI/NFPA 70, "National Electrical Code" (NEC). These products are also intended for installation and use in accordance with the following information.

MUD RINGS

A mud ring positions a flush-mounted wiring device flush with the finished wall surface. Mud rings may be provided with either a fixed or adjustable depth sleeve.

EXTENSION RINGS

Extension rings are suitable for extending properly secured flush- or surface-mounted boxes. One or more extensions may be used. An extension ring is intended to increase the box depth, volume, or both.

CONDUIT BODIES

Conduit bodies that are provided with a volume marking can enclose splices, taps or devices. Conduit bodies that are not provided with a volume marking are covered under Conduit Fittings (DWTT). Conduit bodies certified for use with specific conduit body covers and conduit body covers certified for use with specific conduit bodies are covered under Conduit Bodies and Covers Certified for Use with Specified Equipment (QCKW).

Conduit bodies that have been investigated for a specific combination of conductors are marked, on the conduit body or on or within the unit container of the conduit body, with the maximum number and maximum size of the conductors for which they are intended. For other conductor sizes and combinations, the total cross-sectional area of the fill should not exceed the cross-sectional area of the conductors specified in the marking. The total cross-sectional area is determined using the following type of conductor:

(a) Type THHN or T90 Nylon for a fitting for use with 1/2 or 3/4 (16 or 21) trade size conduit or tubing, and

(b) Type XHHW or RW90 XLPE for a fitting for use with 1 - 4 (27 - 103) trade size tubing and for use with 1 - 6 (27 - 155) trade size conduit.

CONCENTRIC OR ECCENTRIC KNOCKOUTS

All boxes with concentric or eccentric knockouts have been investigated for bonding and are suitable for bonding without any additional bonding means around concentric (or eccentric) knockouts where used in circuits above or below 250 V, and may be marked as such.

CLAMPS

Boxes may or may not be provided with clamps. When clamps are provided, the carton is marked to indicate the type of wiring system or combination of systems for which they have been tested. The clamps are marked with the following letters or combinations thereof to indicate that they are suitable for use with armored cable ("A"): flexible metal conduit - "F," nonmetallic-sheathed cable - "N," or flexible tubing (loom) - "T." Clamps suitable for Type MC metal-clad cable are marked "MCI" for metal-clad interlocking armored cable, "MCI-A" for metal-clad interlocking armor ground cable, "MCS" for metal-clad continuous smooth-sheath cable, and "MCC" for metal-clad continuous corrugated-sheath cable. If suitable for all seven types, the clamp is marked "ALL." Clamps suitable for nonmetallic-sheathed cable are also suitable for multiconductor underground feeder and branch circuit cable where used in dry locations.

Clamps have been tested for securing only one cable per clamp, except multiple section clamps are considered suitable for securing one cable under each section of the clamp, each cable entering a separate knockout.

GROUNDING

Clamps for armored cable, flexible metal conduit, metal-clad interlocking armor ground cable, metal-clad continuous smooth-sheath cable, or metal-clad continuous corrugated-sheath cable are considered suitable for grounding where installed in accordance with the NEC.

FIXTURE/LUMINAIRE SUPPORT

A box, with or without a bracket or bar hanger, intended for support of a fixture/luminaire weighing 50 lbs or less is marked "FOR FIXTURE/LUMINAIRE SUPPORT" on the carton to indicate that the box is intended for fixture/luminaire support. A box, with or without a bracket or bar hanger, intended for support of a fixture/luminaire weighing more than 50 lbs is marked with the weight of the fixture/luminaire to be supported. Metallic device boxes and device plaster rings have not been investigated for support of a ceiling fixture/luminaire unless marked for use in ceilings, walls, and with the weight of the product to be supported. Metallic device boxes or metallic device boxes intended to be installed in an existing structure have been investigated for the support of utilization equipment weighing not more than 6 lbs.

INTEGRAL CONNECTORS

Boxes with integral connectors for electrical metallic tubing or for unthreaded rigid metallic conduit are provided with a marking on the carton to indicate the specific type or types of wiring system for which the boxes have been tested.

CEILING-SUSPENDED-FAN SUPPORT

A box, or a box with a bracket or bar hanger intended for support of a ceiling-suspended (paddle) fan weighing 35 lbs or less is marked "ACCEPTABLE FOR FAN SUPPORT" on the product. A box, or a box with a bracket or bar hanger intended for support of a ceiling-suspended (paddle) fan weighing more than 35 lbs but not more than 70 lbs is marked "ACCEPTABLE FOR FAN SUPPORT OF 70 LBS OR LESS" on the product. A box, or a box with a bracket or bar hanger intended for support of a ceiling-suspended (paddle) fan is acceptable for use with a fixture/luminaire when provided with the above fixture/luminaire-support markings.

CONCRETE TIGHT

All metal boxes, except aluminum alloy boxes, are provided with corrosion protection suitable for installation in concrete. Aluminum alloy boxes covered under this category are not considered acceptable for installation in concrete or cinder fill unless protected by asphalt paint or the equivalent. Boxes designated as "concrete tight" may have no means of support other than the concrete and often accommodate covers at top and bottom.

FLOOR BOXES

Floor boxes designed for floor installation as covered in the NEC are provided with covers and gaskets to exclude surface water and sweeping compounds that might be present in floor cleaning operations. Covers with gaskets may be shipped separately from the boxes. Both products are provided with installation instructions. Those boxes intended for installation in concrete floors are frequently provided with leveling screws, threaded hubs or both, and are provided with a marking on the carton to identify boxes of this type such as "Floor Box Cover," "Floor Box" or "Floor Box, Concrete Tight," as appropriate. Floor boxes may be provided with wiring devices. Refer to **WET AND DAMP LOCATIONS** below for clarifying information on the suitability of concrete-tight floor boxes not intended to be exposed to weather that are installed in concrete slabs or masonry.

WET AND DAMP LOCATIONS

Boxes and covers intended for use in wet locations as defined by the NEC are marked "Wet Location." Damp location boxes and covers are intended to be so located or equipped as to prevent water from entering or accumulating in the box and are marked "Damp Location." Boxes with threaded conduit hubs will normally prevent water from entering except for condensation within the box or connected conduit.

Box and device cover combinations, and flush device covers that provide protection from the weather only when the cover is closed, are marked "Wet Location Only When Cover Closed" and may be marked "Damp Location." Outlet box hoods intended for use in damp or wet locations are marked for each location and may be marked "Extra-Duty."

Floor boxes designated as "concrete tight" installed in concrete slabs or masonry are not considered to be in wet locations when the following conditions are met:

1. a vapor barrier is installed between the earth and a concrete slab or masonry (i.e., the concrete slab or masonry is not in direct contact with the earth),
2. the floor box is protected from exposure to weather within a building as defined by the NEC, and
3. the concrete slab or masonry above the vapor barrier is not subject to saturation by water or other liquids.

ENVIRONMENTAL INSTALLATION

Boxes may be marked with the environmental Enclosure Type number (1, 2, 3, 3R, etc.) as described in Electrical Equipment for Use in Ordinary Locations (AALZ).

Boxes marked with Enclosure Type 3X or "Corrosion Protection" provide the same level of protection as Type 3 enclosures, and are provided with an additional level of corrosion protection for the enclosure.

RELATED PRODUCTS

Outlet box assemblies that include certified outlet boxes and one or more of the following certified parts: wiring device, mud ring, cover plate, wet-location gasket and cover plate, wet-location gasket and outlet box hood, or other factory-assembled parts, are covered under Wiring Assemblies (QQYZ).

For information on the use of metallic electrical outlet boxes in fire-rated assemblies, see Fire-resistance Ratings - ANSI/UL 263 (BXUV).

ADDITIONAL INFORMATION

For additional information, see Electrical Equipment for Use in Ordinary Locations (AALZ).

REQUIREMENTS

The basic standards used to investigate products in this category are ANSI/UL 514A, "Metallic Outlet Boxes," and ANSI/UL 514D, "Cover Plates for Flush-Mounted Wiring Devices."

UL MARK

The Certification Mark of UL on the product, or the UL symbol on the product and the Certification Mark on the smallest unit container in which the product is packaged is the only method provided by UL to identify products manufactured under its Certification and Follow-Up Service. The Certification Mark for these products includes the UL symbol, the words "CERTIFIED" and "SAFETY," the geographic identifier(s), and a file number.

Alternate UL Mark

The Listing Mark of UL on the product, or the UL symbol on the product and the Listing Mark on the smallest unit container in which the product is packaged is the only method provided by UL to identify products manufactured under its Listing and Follow-Up Service. The Listing Mark for these products includes the UL symbol (as illustrated in the Introduction of this Directory) together with the word "LISTED," a control number, and one of the following product names: "Outlet Box," "Outlet Box and Cover," "Extension Ring," "Flush Device Box," or other appropriate product name as shown in the individual Listings.

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Fire-resistance Ratings - ANSI/UL 263

METALLIC ELECTRICAL OUTLET BOXES

Metallic outlet boxes with metallic or nonmetallic cover plates may be used in floor-ceiling and roof-ceiling assemblies with ratings not exceeding 2 hours. These assemblies should have gypsum board membranes. The metallic outlet boxes should be securely fastened to the joists and the opening in the gypsum board facing should be cut so that the clearance between the box and the gypsum board does not exceed 1/8 in. The surface area of individual boxes should not exceed 16 sq. in. The aggregate surface area of the boxes should not exceed 100 sq. in. per 100 sq. ft of ceiling surface.

METALLIC ELECTRICAL OUTLET BOXES

Certified single- and double-gang metallic outlet and switch boxes with metallic or nonmetallic cover plates may be used in bearing and nonbearing wood stud and steel stud walls with ratings not exceeding 2 h. The metallic outlet or switch boxes should be securely fastened to the studs and the opening in the gypsum board facing should be cut so that the clearance between the box and the wallboard does not exceed 1/8 in. The surface area of individual metallic outlet or switch boxes should not exceed 16 sq in. The aggregate surface area of the boxes should not exceed 100 sq in. per 100 sq ft of wall surface. The aggregate surface area of the boxes may be exceeded when Wall-opening Protective Materials (CLIV) are installed according to the requirements of their certification.

Metallic boxes located on opposite sides of walls or partitions should be separated by a minimum horizontal distance of 24 in. This minimum separation distance between metallic boxes may be reduced when Wall-opening Protective Materials (CLIV) are installed according to the requirements of their certification.

Metallic boxes should not be installed on opposite side of walls or partitions of staggered stud construction unless wall-opening protective materials are installed with the metallic boxes in accordance with certification requirements for the protective materials.

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ARTICLE 100 DEFINITIONS

Accessible (as applied to wiring methods). Capable of being removed or exposed without damaging the building structure or finish or not permanently closed in by the structure or finish of the building.

Ampacity. The maximum current, in amperes, that a conductor can carry continuously under the conditions of use without exceeding its temperature rating.

Approved. Acceptable to the authority having jurisdiction.

Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

Informational Note: The phrase "authority having jurisdiction," or its acronym AHJ, is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

Bonded (Bonding). Connected to establish electrical continuity and conductivity.

Bonding Conductor or Jumper. A reliable conductor to ensure the required electrical conductivity between metal parts required to be electrically connected.

Branch Circuit. The circuit conductors between the final over-current device protecting the circuit and the outlet(s).

Branch Circuit, Appliance. A branch circuit that supplies energy to one or more outlets to which appliances are to be connected and that has no permanently connected luminaires that are not a part of an appliance.

Branch Circuit, General-Purpose. A branch circuit that supplies two or more receptacles or outlets for lighting and appliances.

Conduit Body. A separate portion of a conduit or tubing system that provides access through a removable cover(s) to the interior of the system at a junction of two or more sections of the system or at a terminal point of the system.

Boxes such as FS and FD or larger cast or sheet metal boxes are not classified as conduit bodies.

Connector, Pressure (Solderless). A device that establishes a connection between two or more conductors or between one or more conductors and a terminal by means of mechanical pressure and without the use of solder.

Continuous Load. A load where the maximum current is expected to continue for 3 hours or more.

Device. A unit of an electrical system, other than a conductor, that carries or controls electric energy as its principal function.

Electric Sign. A fixed, stationary, or portable self-contained, electrically operated and/or electrically illuminated utilization equipment with words or symbols designed to convey information or attract attention.

Enclosed. Surrounded by a case, housing, fence, or wall(s) that prevents persons from accidentally contacting energized parts.

Equipment. A general term, including fittings, devices, appliances, luminaires, apparatus, machinery, and the like used as a part of, or in connection with, an electrical installation.

Feeder. All circuit conductors between the service equipment, the source of a separately derived system, or other power supply source and the final branch-circuit overcurrent device.

Fitting. An accessory such as a locknut, bushing, or other part of a wiring system that is intended primarily to perform a mechanical rather than an electrical function.

Grounded (Grounding). Connected (connecting) to ground or to a conductive body that extends the ground connection.

Grounded Conductor. A system or circuit conductor that is intentionally grounded.

Ground-Fault Circuit Interrupter (GFCI). A device intended for the protection of personnel that functions to de-energize a circuit or portion thereof within an established period of time when a current to ground exceeds the values established for a Class A device.

Informational Note: Class A ground-fault circuit interrupters trip when the current to ground is 6 mA or higher and do not trip when the current to ground is less than 4 mA. For further information, see UL 943, *Standard for Ground-Fault Circuit Interrupters*.

Grounding Conductor, Equipment (EGC). The conductive path(s) that provides a ground-fault current path and connects normally non-current-carrying metal parts of equipment together and to the system grounded conductor or to the grounding electrode conductor, or both.

Informational Note No. 1: It is recognized that the equipment grounding conductor also performs bonding.
Informational Note No. 2: See 250.118 for a list of acceptable equipment grounding conductors.

Grounding Electrode. A conducting object through which a direct connection to earth is established.

Grounding Electrode Conductor. A conductor used to connect the system grounded conductor or the equipment to a grounding electrode or to a point on the grounding electrode system.

Lighting Outlet. An outlet intended for the direct connection of a lampholder or luminaire.

Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

Informational Note: The means for identifying listed equipment may vary for each organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. Use of the system employed by the listing organization allows the authority having jurisdiction to identify a listed product.

Location, Damp. Locations protected from weather and not subject to saturation with water or other liquids but subject to moderate degrees of moisture.

Informational Note: Examples of such locations include partially protected locations under canopies, marquees, roofed open porches, and like locations, and interior locations subject to moderate degrees of moisture, such as some basements, some barns, and some cold-storage warehouses.

Location, Dry. A location not normally subject to dampness or wetness. A location classified as dry may be temporarily subject to dampness or wetness, as in the case of a building under construction.

Location, Wet. Installations underground or in concrete slabs or masonry in direct contact with the earth; in locations subject to saturation with water or other liquids, such as vehicle washing areas; and in unprotected locations exposed to weather.

Luminaire. A complete lighting unit consisting of a light source such as a lamp or lamps, together with the parts designed to position the light source and connect it to the power supply. It may also include parts to protect the light source or the ballast or to distribute the light. A lampholder itself is not a luminaire.

Neutral Conductor. The conductor connected to the neutral point of a system that is intended to carry current under normal conditions.

Outlet. A point on the wiring system at which current is taken to supply utilization equipment.

Overcurrent. Any current in excess of the rated current of equipment or the ampacity of a conductor. It may result from overload, short circuit, or ground fault.

Informational Note: A current in excess of rating may be accommodated by certain equipment and conductors for a given set of conditions. Therefore, the rules for overcurrent protection are specific for particular situations.

Overload. Operation of equipment in excess of normal, full-load rating, or of a conductor in excess of rated ampacity that, when it persists for a sufficient length of time, would cause damage or dangerous overheating. A fault, such as a short circuit or ground fault, is not an overload.

Panelboard. A single panel or group of panel units designed for assembly in the form of a single panel, including buses and automatic overcurrent devices, and equipped with or without switches for the control of light, heat, or power circuits; designed to be placed in a cabinet or cutout box placed in or against a wall, partition, or other support; and accessible only from the front.

Photovoltaic (PV) System. The total components and subsystem that, in combination, convert solar energy into electric energy for connection to a utilization load.

Plenum. A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.

Power Outlet. An enclosed assembly that may include receptacles, circuit breakers, fuseholders, fused switches, buses, and watt-hour meter mounting means; intended to supply and control power to mobile homes, recreational vehicles, park trailers, or boats or to serve as a means for distributing power required to operate mobile or temporarily installed equipment.

Qualified Person. One who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved.

Informational Note: Refer to NFPA 70E-2012, *Standard for Electrical Safety in the Workplace*, for electrical safety training requirements.

Raceway. An enclosed channel designed expressly for holding wires, cables, or busbars, with additional functions as permitted in this Code.

Informational Note: A raceway is identified within specific article definitions.

Raintight. Constructed or protected so that exposure to a beating rain will not result in the entrance of water under specified test conditions.

Receptacle. A contact device installed at the outlet for the connection of an attachment plug, or for the direct connection of electrical utilization equipment designed to mate with the corresponding contact device. A single receptacle is a single contact device with no other contact device on the same yoke. A multiple receptacle is two or more contact devices on the same yoke.

Receptacle Outlet. An outlet where one or more receptacles are installed.

Switch, General-Use. A switch intended for use in general distribution and branch circuits. It is rated in amperes, and it is capable of interrupting its rated current at its rated voltage.

Switch, General-Use Snap. A form of general-use switch constructed so that it can be installed in device boxes or on box covers, or otherwise used in conjunction with wiring systems recognized by this Code.

Voltage (of a circuit). The greatest root-mean-square (rms) (effective) difference of potential between any two conductors of the circuit concerned.

Informational Note: Some systems, such as 3-phase 4-wire, single-phase 3-wire, and 3-wire direct current, may have various circuits of various voltages.

Voltage, Nominal. A nominal value assigned to a circuit or system for the purpose of conveniently designating its voltage class (e.g., 120/240 volts, 480Y/277 volts, 600 volts.)

Informational Note No. 1: The actual voltage at which a circuit operates can vary from the nominal within a range that permits satisfactory operation of equipment.

Informational Note No. 2: See ANSI C84.1-2011, *Voltage Ratings for Electric Power Systems and Equipment (60 Hz)*.

Informational Note No. 3: Certain battery units may be considered to be rated at nominal 48 volts dc, but may have a charging float voltage up to 58 volts. In dc applications, 60 volts is used to cover the entire range of float voltages.

Voltage to Ground. For grounded circuits, the voltage between the given conductor and that point or conductor of the circuit that is grounded; for ungrounded circuits, the greatest voltage between the given conductor and any other conductor of the circuit.

Watertight. Constructed so that moisture will not enter the enclosure under specified test conditions.

Weatherproof. Constructed or protected so that exposure to the weather will not interfere with successful operation.

Informational Note: Rainproof, raintight, or watertight equipment can fulfill the requirements for weatherproof where varying weather conditions other than wetness, such as snow, ice, dust, or temperature extremes, are not a factor.

210.8 Ground-Fault Circuit-Interrupter Protection for Personnel. A listed Class A GFCI shall provide protection in accordance with 210.8(A) through (F). The GFCI shall be installed in a readily accessible location.

Informational Note: See 215.9 for GFCI protection on feeders. For the purposes of this section, the distance from receptacles shall be measured as the shortest path the power supply cord connected to the receptacle would follow without piercing a floor, wall, ceiling, or fixed barrier.

(A) Dwelling Units.

All 125-volt through 250-volt receptacles installed in the following locations and supplied by single-phase branch circuits rated 150 volts or less to ground shall have ground-fault circuit-interrupter protection for personnel:

- (1) Bathrooms
- (2) Garages and also accessory buildings that have a floor located at or below grade level not intended as habitable rooms and limited to storage areas, work areas, and areas of similar use
- (3) Outdoors
- (4) Crawl spaces — at or below grade level
- (5) Basements
- (6) Kitchens
- (7) Areas with sinks and permanent provisions for food preparation, beverage preparation, or cooking
- (8) Sinks - where receptacles are installed within 1.8 m (6 ft) from the top inside edge of the bowl of the sink
- (9) Boathouses
- (10) Bathtubs or shower stalls — where receptacles are installed within 1.8 m (6 ft) of the outside edge of the bathtub or shower stall
- (11) Laundry areas
- (12) Indoor damp and wet locations

Exception No. 1: Receptacles that are not readily accessible and are supplied by a branch circuit dedicated to electric snow-melting, deicing, or pipeline and vessel heating equipment shall be permitted to be installed in accordance with 426.28 or 427.22, as applicable.

Exception No. 2: A receptacle supplying only a permanently installed premises security system shall be permitted to omit ground-fault circuit-interrupter protection.

Exception No. 3: Listed weight-supporting ceiling receptacles (WSCR) utilized in combination with compatible weight-supporting attachment fittings (WSAF) installed for the purpose of supporting a ceiling luminaire or ceiling-suspended fan shall be permitted to omit ground-fault circuit-interrupter protection. If a general-purpose convenience receptacle is integral to the ceiling luminaire or ceiling-suspended fan, GFCI protection shall be provided.

Exception No. 4: Factory-installed receptacles that are not readily accessible and are mounted internally to bathroom exhaust fan assemblies shall not require GFCI protection unless required by the installation instructions or listing.

Informational Note: See 760.41(B) and 760.121(B) for power supply requirements for fire alarm systems.

(B) Other Than Dwelling Units.

All 125-volt through 250-volt receptacles supplied by single-phase branch circuits rated 150 volts or less to ground, 50 amperes or less, and all receptacles supplied by three-phase branch circuits rated 150 volts or less to ground, 100 amperes or less, installed in the following locations shall be provided with GFCI protection:

- (1) Bathrooms
- (2) Kitchens
- (3) Areas with sinks and permanent provisions for food preparation, beverage preparation, or cooking

- (4) Buffet serving areas with permanent provisions for food serving, beverage serving, or cooking
- (5) Rooftops
- (6) Outdoors
- (7) Sinks where receptacles or cord-and-plug-connected fixed or stationary appliances are installed within 1.8 m (6 ft) from the top inside edge of the bowl of the sink
- (8) Indoor damp or wet locations
- (9) Locker rooms with associated showering facilities
- (10) Garages, accessory buildings, service bays, and similar areas other than vehicle exhibition halls and showrooms
- (11) Crawl spaces at or below grade level
- (12) Unfinished areas of basements
- (13) Aquariums, bait wells, and similar open aquatic vessels or containers, such as tanks or bowls, where receptacles are installed within 1.8 m (6 ft.) from the top inside edge or rim or from the conductive support framing of the vessel or container
- (14) Laundry areas
- (15) Bathtubs and shower stalls where receptacles are installed within 1.8 m (6 ft) of the outside edge of the bathtub or shower stall

Exception No. 1: Receptacles that are not readily accessible and are supplied by a branch circuit dedicated to electric snow-melting, deicing, or pipeline and vessel heating equipment shall be permitted to be installed in accordance with 426.28 or 427.22, as applicable.

Exception No. 2: Receptacles on rooftops shall not be required to be readily accessible other than from the rooftop.

Exception No. 3: Receptacles or cord-and-plug-connected fixed and stationary appliances installed within 1.8 m (6 ft) from the top inside edge of a bowl of a sink shall not be required to be GFCI protected in industrial establishments where the conditions of maintenance and supervision ensure that only qualified personnel are involved, an assured equipment grounding conductor program in accordance with 590.6(B)(2) shall be permitted for only those receptacle outlets used to supply equipment that would create a greater hazard if power is interrupted or that has a design not compatible with GFCI protection.

Exception No. 4: Receptacles or cord-and-plug-connected fixed and stationary appliances installed within 1.8 m (6 ft) from the top inside edge of a bowl of a sink shall not be required to be GFCI protected in industrial laboratories where the receptacles are used to supply equipment if removal of power would introduce a greater hazard.

Exception No. 5: Receptacles located in patient bed locations of Category 2 (general care) or Category 1 (critical care) spaces of health care facilities shall be permitted to comply with 517.21.

Exception No. 6: Listed weight-supporting ceiling receptacles (WSCR) utilized in combination with compatible weight-supporting attachment fittings (WSAF) installed for the purpose of serving a ceiling luminaire or ceiling-suspended fan shall be permitted to omit GFCI protection. If a general-purpose convenience receptacle is integral to the ceiling luminaire or ceiling-suspended fan, GFCI protection shall be provided.

(C) Crawl Space Lighting Outlets.

GFCI protection shall be provided for lighting outlets not exceeding 120 volts installed in crawl spaces.

(D) Specific Appliances.

GFCI protection shall be provided for the branch circuit or outlet supplying the following appliances rated 150 volts or less to ground and 60 amperes or less, single- or 3-phase:

- (1) Automotive vacuum machines
- (2) Drinking water coolers and bottle fill stations
- (3) High-pressure spray washing machines
- (4) Tire inflation machines
- (5) Vending machines
- (6) Sump pumps

- (7) Dishwashers
- (8) Electric ranges
- (9) Wall-mounted ovens
- (10) Counter-mounted cooking units
- (11) Clothes dryers
- (12) Microwave ovens

(E) Equipment Requiring Servicing.

GFCI protection shall be provided for the receptacles required by 210.63.

F) Outdoor Outlets.

For dwellings, all outdoor outlets, other than those covered in 210.8(A), Exception No. 1, including outlets installed in the following locations, and supplied by single-phase branch circuits rated 150 volts or less to ground, 50 amperes or less, shall be provided with GFCI protection:

- (1) Garages that have floors located at or below grade level
- (2) Accessory buildings
- (3) Boathouses

If equipment supplied by an outlet covered under the requirements of this section is replaced, the outlet shall be supplied with GFCI protection.

Exception No. 1: GFCI protection shall not be required on lighting outlets other than those covered in 210.8(B).

Exception No. 2: GFCI protection shall not be required for listed HVAC equipment. This exception shall expire September 1, 2026.

210.11 Branch Circuits Required.

Branch circuits for lighting and for appliances, including motor-operated appliances, shall be provided to supply the loads calculated in accordance with 220.10. In addition, branch circuits shall be provided for specific loads not covered by 220.10 where required elsewhere in this Code and for dwelling unit loads as specified in 210.11(C).

(A) Number of Branch Circuits.

The minimum number of branch circuits shall be determined from the total calculated load and the size or rating of the circuits used. In all installations, the number of circuits shall be sufficient to supply the load served. In no case shall the load on any circuit exceed the maximum specified by 220.11.

(B) Load Evenly Proportioned Among Branch Circuits.

Where the load is calculated on the basis of volt-amperes per square meter or per square foot, the wiring system up to and including the branch-circuit panelboard(s) shall be provided to serve not less than the calculated load. This load shall be evenly proportioned among multioutlet branch circuits within the panelboard(s). Branch-circuit overcurrent devices and circuits shall be required to be installed only to serve the connected load.

(C) Dwelling Units.

(1) Small-Appliance Branch Circuits. In addition to the number of branch circuits required by other parts of this section, two or more 20-ampere small-appliance branch circuits shall be provided for all receptacle outlets specified by 210.52(B).

(2) Laundry Branch Circuits. In addition to the number of branch circuits required by other parts of this section, at least one additional 20-ampere branch circuit shall be provided to supply the laundry receptacle outlet(s) required by 210.52(F). This circuit shall have no other outlets.

(3) Bathroom Branch Circuits. In addition to the number of branch circuits required by other parts of this section, one or more 120-volt, 20-ampere branch circuit shall be provided to supply bathroom(s) receptacle outlet(s) required by 210.52(D) and any countertop and similar work surface receptacle outlets. Such circuits shall have no other outlets.

Exception: Where the 20-ampere circuit supplies a single bathroom, outlets for other equipment within the same bathroom shall be permitted to be supplied in accordance with 210.23(B)(1) and (B)(2).

(4) Garage Branch Circuits. In addition to the number of branch circuits required by other parts of this section, at least one 120-volt, 20-ampere branch circuit shall be installed to supply receptacle outlets, including those required by 210.52(G)(1) for attached garages and in detached garages with electric power. This circuit shall have no other outlets. Additional branch circuits rated 15 amperes or greater shall be permitted to serve receptacle outlets other than those required by 210.52(G)(1).

Exception No. 1: This circuit shall be permitted to supply outdoor receptacle outlets.

Exception No. 2: Where the 20-ampere circuit supplies a single vehicle bay garage, outlets for other equipment within the same garage shall be permitted to be supplied in accordance with 210.23(B)(1) and (B)(2).

210.12 Arc-Fault Circuit-Interrupter Protection.

Arc-fault circuit-interrupter (AFCI) protection shall be installed in accordance with 210.12(B) through (E) by any of the means described in 210.12(A)(1) through (A)(6). The AFCI shall be listed and installed in a readily accessible location.

(A) Means of Protection. AFCI protection shall be provided by any of the following means:

- (1) A listed combination-type AFCI installed to provide protection of the entire branch circuit.
- (2) A listed branch-feeder-type AFCI installed at the origin of the branch-circuit in combination with a listed outlet branch-circuit-type AFCI installed on the branch circuit at the first outlet box, which shall be marked to indicate that it is the first outlet of the branch circuit.
- (3) A listed supplemental arc protection circuit breaker installed at the origin of the branch circuit in combination with a listed outlet branch-circuit-type AFCI installed on the branch circuit at the first outlet box if all of the following conditions are met:
 - a. The branch-circuit wiring shall be continuous from the branch-circuit overcurrent device to the outlet branch-circuit AFCI.
 - b. The maximum length of the branch-circuit wiring from the branch-circuit overcurrent device to the first outlet shall not exceed 15.2 m (50 ft) for a 14 AWG conductor or 21.3 m (70 ft) for a 12 AWG conductor.
 - c. The first outlet box shall be marked to indicate that it is the first outlet of the branch circuit.
- (4) A listed outlet branch-circuit-type AFCI installed on the branch circuit at the first outlet in combination with a listed branch-circuit overcurrent protective device if all of the following conditions are met:
 - a. The branch-circuit wiring shall be continuous from the branch-circuit overcurrent device to the outlet branch-circuit AFCI.
 - b. The maximum length of the branch-circuit wiring from the branch-circuit overcurrent device to the first outlet shall not exceed 15.2 m (50 ft) for a 14 AWG conductor or 21.3 m (70 ft) for a 12 AWG conductor.
 - c. The first outlet box shall be marked to indicate that it is the first outlet of the branch circuit.

d. The combination of the branch-circuit overcurrent device and outlet branch-circuit AFCI shall be identified as meeting the requirements for a system combination-type AFCI and listed as such.

(5) If metal raceway, metal wireways, metal auxiliary gutters, or Type MC or Type AC cable meeting the applicable requirements of 250.118, with metal boxes, metal conduit bodies, and metal enclosures are installed for the portion of the branch circuit between the branch-circuit overcurrent device and the first outlet, it shall be permitted to install a listed outlet branch-circuit-type AFCI at the first outlet to provide protection for the remaining portion of the branch circuit.

(6) Where a listed metal or nonmetallic conduit or tubing or Type MC cable is encased in not less than 50 mm (2 in.) of concrete for the portion of the branch circuit between the branch-circuit over current device and the first outlet, it shall be permitted to install a listed outlet branch-circuit-type AFCI at the first outlet to provide protection for the remaining portion of the branch circuit.

Informational Note: See UL 1699-2011, Standard for Arc-Fault Circuit-Interrupters, for information on combination-type and branch/feeder-type AFCI devices. See UL Subject 1699A, Outline of Investigation for Outlet Branch Circuit Arc-Fault Circuit-Interrupters, for information on outlet branch-circuit type AFCI devices. See UL Subject 1699C, Outline of Investigation for System Combination Arc-Fault Circuit Interrupters, for information on system combination AFCIs.

(B) Dwelling Units. All 120-volt, single-phase, 10-, 15-, and 20-ampere branch circuits supplying outlets or devices installed in the following locations shall be protected by any of the means described in 210.12(A)(1) through (A)(6):

- (1) Kitchens
- (2) Family rooms
- (3) Dining rooms
- (4) Living rooms
- (5) Parlors
- (6) Libraries
- (7) Dens
- (8) Bedrooms
- (9) Sunrooms
- (10) Recreation rooms
- (11) Closets
- (12) Hallways
- (13) Laundry areas
- (14) Similar areas

Exception No. 1: AFCI protection shall not be required for an individual branch circuit supplying a fire alarm system installed in accordance with 760.41(B) or 760.121(B). The branch circuit shall be installed in a metal raceway, metal auxiliary gutter, steel-armored cable, or Type MC or Type AC cable meeting the applicable requirements of 250.118, with metal boxes, conduit bodies, and enclosures.

Exception No. 2: AFCI protection shall not be required for the individual branch circuit supplying an outlet for arc welding equipment in a dwelling unit until January 1, 2025.

Informational Note No. 1: See NFPA 72-2022, National Fire Alarm and Signaling Code, 29.9.4(5), for information on secondary power source requirements for smoke alarms installed in dwelling units.

Informational Note No. 2: See 760.41(B) and 760.121(B) for power source requirements for the fire alarm systems.

(C) Dormitory Units. All 120-volt, single-phase, 10-, 15-, and 20-ampere branch circuits supplying outlets or devices installed in the following locations shall be protected by any of the means described in 210.12(A)(1) through (A)(6):

- (1) Bedrooms
- (2) Living rooms
- (3) Hallways
- (4) Closets
- (5) Bathrooms
- (6) Similar rooms

(D) Other Occupancies. All 120-volt, single-phase, 10-, 15-, and 20-ampere branch circuits supplying outlets or devices installed in the following locations shall be protected by any of the means described in 210.12(A)(1) through (A)(6):

- (1) Guest rooms and guest suites of hotels and motels
- (2) Areas used exclusively as patient sleeping rooms in nursing homes and limited-care facilities
- (3) Areas designed for use exclusively as sleeping quarters in fire stations, police stations, ambulance stations, rescue stations, ranger stations, and similar locations

(E) Branch Circuit Wiring Extensions, Modifications, or Replacements. If branch-circuit wiring for any of the areas specified in 210.12(B), (C), or (D) is modified, replaced, or extended, the branch circuit shall be protected by one of the following:

- (1) By any of the means described in 210.12(A)(1) through (A)(6)
- (2) A listed outlet branch-circuit-type AFCI located at the first receptacle outlet of the existing branch circuit

Exception: AFCI protection shall not be required where the extension of the existing branch-circuit conductors is not more than 1.8 m (6 ft) and does not include any additional outlets or devices, other than splicing devices. This measurement shall not include the conductors inside an enclosure, cabinet, or junction box.

210.50 Receptacle Outlets.

Receptacle outlets shall be installed as specified in 210.52 through 210.65.

Informational Note: See Informative Annex J for information regarding ADA accessibility design.

(A) Cord Pendants. A cord connector that is supplied by a permanently connected cord pendant shall be considered a receptacle outlet.

(B) Cord Connections. A receptacle outlet shall be installed wherever flexible cords with attachment plugs are used. Where flexible cords are permitted to be permanently connected, receptacles shall be permitted to be omitted for such cords.

(C) Appliance Receptacle Outlets. Appliance receptacle outlets installed in a dwelling unit for specific appliances, such as laundry equipment, shall be installed within 1.8 m (6 ft) of the intended location of the appliance.

210.52 Dwelling Unit Receptacle Outlets.

This section provides requirements for 125-volt, 15- and 20-ampere receptacle outlets. The receptacles required by this section shall be in addition to any receptacle that is as follows:

- (1) Part of a luminaire or appliance, or
- (2) Controlled by a listed wall-mounted control device in accordance with 210.70(A)(1), Exception No. 1, or
- (3) Located within cabinets or cupboards, or

(4) Located more than 1.7 m (51/2 ft) above the floor

Permanently installed electric baseboard heaters equipped with factory-installed receptacle outlets or outlets provided as a separate assembly by the manufacturer shall be permitted as the required outlet or outlets for the wall space utilized by such permanently installed heaters. Such receptacle outlets shall not be connected to the heater circuits.

Informational Note: Listed baseboard heaters include instructions that may not permit their installation below receptacle outlets.

(A) General Provisions. In every kitchen, family room, dining room, living room, parlor, library, den, sunroom, bedroom, recreation room, or similar room or area of dwelling units, receptacle outlets shall be installed in accordance with the general provisions specified in 210.52(A)(1) through (A)(4).

(1) Spacing.

Receptacles shall be installed such that no point measured horizontally along the floor line of any wall space is more than 1.8 m (6 ft) from a receptacle outlet.

(2) Wall Space.

As used in this section, a wall space shall include the following:

(1) Any space 600 mm (2 ft) or more in width (including space measured around corners) and unbroken along the floor line by doorways and similar openings, fireplaces, stationary appliances, and fixed cabinets that do not have countertops or similar work surfaces

(2) The space occupied by fixed panel in wall, excluding sliding panels.

(3) The space afforded by fixed room dividers, such as freestanding bar-type counters or railings

(3) Floor Receptacles.

Receptacle outlets in or on floors shall not be counted as part of the required number of receptacle outlets unless located within 450 mm (18 in.) of the wall.

(4) Countertop and Similar Work Surface Receptacle Outlets.

Receptacles installed for countertop and similar work surfaces as specified in 210.52(C) shall not be considered as the receptacle outlets required by 210.52(A).

(B) Small Appliances.

(1) Receptacle Outlets Served.

In the kitchen, pantry, breakfast room, dining room, or similar area of a dwelling unit, the two or more 20-ampere small-appliance branch circuits required by 210.11(C)(1) shall serve all wall and floor receptacle outlets covered by 210.52(A), all countertop outlets covered by 210.52(C), and receptacle outlets for refrigeration equipment.

Exception No. 1: In addition to the required receptacles specified by 210.52, switched receptacles supplied from a general-purpose 15- or 20-ampere branch circuit shall be permitted in accordance with 210.70(A)(1), Exception No. 1.

Exception No. 2: In addition to the required receptacles specified by 210.52, a receptacle outlet to serve a specific appliance shall be permitted to be supplied from an individual branch circuit rated 15 amperes or greater.

(2) No Other Outlets.

The two or more small-appliance branch circuits specified in 210.52(B)(1) shall have no other outlets.

Exception No. 1: A receptacle installed solely for the electrical supply to and support of an electric clock in any of the rooms specified in 210.52(B)(1) shall be permitted to be served by a small-appliance branch circuit.

Exception No. 2: Receptacles installed to provide power for supplemental equipment and lighting on gas-fired ranges, ovens, or counter-mounted cooking units shall be permitted to be served by a small-appliance branch circuit.

(3) Kitchen Receptacle Requirements.

Receptacles installed in a kitchen to serve countertop surfaces shall be supplied by not fewer than two small-appliance branch circuits, either or both of which shall also be permitted to supply receptacle outlets in the

same kitchen and in other rooms specified in 210.52(B)(1). Additional small-appliance branch circuits shall be permitted to supply receptacle outlets in the kitchen and other rooms specified in 210.52(B)(1). No small-appliance branch circuit shall serve more than one kitchen.

(C) Countertops and Work Surfaces.

In kitchens, pantries, breakfast rooms, dining rooms, and similar areas of dwelling units, receptacle outlets for countertop and work surfaces that are 300 mm (12 in.) or wider shall be installed in accordance with 210.52(C)(1) through (C)(3) and shall not be considered as the receptacle outlets required by 210.52(A).

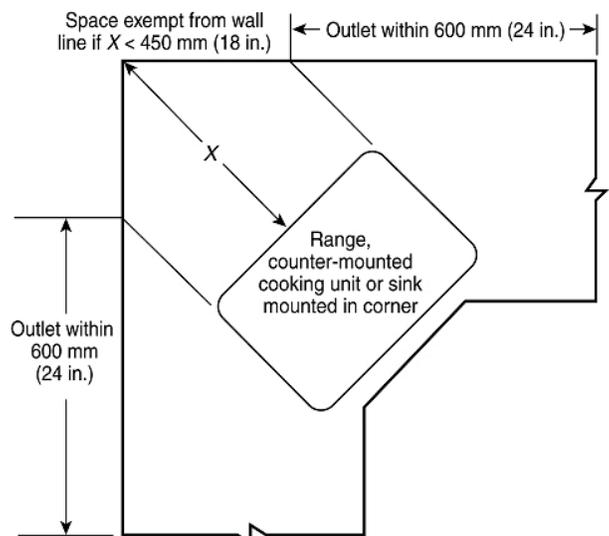
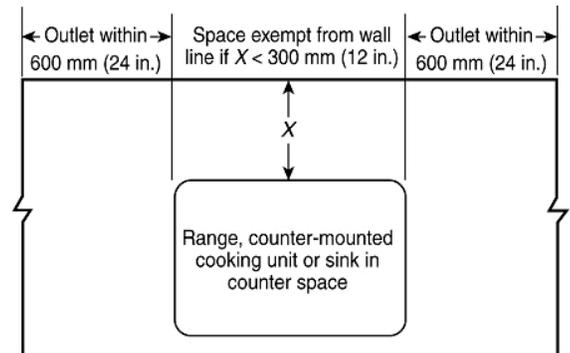
For the purposes of this section, where using multioutlet assemblies, each 300 mm (12 in.) of multioutlet assembly containing two or more receptacles installed in individual or continuous lengths shall be considered to be one receptacle outlet.

(1) Wall Spaces.

Receptacle outlets shall be installed so that no point along the wall line is more than 600 mm (24 in.) measured horizontally from a receptacle outlet in that space. The location of the receptacles shall be in accordance with 210.52(C)(3).

Exception No. 1: Receptacle outlets shall not be required directly behind a range, counter-mounted cooking unit, or sink in the installation described in Figure 210.52(C)(1).

Exception No. 2: Where a required receptacle outlet cannot be installed in the wall areas shown in Figure 210.52(C)(1), the receptacle outlet shall be permitted to be installed as close as practicable to the countertop area to be served. The total number of receptacle outlets serving the countertop shall not be less than the number needed to satisfy 210.52(C)(1). These outlet shall be located in accordance with 210.52(C)(3).



(2) Island and Peninsular Countertops and Work Surfaces.

Receptacle outlets, if installed to serve an island or peninsular countertop or work surface, shall be installed in accordance with 210.52(C)(3). If a receptacle outlet is not provided to serve an island or peninsular countertop or work surface, provisions shall be provided at the island or peninsular for future addition of a receptacle outlet to serve the island or peninsular countertop or work surface.

(3) Receptacle Outlet Location.

Receptacle outlets shall be located in one or more of the following:

- (1) On or above, but not more than 500 mm (20 in.) above, a countertop or work surface
- (2) In a countertop using receptacle outlet assemblies listed for use in countertops
- (3) In a work surface using receptacle outlet assemblies listed for use in work surfaces or listed for use in counter tops

Receptacle outlets rendered not readily accessible by appliances fastened in place, appliance garages, sinks, or rangetops as covered in 210.52(C)(1), Exception No. 1, or appliances occupying assigned spaces shall not be considered as these required outlets.

Informational Note No. 1: See 406.5(E) for installation of receptacles in countertops and 406.5(F) for installation of receptacles in work surfaces. See 380.10 for installation of multioutlet assemblies.

Informational Note No. 2: See Informative Annex J and ANSI/ICC A117.1-2009, Standard on Accessible and Usable Buildings and Facilities, for additional information.

(D) Bathrooms.

At least one receptacle outlet shall be installed in bathrooms within 900 mm (3 ft) of the outside edge of each sink. The receptacle outlet shall be located on a wall or partition that is adjacent to the sink or sink countertop, located on the countertop, or installed on the side or face of the sink cabinet. In no case shall the receptacle be located more than 300 mm (12 in.) below the top of the sink or sink countertop. Receptacle outlet assemblies listed for use in countertops shall be permitted to be installed in the countertop.

Informational Note: See 406.5(E) and 406.5(G) for requirements on installation of receptacles in countertops

(E) Outdoor Outlets.

Outdoor receptacle outlets shall be installed in accordance with 210.52(E)(1) through (E)(3).

(1) One-Family and Two-Family Dwellings.

For a one-family dwelling and each unit of a two-family dwelling that is at grade level, at least one receptacle outlet readily accessible from grade and not more than 2.0 m (6 1/2 ft) above grade level shall be installed at the front and back of the dwelling.

(2) Multifamily Dwellings.

For each dwelling unit of a multifamily dwelling where the dwelling unit is located at grade level and provided with individual exterior entrance/egress, at least one receptacle outlet readily accessible from grade and not more than 2.0 m (6 1/2 ft) above grade level shall be installed.

(3) Balconies, Decks, and Porches.

Balconies, decks, and porches that are within 102 mm (4 in.) horizontally of the dwelling unit shall have at least one receptacle outlet accessible from the balcony, deck, or porch. The receptacle outlet shall not be located more than 2.0 m (6 1/2 ft) above the balcony, deck, or porch walking surface.

(F) Laundry Areas.

In dwelling units, at least one receptacle outlet shall be installed in areas designated for the installation of laundry equipment.

Exception No. 1: A receptacle for laundry equipment shall not be required in a dwelling unit of a multifamily building where laundry facilities are provided on the premises for use by all building occupants.

Exception No. 2: A receptacle for laundry equipment shall not be required in other than one-family dwellings where laundry facilities are not to be installed or permitted.

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(G) Basements, Garages, and Accessory Buildings.

For one- and two-family dwellings, and multifamily dwellings, at least one receptacle outlet shall be installed in the areas specified in 210.52(G)(1) through (G)(3). These receptacle shall be in addition to receptacles required for specific equipment. Receptacles supplying only a permanently installed premises security system shall not be considered as meeting these requirements.

(1) Garages.

In each attached garage and in each detached garage with electric power, at least one receptacle outlet shall be installed in each vehicle bay and not more than 1.7 m (5 1/2 ft) above the floor.

Exception: Garage spaces not attached to an individual dwelling unit of a multifamily dwelling shall not require a receptacle outlet in each vehicle bay.

(2) Accessory Buildings.

In each accessory building with electric power.

(3) Basements.

In each separate unfinished portion of a basement.

(H) Hallways.

In dwelling units, hallways of 3.0 m (10 ft) or more in length shall have at least one receptacle outlet.

As used in this subsection, the hallway length shall be considered the length along the centerline of the hallway without passing through a doorway.

(I) Foyers.

Foyers that are not part of a hallway in accordance with 210.52(H) and that have an area that is greater than 5.6 m² (60 ft²) shall have a receptacle(s) located in each wall space 900 mm (3 ft) or more in width. Doorways, door-side windows that extend to the floor, and similar openings shall not be considered wall space.

250.4 General Requirements for Grounding and Bonding.

The following general requirements identify what grounding and bonding of electrical systems are required to accomplish. The prescriptive methods contained in this article shall be followed to comply with the performance requirements of this section.

(A) Grounded Systems.

(1) Electrical System Grounding.

Electrical systems that are grounded shall be connected to earth in a manner that will limit the voltage imposed by lightning, line surges, or unintentional contact with higher-voltage lines and that will stabilize the voltage to earth during normal operation.

Informational Note No. 1: An important consideration for limiting the imposed voltage is the routing of bonding and grounding electrode conductors so that they are not any longer than necessary to complete the connection without disturbing the permanent parts of the installation and so that unnecessary bends and loops are avoided.

Informational Note No. 2: See NFPA 780-2020, Standard for the Installation of Lightning Protection Systems, for information on installation of grounding and bonding for lightning protection systems.

(2) Grounding of Electrical Equipment.

Normally non-current-carrying conductive materials enclosing electrical conductors or equipment, or forming part of such equipment, shall be connected to earth so as to limit the voltage to ground on these materials.

(3) Bonding of Electrical Equipment.

Normally non-current-carrying conductive materials enclosing electrical conductors or equipment, or forming part of such equipment, shall be connected together and to the electrical supply source in a manner that establishes an effective ground-fault current path.

(4) Bonding of Electrically Conductive Materials and Other Equipment.

Normally non-current-carrying electrically conductive materials that are likely to become energized shall be connected together and to the electrical supply source in a manner that establishes an effective ground-fault current path.

(5) Effective Ground-Fault Current Path.

Electrical equipment and wiring and other electrically conductive material likely to become energized shall be installed in a manner that creates a low-impedance circuit facilitating the operation of the overcurrent device or ground detector for impedance grounded systems. It shall be capable of safely carrying the maximum ground-fault current likely to be imposed on it from any point on the wiring system where a ground fault occurs to the electrical supply source. The earth shall not be considered as an effective ground-fault current path.

(B) Ungrounded Systems.

(1) Grounding Electrical Equipment.

Non-current-carrying conductive materials enclosing electrical conductors or equipment, or forming part of such equipment, shall be connected to earth in a manner that will limit the voltage imposed by lightning or unintentional contact with higher-voltage lines and limit the voltage to ground on these materials.

Informational Note: See NFPA 780-2020, Standard for the Installation of Lightning Protection Systems, for information on installation of grounding and bonding for lightning protection systems.

(2) Bonding of Electrical Equipment.

Non-current-carrying conductive materials enclosing electrical conductors or equipment, or forming part of such equipment, shall be connected together and to the supply system grounded equipment in a manner that creates a low-impedance path for ground-fault current that is capable of carrying the maximum fault current likely to be imposed on it.

(3) Bonding of Electrically Conductive Materials and Other Equipment.

Electrically conductive materials that are likely to become energized shall be connected together and to the supply system grounded equipment in a manner that creates a low-impedance path for ground-fault current that is capable of carrying the maximum fault current likely to be imposed on it.

(4) Path for Fault Current.

Electrical equipment, wiring, and other electrically conductive material likely to become energized shall be installed in a manner that creates a low-impedance circuit from any point on the wiring system to the electrical supply source to facilitate the operation of overcurrent devices should a second ground fault from a different phase occur on the wiring system. The earth shall not be considered as an effective fault-current path.

250.8 Connection of Grounding and Bonding Equipment.

(A) Permitted Methods.

Equipment grounding conductors, grounding electrode conductors, and bonding jumpers shall be connected by one or more of the following means:

- (1) Listed pressure connectors
- (2) Terminal bars
- (3) Pressure connectors listed as grounding and bonding equipment
- (4) Exothermic welding process
- (5) Machine screw-type fasteners that engage not less than two threads or are secured with a nut
- (6) Thread-forming machine screws that engage not less than two threads in the enclosure
- (7) Connections that are part of a listed assembly
- (8) Other listed means

(B) Methods Not Permitted.

Connection devices or fittings that depend solely on solder shall not be used.

250.10 Protection of Ground Clamps and Fittings.

Ground clamps or other fittings exposed to physical damage shall be enclosed in metal, wood, or equivalent protective covering.

250.12 Clean Surfaces.

Nonconductive coatings (such as paint, lacquer, and enamel) on equipment to be grounded or bonded shall be removed from threads and other contact surfaces to ensure electrical continuity or shall be connected by means of fittings designed to make such removal unnecessary.

Part V. Bonding

250.90 General.

Bonding shall be provided if necessary to ensure electrical continuity and the capacity to conduct safely any fault current likely to be imposed.

250.92 Services.

(A) Bonding of Equipment for Services.

The normally non-current-carrying metal parts of equipment indicated in the following shall be bonded together:

- (1) All raceways, cable trays, cablebus framework, auxiliary gutters, or service cable armor or sheath that enclose, contain, or support service conductors, except as permitted in 250.80
- (2) All enclosures containing service conductors, including meter fittings, boxes, or the like, interposed in the service raceway or armor

(B) Method of Bonding at the Service.

Bonding jumpers meeting the requirements of this article shall be used around impaired connections, such as reducing washers or oversized, concentric, or eccentric knockouts. Standard locknuts or bushings shall not be the only means for the bonding required by this section but shall be permitted to be installed to make a mechanical connection of the raceway(s).

Electrical continuity at service equipment, service raceways, and service conductor enclosures shall be ensured by one or more of the following methods:

- (1) Bonding equipment to the grounded service conductor by an applicable method in 250.8(A)
- (2) Connections made up wrenchtight using threaded couplings, threaded entries, or listed threaded hubs on enclosures
- (3) Threadless couplings and connectors if made up tight for metal raceways and metal-clad cables
- (4) Other listed devices, such as bonding-type locknuts, bushings, or bushings with bonding jumpers

250.102 Grounded Conductor, Bonding Conductors, and Jumpers.

(A) Material. Bonding jumpers shall be of copper, aluminum, copper-clad aluminum, or other corrosion-resistant material. A bonding jumper shall be a wire, bus, screw, or similar suitable conductor.

(B) Attachment. Bonding jumpers shall be attached in the manner specified in 250.8 for circuits and equipment and in 250.70 for grounding electrodes.

(C) Size — Supply-Side Bonding Jumper.

(1) Size for Supply Conductors in a Single Raceway or Cable. The supply-side bonding jumper shall not be smaller than specified in Table 250.102(C)(1).

(2) Size for Parallel Conductor Installations in Two or More Raceways or Cables. If the ungrounded supply conductors are connected in parallel in two or more raceways or cables, the supply-side bonding jumper shall be sized in accordance with either of the following:

- (1) An individual bonding jumper for each raceway or cable shall be selected from Table 250.102(C)(1) base on the size of the largest ungrounded supply conductor in each raceway or cable.
- (2) A single bonding jumper installed for bonding two or more raceways or cables shall be sized in accordance with Table 250.102(C)(1) based on the sum of the circular mil areas of the largest ungrounded conductors from each set connected in parallel in each raceway or cable. The size of the grounded conductor(s) in each raceway or cable shall be based on the largest ungrounded conductor in each raceway or cable, or the sum of the circular mil areas of the largest ungrounded conductors from each set connected in parallel in each raceway or cable.

Informational Note No. 1: The term supply conductors includes ungrounded conductors that do not have overcurrent protection on their supply side and terminate at service equipment or the first disconnecting means of a separately derived system.

Informational Note No. 2: See Chapter 9, Table 8, for the circular mil area of conductors 18 AWG through 4/0 AWG

(D) Size — Equipment Bonding Jumper on Load Side of an Overcurrent Device. The equipment bonding jumper on the load side of an overcurrent device(s) shall be sized in accordance with 250.122.

A single common continuous equipment bonding jumper shall be permitted to connect two or more raceways or cables if the bonding jumper is sized in accordance with 250.122 for the largest overcurrent device supplying circuits therein.

(E) Installation. Bonding jumpers or conductors and equipment bonding jumpers shall be permitted to be installed inside or outside of a raceway or an enclosure.

(1) Inside a Raceway or an Enclosure. If installed inside a raceway, equipment bonding jumpers and bonding jumpers or conductors shall comply with the requirements of 250.119 and 250.148.

(2) Outside a Raceway or an Enclosure. If installed on the outside, the length of the bonding jumper or conductor or equipment bonding jumper shall not exceed 1.8 m (6 ft) and shall be routed with the raceway or enclosure.

Exception: An equipment bonding jumper or supply-side bonding jumper longer than 1.8 m (6 ft) shall be permitted at outside pole locations for the purpose of bonding or grounding isolated sections of metal raceways or elbows installed in exposed risers of metal conduit or other metal raceway, and for bonding grounding electrodes, and shall not be required to be routed with a raceway or enclosure.

(3) Protection. Bonding jumpers or conductors and equipment bonding jumpers shall be installed in accordance with 250.64(A) and (B).

Article 300 General Requirements for Wiring Methods and Materials

300.1 Scope.

(A) All Wiring Installations. This article covers general requirements for wiring methods and materials for all wiring installations unless modified by other articles in Chapter 3.

(B) Integral Parts of Equipment. The requirements of this article are not intended to apply to the conductors that form an integral part of equipment, such as motors, controllers, motor control centers, or factory-assembled control equipment or listed utilization equipment.

(C) Metric Designators and Trade Sizes. Metric designators and trade sizes for conduit, tubing, and associated fittings and accessories shall be in accordance with Table 300.1(C).

Table 300.1(C) Metric Designators and Trade Sizes

Metric Designator	Trade Size
12	3/8
16	1/2
21	3/4
27	1
35	1 1/4
41	1 1/2
53	2
63	2 1/2
78	3
91	3 1/2
103	4
129	5
155	6

Note: The metric designators and trade sizes are for identification purposes only and are not actual dimensions.

300.4 Protection Against Physical Damage.

Where subject to physical damage, conductors, raceways, and cables shall be protected.

(A) Cables and Raceways Through Wood Members.

(1) Bored Holes. In both exposed and concealed locations, where a cable- or raceway-type wiring method is installed through bored holes in joists, rafters, or wood members, holes shall be bored so that the edge of the hole is not less than 32 mm (1 1/4 in.) from the edges of the wood member. Where this distance cannot be maintained, the cable or raceway shall be protected from penetration by screws or nails by a steel plate(s) or bushing(s) at least 1.6 mm (1/16 in.) thick, and of appropriate length and width, installed to cover the area of the wiring.

Exception No. 1: Steel plates shall not be required to protect rigid metal conduit, intermediate metal conduit, rigid PVC conduit, RTRC, or electrical metallic tubing.

Exception No. 2: A listed and marked steel plate less than 1.6 mm (1/16 in.) thick that provides equal or better protection against nail or screw penetration shall be permitted.

(2) Notches in Wood. Where there is no objection because of weakening the building structure, in both exposed and concealed locations, cables or raceways shall be permitted to be laid in notches in wood studs, joists, rafters, or other wood members where the cable or raceway at those points is protected from penetration by nails or screws by a steel plate at least 1.6 mm (1/16 in.) thick, and of appropriate length and width, installed to cover the area of the wiring. The steel plate shall be installed before the building finish is applied.

Exception No. 1: Steel plates shall not be required to protect rigid metal conduit, intermediate metal conduit, rigid nonmetallic conduit, or electrical metallic tubing.

Exception No. 2: A listed and marked steel plate less than 1.6 mm (1/16 in.) thick that provides equal or better protection against nail or screw penetration shall be permitted.

(B) Nonmetallic-Sheathed Cables and Electrical Nonmetallic Tubing Through Metal Framing Members.

(1) Nonmetallic-Sheathed Cable.

In both exposed and concealed locations where nonmetallic-sheathed cables pass through either factory- or field-punched, cut, or drilled slots or holes in metal members, the cable shall be protected by listed bushings or listed grommets covering all metal edges that are securely fastened in the opening prior to installation of the cable.

(2) Nonmetallic-Sheathed Cable and Electrical Nonmetallic Tubing.

Where nails or screws are likely to penetrate nonmetallic-sheathed cable or electrical nonmetallic tubing, a steel sleeve, steel plate, or steel clip not less than 1.6 mm (1/16 in.) in thickness shall be used to protect the cable or tubing.

Exception: A listed and marked steel plate less than 1.6 mm (1/16 in.) thick that provides equal or better protection against nail or screw penetration shall be permitted.

(C) Cables Through Spaces Behind Panels Designed to Allow Access.

Cables or raceway-type wiring methods, installed behind panels designed to allow access shall be supported according to their applicable articles.

(D) Cables and Raceways Parallel to Framing Members and Furring Strips.

In both exposed and concealed locations, where a cable- or raceway-type wiring method is installed parallel to framing members, such as joists, rafters, or studs, or is installed parallel to furring strips, the cable or raceway shall be installed and supported so that the nearest outside surface of the cable or raceway is not less than 32 mm (1 1/4 in.) from the nearest edge of the framing member or furring strips where nails or screws are likely to penetrate. Where this distance cannot be maintained, the cable or raceway shall be protected from penetration by nails or screws by a steel plate, sleeve, or equivalent at least 1.6 mm (1/16 in.) thick.

Exception No. 1: Steel plates, sleeves, or the equivalent shall not be required to protect rigid metal conduit, intermediate metal conduit, rigid nonmetallic conduit, or electrical metallic tubing.

Exception No. 2: For concealed work in finished buildings, or finished panels for prefabricated buildings where such supporting is impracticable, it shall be permissible to fish the cables between access points.

Exception No. 3: A listed and marked steel plate less than 1.6 mm (1/16 in.) thick that provides equal or better protection against nail or screw penetration shall be permitted.

(E) Cables, Raceways, or Boxes Installed in or Under Metal-Corrugated Roof Decking.

A cable, raceway, or box, installed in exposed or concealed locations under metal-corrugated sheet roof decking, shall be installed and supported so there is not less than 38 mm (1 1/2 in.) measured from the lowest surface of the roof decking to the top of the cable, raceway, or box. A cable, raceway, or box shall not be installed in concealed locations in metal-corrugated, sheet decking-type roof.

Informational Note: Roof decking material is often repaired or replaced after the initial raceway or cabling and roofing installation and might be penetrated by screws or other mechanical devices designed to provide "hold down" strength of the waterproof membrane or roof insulating material.

Exception No. 1: Rigid metal conduit and intermediate metal conduit, with listed steel or malleable iron fittings and boxes, shall not be required to comply with 300.4(E).

Exception No. 2: The 38 mm (1 1/2 in.) spacing is not required where metal-corrugated sheet roof decking is covered with a minimum thickness 50 mm (2 in.) concrete slab, measured from the top of the corrugated roofing.

(F) Cables and Raceways Installed in Shallow Grooves. Cable- or raceway-type wiring methods installed in a groove, to be covered by wallboard, siding, paneling, carpeting, or similar finish, shall be protected by 1.6 mm (1/16 in.) thick steel plate, sleeve, or equivalent or by not less than 32-mm (1 1/4-in.) free space for the full length of the groove in which the cable or raceway is installed.

Exception No. 1: Steel plates, sleeves, or the equivalent shall not be required to protect rigid metal conduit, intermediate metal conduit, rigid PVC conduit, RTRC, or electrical metallic tubing.

Exception No. 2: A listed and marked steel plate less than 1.6 mm (1/16 in.) thick that provides equal or better protection against nail or screw penetration shall be permitted.

(G) Fittings. Where raceways contain 4 AWG or larger insulated circuit conductors, and these conductors enter a cabinet, a box, an enclosure, or a raceway, prior to the installation of conductors, the conductors shall be protected in accordance with any of the following:

- (1) An identified fitting providing a smoothly rounded insulating surface
- (2) A listed metal fitting that has smoothly rounded edges
- (3) Separation from the fitting or raceway using an identified insulating material that is securely fastened in place
- (4) Threaded hubs or bosses that are an integral part of a cabinet, box, enclosure, or raceway providing a smoothly rounded or flared entry for conductors

Conduit bushings constructed wholly of insulating material shall not be used to secure a fitting or raceway. The insulating fitting or insulating material shall have a temperature rating not less than the insulation temperature rating of the installed conductors.

(H) Structural Joints. A listed expansion/deflection fitting or other approved means shall be used where a raceway crosses a structural joint intended for expansion, contraction, or deflection, used in buildings, bridges, parking garages, or other structures.

300.6 Protection Against Corrosion and Deterioration.

Raceways, cable trays, cablebus, auxiliary gutters, cable armor, boxes, cable sheathing, cabinets, enclosures (other than surrounding fences and walls), elbows, couplings, fittings, supports, and support hardware shall be of materials suitable for the environment in which they are to be installed.

(A) Ferrous Metal Equipment. Ferrous metal raceways, cable trays, cablebus, auxiliary gutters, cable armor, boxes, cable sheathing, cabinets, enclosures (other than surrounding fences and walls), elbows, couplings, nipples, fittings, supports, and support hardware shall be suitably protected against corrosion inside and outside (except threads at joints) by a coating of approved corrosion-resistant material. Where corrosion protection is necessary and the conduit is threaded anywhere other than at the factory where the product is listed, the threads shall be coated with an approved electrically conductive, corrosion-resistant compound.

Exception: Stainless steel shall not be required to have protective coatings.

(1) Protected from Corrosion Solely by Enamel.

Where protected from corrosion solely by enamel, ferrous metal raceways, cable trays, cablebus, auxiliary gutters, cable armor, boxes, cable sheathing, cabinets, enclosures (other than surrounding fences and walls), elbows, couplings, nipples, fittings, supports, and support hardware shall not be used outdoors or in wet locations as described in 300.6(D).

(2) Organic Coatings on Boxes or Cabinets.

Where boxes, cabinets, or enclosures (other than surrounding fences and walls) have an approved system of organic coatings and are marked "Raintight," "Rainproof," or "Outdoor Type," they shall be permitted outdoors.

(3) In Concrete or in Direct Contact with the Earth.

Ferrous metal raceways, cable armor, boxes, cable sheathing, cabinets, enclosures (other than surrounding fences and walls), elbows, couplings, nipples, fittings, supports, and support hardware shall be permitted to be installed in concrete, in direct contact with the earth, or in areas subject to severe corrosive influences where made of material approved for the condition or where provided with corrosion protection approved for the condition.

(B) Aluminum Metal Equipment. Aluminum raceways, cable trays, cablebus, auxiliary gutters, cable armor, boxes, cable sheathing, cabinets, enclosures (other than surrounding fences and walls), elbows, couplings, nipples, fittings, supports, and support hardware embedded or encased in concrete or in direct contact with the earth shall be provided with supplementary corrosion protection.

(C) Nonmetallic Equipment. Nonmetallic raceways, cable trays, cablebus, auxiliary gutters, boxes, cables with a nonmetallic outer jacket and internal metal armor or jacket, cable sheathing, cabinets, enclosures (other than surrounding fences and walls), elbows, couplings, nipples, fittings, supports, and support hardware shall be made of material approved for the condition and shall comply with 300.6(C)(1) and (C)(2) as applicable to the specific installation.

(1) Exposed to Sunlight.

Where exposed to sunlight, the materials shall be listed as sunlight resistant or shall be identified as sunlight resistant.

(2) Chemical Exposure.

Where subject to exposure to chemical solvents, vapors, splashing, or immersion, materials or coatings shall either be inherently resistant to chemicals based on their listing or be identified for the specific chemical reagent.

(D) Indoor Wet Locations. In portions of dairy processing facilities, laundries, canneries, and other indoor wet locations, and in locations where walls are frequently washed or where there are surfaces of absorbent materials, such as damp paper or wood, the entire wiring system, where installed exposed, including all boxes, cabinets, enclosures (other than surrounding fences and walls), fittings, raceways, and cable used therewith, shall be mounted so that there is at least a 6 mm (1/4 in.) airspace between it and the wall or supporting surface.

Exception: Nonmetallic raceways, boxes, and fittings shall be permitted to be installed without the airspace on a concrete, masonry, tile, or similar surface.

Informational Note: In general, areas where acids and alkali chemicals are handled and stored might present such corrosive conditions, particularly when wet or damp. Severe corrosive conditions might also be present in portions of meatpacking plants, tanneries, glue houses, and some stables; in installations immediately adjacent to a seashore and swimming pool areas; in areas where chemical deicers are used; and in storage cellars or rooms for hides, casings, fertilizer, salt, and bulk chemicals.

300.10 Electrical Continuity of Metal Raceways, Cable Armor, and Enclosures.

Metal raceways, cable armor, and other metal enclosures for conductors shall be metallically joined together into a continuous electrical conductor and shall be connected to all boxes, fittings, and cabinets to provide effective electrical continuity. Unless specifically permitted elsewhere in this Code, raceways and cable assemblies shall be mechanically secured to boxes, fittings, cabinets, and other enclosures.

Exception No. 1: Short sections of raceways used to provide support or protection of cable assemblies from physical damage shall not be required to be made electrically continuous.

Exception No. 2: Equipment enclosures to be isolated, as permitted by 250.96(B), shall not be required to be metallically joined to the metal raceway.

300.11 Securing and Supporting.

(A) Secured in Place. Raceways, cable assemblies, boxes, cabinets, and fittings shall be securely fastened in place.

(B) Wiring Systems Installed Above Suspended Ceilings. Support wires that do not provide secure support shall not be the sole support. Support wires and associated fittings that provide secure support and that are installed in addition to the ceiling grid support wires shall be permitted as the sole support. Where independent support wires are used, they shall be secured at both ends. Cables and raceways shall not be supported by ceiling grids.

(1) Fire-Rated Assemblies.

Wiring located within the cavity of a fire-rated floor–ceiling or roof–ceiling assembly shall not be secured to, or supported by, the

ceiling assembly, including the ceiling support wires. An independent means of secure support shall be provided and shall be permitted to be attached to the assembly. Where independent support wires are used, they shall be distinguishable by color, tagging, or other effective means from those that are part of the fire-rated design.

Exception: The ceiling support system shall be permitted to support wiring and equipment that have been tested as part of the fire-rated assembly.

Informational Note: See ASTM E119, Standard Test Methods for Fire Tests of Building Construction and Materials, for one method of testing to determine fire rating.

(2) Non-Fire-Rated Assemblies.

Wiring located within the cavity of a non-fire-rated floor–ceiling or roof–ceiling assembly shall not be secured to, or supported by, the ceiling assembly, including the ceiling support wires. An independent means of secure support shall be provided and shall be permitted to be attached to the assembly. Where independent support wires are used, they shall be distinguishable by color, tagging, or other effective means.

Exception: The ceiling support system shall be permitted to support branch-circuit wiring and associated equipment where installed in accordance with the ceiling system manufacturer's instructions.

(C) Raceways Used as Means of Support. Raceways shall be used only as a means of support for other raceways, cables, or nonelectrical equipment under any of the following conditions:

(1) Where the raceway or means of support is identified as a means of support

(2) Where the raceway contains power supply conductors for electrically controlled equipment and is used to support Class 2 or Class 3 circuit conductors or cables that are solely for the purpose of connection to the equipment control circuits

(3) Where the raceway is used to support boxes or conduit bodies in accordance with 314.23 or to support luminaires in accordance with 410.36(E)

(D) Cables Not Used as Means of Support. Cable wiring methods shall not be used as a means of support for other cables, raceways, or nonelectrical equipment.

300.14 Length of Free Conductors at Outlets, Junctions, and Switch Points.

At least 150 mm (6 in.) of free conductor, measured from the point in the box where it emerges from its raceway or cable sheath, shall be left at each outlet, junction, and switch point for splices or the connection of luminaires or devices. The 150 mm (6 in.) free conductor shall be permitted to be spliced or unspliced. Where the opening to an outlet, junction, or switch point is less than 200 mm (8 in.) in any dimension, each conductor shall be long enough to extend at least 75 mm (3 in.) outside the opening.

Exception: Conductors that are not spliced or terminated at the outlet, junction, or switch point shall not be required to comply with 300.14.

300.15 Boxes, Conduit Bodies, or Fittings — Where Required.

A box shall be installed at each outlet and switch point for concealed knob-and-tube wiring.

Fittings and connectors shall be used only with the specific wiring methods for which they are designed and listed.

Where the wiring method is conduit, tubing, Type AC cable, Type MC cable, Type MI cable, nonmetallic-sheathed cable, or other cables, a box or conduit body shall be installed at each outlet point, switch point, conductor splice point, conductor junction point, conductor termination point, wiring method transition point, or conductor pull point, unless otherwise permitted in 300.15(A) through (L).

(A) Wiring Methods with Interior Access.

A box or conduit body shall not be required for each splice, junction, switch, pull, termination, or outlet points in wiring methods with removable covers, such as

wireways, multioutlet assemblies, auxiliary gutters, and surface raceways. The covers shall be accessible after installation.

(B) Equipment.

An integral junction box or wiring compartment as part of approved equipment shall be permitted in lieu of a box.

(C) Protection.

A box or conduit body shall not be required where cables enter or exit from conduit or tubing that is used to provide cable support or protection against physical damage. A fitting shall be provided on the end(s) of the conduit or tubing to protect the cable from abrasion.

(D) Type MI Cable.

A box or conduit body shall not be required where accessible fittings are used for straight-through splices in mineral-insulated metal-sheathed cable.

(E) Integral Enclosure.

A wiring device with integral enclosure identified for the use, having brackets that securely fasten the device to walls or ceilings of conventional on-site frame construction, for use with nonmetallic-sheathed cable, shall be permitted in lieu of a box or conduit body.

Informational Note: See 334.30(C); 545.10; 550.15(I); 551.47(E), Exception No. 1; and 552.48(E), Exception No. 1.

(F) Fitting.

A fitting identified for the use shall be permitted in lieu of a box or conduit body where conductors are not spliced or terminated within the fitting. The fitting shall be accessible after installation, unless listed for concealed installation.

(G) Direct-Buried Conductors and Cables.

As permitted in 300.5(E), a box or conduit body shall not be required for splices and taps in direct-buried conductors and cables.

(H) Insulated Devices.

As permitted in 334.4(B), a box or conduit body shall not be required for insulated devices supplied by nonmetallic-sheathed cable.

(I) Enclosures.

A box or conduit body shall not be required where a splice, switch, terminal, or pull point is in a cabinet or cutout box, in an enclosure for a switch or overcurrent device as permitted in 312.8, in a motor controller as permitted in 430.10(A), or in a motor control center.

(J) Luminaires.

A box or conduit body shall not be required where a luminaire is used as a raceway as permitted in 410.64.

(K) Embedded.

A box or conduit body shall not be required for splices where conductors are embedded as permitted in 424.40, 424.41(D), 426.22(C), 426.24(A), and 427.19(A).

(L) Manholes and Handhole Enclosures. A box or conduit body shall not be required for conductors in manholes or handhole enclosures, except where connecting to electrical equipment. The installation shall comply with Part V of Article 110 for manholes, and 314.30 for handhole enclosures.

Article 314 Outlet, Device, Pull, and Junction Boxes; Conduit Bodies; Fittings; and Handhole Enclosures

Part I. General

314.1 Scope.

This article covers the installation and use of all boxes and conduit bodies used as outlet, device, junction, or pull boxes, depending on their use, and handhole enclosures. Cast metal, sheet metal, nonmetallic, and other boxes such as FS, FD, and larger boxes are not classified as conduit bodies. This article also includes installation requirements for fittings used to join raceways and to connect raceways and cables to boxes and conduit bodies.

314.2 Round Boxes.

Round boxes shall not be used where conduits or connectors requiring the use of locknuts or bushings are to be connected to the side of the box.

314.3 Nonmetallic Boxes.

Nonmetallic boxes shall be permitted only with open wiring on insulators, concealed knob-and-tube wiring, cabled wiring methods with entirely nonmetallic sheaths, flexible cords, and nonmetallic raceways.

Exception No. 1: Where internal bonding means are provided between all entries, nonmetallic boxes shall be permitted to be used with metal raceways or metal-armored cables.

Exception No. 2: Where integral bonding means with a provision for attaching an equipment bonding jumper inside the box are provided between all threaded entries in nonmetallic boxes listed for the purpose, nonmetallic boxes shall be permitted to be used with metal raceways or metal-armored cables.

314.4 Metal Boxes.

Metal boxes shall be grounded and bonded in accordance with Parts I, IV, V, VI, VII, and X of Article 250 as applicable, except as permitted in 250.112(I).

314.5 Screws or Other Fasteners.

Screws or other fasteners installed in the field that enter wiring spaces shall be as provided by or specified by the manufacturer or shall comply with the following as applicable:

- (1) Screws shall be machine type with blunt ends.
- (2) Other fasteners shall have blunt ends.
- (3) Screws attaching a cover shall extend no more than 10 mm (3/8 in.).
- (4) Screws or other fasteners, other than in (3), penetrating a cover shall extend no more than 8 mm (5/16 in.).
- (5) Screws or other fasteners penetrating a wall of a box exceeding 1650 cm³ (100 in.³) shall extend no more than 6 mm (1/4 in.), or more than 11 mm (7/16 in.) if located within 10 mm (3/8 in.) of an adjacent box wall.
- (6) Screws or other fasteners penetrating the wall of a box not exceeding 1650 cm³ (100 in.³) and not covered in 314.23(B)(1) shall be made flush with the box interior.
- (7) Screws or other fasteners penetrating the wall of a conduit body shall be made flush with the conduit body interior.

Exception to (3) through (6): A screw shall be permitted to be longer if the end of the screw is protected with an approved means.

Part II. Installation

314.15 Damp or Wet Locations.

In damp or wet locations, boxes, conduit bodies, outlet box hoods, and fittings shall be placed or equipped so as to prevent moisture from entering or accumulating within the box, conduit body, or fitting. Boxes, conduit bodies, outlet box hoods, and fittings installed in wet locations shall be listed for use in wet locations. Approved drainage openings not smaller than 3 mm (1/8 in.) and not larger than 6 mm (1/4 in.) in diameter shall be permitted to be installed in the field in boxes or conduit bodies listed for use in damp or wet locations. For installation of listed drain fittings, larger openings are permitted to be installed in the field in accordance with manufacturer's instructions.

Informational Note No. 1: See 314.27(B) for boxes in floors.

Informational Note No. 2: See 300.6 for protection against corrosion.

314.16 Number of Conductors in Outlet, Device, and Junction Boxes, and Conduit Bodies.

Boxes and conduit bodies shall be of an approved size to provide free space for all enclosed conductors. In no case shall the volume of the box, as calculated in 314.16(A), be less than the fill calculation as calculated in 314.16(B). The minimum volume for conduit bodies shall be as calculated in 314.16(C).

This section shall not apply to terminal housings supplied with motors or generators.

Informational Note: See 430.12 for volume requirements of motor or generator terminal housings.



Boxes and conduit bodies enclosing conductors 4 AWG or larger shall also comply with 314.28. Outlet and device boxes shall also comply with 314.24.

(A) Box Volume Calculations.

The volume of a wiring enclosure (box) shall be the total volume of the assembled sections and, where used, the space provided by plaster rings, domed covers, extension rings, and so forth, that are marked with their volume or are made from boxes the dimensions of which are listed in Table 314.16(A).

Where a box is provided with one or more securely installed barriers, the volume shall be apportioned to each of the resulting spaces. Each barrier, if not marked with its volume, shall be considered to take up 8.2 cm³ (1/2 in.³) if metal, and 16.4 cm³ (1.0 in.³) if nonmetallic.

(1) Standard Boxes. The volumes of standard boxes that are not marked with their volume shall be as given in Table 314.16(A).

(2) Other Boxes. Boxes 1650 cm³ (100 in.³) or less, other than those described in Table 314.16(A), and nonmetallic boxes shall be durably and legibly marked by the manufacturer with their volume(s). Boxes described in Table 314.16(A) that have a volume larger than is designated in the table shall be permitted to have their volume marked as required by this section.

Table 314.16(A) Metal Boxes												
Box Trade Size			Minimum Volume		Maximum Number of Conductors*							
					(arranged by AWG size)							
mm	in.		cm ³	in. ³	18	16	14	12	10	8	6	
100 × 32	(4 × 11/4)	round/octagonal	205	12.5	8	7	6	5	5	4	2	
100 × 38	(4 × 11/2)	round/octagonal	254	15.5	10	8	7	6	6	5	3	
100 × 54	(4 × 21/8)	round/octagonal	353	21.5	14	12	10	9	8	7	4	
100 × 32	(4 × 11/4)	square	295	18	12	10	9	8	7	6	3	
100 × 38	(4 × 11/2)	square	344	21	14	12	10	9	8	7	4	
100 × 54	(4 × 21/8)	square	497	30.3	20	17	15	13	12	10	6	
120 × 32	(411/16 × 11/4)	square	418	25.5	17	14	12	11	10	8	5	
120 × 38	(411/16 × 11/2)	square	484	29.5	19	16	14	13	11	9	5	
120 × 54	(411/16 × 21/8)	square	689	42	28	24	21	18	16	14	8	
75 × 50 × 38	(3 × 2 × 11/2)	device	123	7.5	5	4	3	3	3	2	1	
75 × 50 × 50	(3 × 2 × 2)	device	164	10	6	5	5	4	4	3	2	
75 × 50 × 57	(3 × 2 × 21/4)	device	172	10.5	7	6	5	4	4	3	2	
75 × 50 × 65	(3 × 2 × 21/2)	device										

(B) Box Fill Calculations. The volumes in 314.16(B)(1) through (B)(6), as applicable, shall be added together. No allowance shall be required for small fittings such as locknuts and bushings. Each space within a box installed with a barrier shall be calculated separately.

(1) Conductor Fill.

Each conductor that originates outside the box and terminates or is spliced within the box shall be counted once, and each conductor that passes through the box without splice or termination shall be counted once. Each loop or coil of unbroken conductor not less than twice the minimum length required for free conductors in 300.14 shall be counted twice. The conductor fill shall be calculated using Table 314.16(B)(1). A conductor, no part of which leaves the box, shall not be counted.

Exception: An equipment grounding conductor or conductors or not over four fixture wires smaller than 14 AWG, or both, shall be permitted to be omitted from the calculations where they enter a box from a domed luminaire or similar canopy and terminate within that box.

(2) Clamp Fill.

Where one or more internal cable clamps, whether factory or field supplied, are present in the box, a single volume allowance in accordance with Table 314.16(B)(1) shall be made based on the largest conductor present in the box. No allowance shall be required for a cable connector with its clamping mechanism outside the box.

(3) Support Fittings Fill.

Where one or more luminaire studs or hickies are present in the box, a single volume allowance in accordance with Table 314.16(B)(1) shall be made for each type of fitting based on the largest conductor present in the box.

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(4) Device or Equipment Fill.

For each yoke or strap containing one or more devices or equipment, a double volume allowance in accordance with Table 314.16(B)(1) shall be made for each yoke or strap based on the largest conductor connected to a device(s) or equipment supported by that yoke or strap.

A device or utilization equipment wider than a single 50 mm (2 in.) device box as described in Table 314.16(A) shall have double volume allowances provided for each gang required for mounting.

Table 314.16(B)(1) Volume Allowance Required per Conductor		
Size of Conductor or (AWG)	Free Space Within Box for Each Conductor	
	cm ³	in. ³
18	24.6	1.5
16	28.7	1.75
14	32.8	2
12	36.9	2.25
10	41	2.5
8	49.2	3
6	81.9	5

(5) Equipment Grounding Conductor Fill.

Where up to four equipment grounding conductors enter a box, a single volume allowance in accordance with Table 314.16(B)(1) shall be made based on the largest equipment grounding conductor entering the box. A 1/4 volume allowance shall be made for each additional equipment grounding conductor that enters the box, based on the largest equipment grounding conductor entering the box.

(6) Terminal Block Fill.

Where a terminal block is present in a box, a single volume allowance in accordance with Table 314.16(B)(1) shall be made for each terminal block assembly based on the largest conductor(s) terminated to the assembly.

(C) CONDUIT BODIES

(1) General.

Conduit bodies enclosing 6 AWG conductors or smaller, other than short-radius conduit bodies as described in 314.16(C)(3), shall have a cross-sectional area not less than twice the cross-sectional area of the largest conduit or tubing to which they can be attached. The maximum number of conductors permitted shall be the maximum number permitted by Table 1 of Chapter 9 for the conduit or tubing to which it is attached.

(2) With Splices, Taps, or Devices.

Only those conduit bodies that are durably and legibly marked by the manufacturer with their volume shall be permitted to contain splices, taps, or devices. The maximum number of conductors shall be calculated in accordance with 314.16(B). Conduit bodies shall be supported in a rigid and secure manner.

(3) Short Radius Conduit Bodies.

Conduit bodies such as capped elbows and service-entrance elbows that enclose conductors 6 AWG or smaller, and are only intended to enable the installation of the raceway and the contained conductors, shall not contain splices, taps, or devices and shall be of an approved size to provide free space for all conductors enclosed in the conduit body.

314.17 Conductors and Cables Entering Boxes, Conduit Bodies, or Fittings.

Conductors entering boxes, conduit bodies, or fittings shall be protected from abrasion. Conductors and cables shall comply with 314.17(A) through (C).

(A) Openings to Be Closed. Openings through which conductors enter shall be closed in an approved manner.

(B) Boxes and Conduit Bodies. The installation of the conductors and cables in boxes and conduit bodies shall comply with 314.17(B)(1) through (B)(4).

(1) Conductors Entering Through Individual Holes or Through Flexible Tubing.

For messenger-supported wiring, open wiring on insulators, or concealed knob-and-tube wiring, the conductors shall enter the box through individual holes. In installations where metal boxes or conduit bodies are used with conductors unprotected by flexible tubing, the individual openings shall be provided with insulating bushings. Where flexible tubing is used to enclose the conductors, the tubing shall extend from the last insulating support to not less than 6 mm (1/4 in.) inside the box or conduit body and 6 mm (1/4 in.) beyond the end of any cable clamp. The wiring method shall be secured to the box or conduit body.

(2) Cables Entering Through Cable Clamps.

Where cable assemblies with nonmetallic sheaths are used, the sheath shall extend not less than 6 mm (1/4 in.) inside the box and 6 mm (1/4 in.) beyond the end of any cable clamp. Except as covered in 300.15(C), the wiring method shall be secured to the box or conduit body.

Exception: Where nonmetallic-sheathed cable is used with single gang nonmetallic boxes not larger than a nominal size 57 mm x 100 mm (2 1/4 in. x 4 in.) mounted in walls or ceilings, and where the cable is fastened within 200 mm (8 in.) of the box measured along the sheath and where the sheath extends through a cable knockout not less than 6 mm (1/4 in.), securing the cable to the box shall not be required. Multiple cable entries shall be permitted in a single cable knockout opening.

(3) Conductors and Cables Entering Through Raceways.

Where the raceway is complete between boxes, conduit bodies, or both and encloses individual conductors or nonmetallic cable assemblies or both, the conductors or cable assemblies shall not be required to be additionally secured. Where raceways enclose cable assemblies as covered in 300.15(C), the cable assembly shall not be required to be additionally secured within the box or conduit body.

(4) Temperature Limitation.

Nonmetallic boxes and conduit bodies shall be suitable for the lowest temperature-rated conductor entering the box or conduit body.

(C) Conductors 4 AWG or Larger. Installation shall comply with 300.4(G).

Informational Note: See 110.12(A) for requirements on closing unused cable and raceway knockout openings.

314.19 Boxes Enclosing Flush Devices or Flush Equipment.

Boxes used to enclose flush devices or flush equipment shall be of such design that the devices or equipment will be completely enclosed on the back and sides, and substantial support for the devices or equipment will be provided. Screws for supporting the box shall not also be used to attach a device or equipment.

314.20 Flush-Mounted Installations.

Installations within or behind a surface of concrete, tile, gypsum, plaster, or other noncombustible material, including boxes employing a flush-type cover or faceplate, shall be made so that the front edge of the box, plaster ring, extension ring, or listed extender will not be set back of the finished surface more than 6 mm (1/4 in.).

Installations within a surface of wood or other combustible surface material, boxes, plaster rings, extension rings, or listed extenders shall extend to the finished surface or project therefrom.

314.21 Repairing Noncombustible Surfaces.

Noncombustible surfaces that are broken or incomplete around boxes employing a flush-type cover or faceplate shall be repaired so there will be no gaps or open spaces greater than 3 mm (1/8 in.) at the edge of the box.

314.22 Surface Extensions.

Surface extensions shall be made by mounting and mechanically securing an extension ring over the box. Equipment grounding shall be in accordance with Part VI of Article 250.

Exception: A surface extension shall be permitted to be made from the cover of a box where the cover is designed so it is unlikely to fall off or be removed if its securing means becomes loose. The wiring method shall be flexible for an approved length that permits removal of the cover and provides access to the box interior and shall be arranged so that any grounding continuity is independent of the connection between the box and cover.

314.23 Supports.

Enclosures within the scope of this article shall be supported in accordance with 314.23(A) through (H) as applicable.

(A) Surface Mounting.

An enclosure mounted on a building or other surface shall be rigidly and securely fastened in place. If the surface does not provide rigid and secure support, additional support in accordance with this section shall be provided.

(B) Structural Mounting.

An enclosure supported from a structural member or from grade shall be rigidly supported either directly or by using a metal, polymeric, or wood brace.

(1) Nails and Screws.

Nails and screws, where used as a fastening means, shall secure boxes by using brackets on the outside of the enclosure, or by using mounting holes in the back or in one or more sides of the enclosure, or they shall pass through the interior within 6 mm (1/4 in.) of the back or ends of the enclosure. Screws shall not be permitted to pass through the box unless exposed threads in the box are protected using approved means to avoid abrasion of conductor insulation. Mounting holes made in the field shall be approved.

(2) Braces.

Metal braces shall be protected against corrosion and formed from metal that is not less than 0.51 mm (0.020 in.) thick uncoated. Wood braces shall have a cross section not less than nominal 25 mm × 50 mm (1 in. × 2 in.). Wood braces in wet locations shall be treated for the conditions. Polymeric braces shall be identified as being suitable for the use.

(C) Mounting in Finished Surfaces.

An enclosure mounted in a finished surface shall be rigidly secured thereto by clamps, anchors, or fittings identified for the application.

(D) Suspended Ceilings.

An enclosure mounted to structural or supporting elements of a suspended ceiling shall be not more than 1650 cm³ (100 in.³) in size and shall be securely fastened in place in accordance with either 314.23(D)(1) or (D)(2).

(1) Framing Members.

An enclosure shall be fastened to the framing members by mechanical means such as bolts, screws, or rivets, or by the use of clips or other securing means identified for use with the type of ceiling framing member(s) and enclosure(s) employed. The framing members shall be supported in an approved manner and securely fastened to each other and to the building structure.

(2) Support Wires.

The installation shall comply with 300.11(B). The enclosure shall be secured, using identified methods, to ceiling support wire(s), including any additional support wire(s) installed for ceiling support. Support wire(s) used for enclosure support shall be fastened at each end so as to be taut within the ceiling cavity.

(E) Raceway-Supported Enclosure, Without Devices, Luminaires, or Lampholders.

An enclosure that does not contain a device(s), other than splicing devices, or supports a luminaire(s), a lampholder, or other equipment and is supported by entering raceways shall not exceed 1650 cm³ (100 in.³) in size. It shall have threaded entries or identified hubs. It shall be supported by two or more conduits threaded wrenchtight into the enclosure or hubs. Each conduit shall be secured within 900 mm (3 ft) of the enclosure, or within 450 mm (18 in.) of the enclosure if all conduit entries are on the same side.

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Exception: The following wiring methods shall be permitted to support a conduit body of any size, including a conduit body constructed with only one conduit entry, provided that the trade size of the conduit body is not larger than the largest trade size of the conduit or tubing:

- (1) Intermediate metal conduit, IMC
- (2) Rigid metal conduit, RMC
- (3) Rigid polyvinyl chloride conduit, PVC
- (4) Reinforced thermosetting resin conduit, RTRC
- (5) Electrical metallic tubing, EMT

(F) Raceway-Supported Enclosures, with Devices, Luminaires, or Lampholders.

An enclosure that contains a device(s), other than splicing devices, or supports a luminaire(s), a lampholder, or other equipment and is supported by entering raceways shall not exceed 1650 cm³ (100 in.³) in size. It shall have threaded entries or identified hubs. It shall be supported by two or more conduits threaded wrenchtight into the enclosure or hubs. Each conduit shall be secured within 450 mm (18 in.) of the enclosure.

Exception No. 1: Rigid metal or intermediate metal conduit shall be permitted to support a conduit body of any size, including a conduit body constructed with only one conduit entry, provided the trade size of the conduit body is not larger than the largest trade size of the conduit.

Exception No. 2: An unbroken length(s) of rigid or intermediate metal conduit shall be permitted to support a box used for luminaire or lampholder support, or to support a wiring enclosure that is an integral part of a luminaire and used in lieu of a box in accordance with 300.15(B), where all of the following conditions are met:

- (1) The conduit is securely fastened at a point so that the length of conduit beyond the last point of conduit support does not exceed 900 mm (3 ft).
- (2) The unbroken conduit length before the last point of conduit support is 300 mm (12 in.) or greater, and that portion of the conduit is securely fastened at some point not less than 300 mm (12 in.) from its last point of support.
- (3) Where accessible to unqualified persons, the luminaire or lampholder, measured to its lowest point, is at least 2.5 m (8 ft) above grade or standing area and at least 900 mm (3 ft) measured horizontally to the 2.5 m (8 ft) elevation from windows, doors, porches, fire escapes, or similar locations.
- (4) A luminaire supported by a single conduit does not exceed 300 mm (12 in.) in any direction from the point of conduit entry.
- (5) The weight supported by any single conduit does not exceed 9 kg (20 lb).
- (6) At the luminaire or lampholder end, the conduit(s) is threaded wrenchtight into the box, conduit body, integral wiring enclosure, or identified hubs. Where a box or conduit body is used for support, the luminaire shall be secured directly to the box or conduit body, or through a threaded conduit nipple not over 75 mm (3 in.) long.

(G) Enclosures in Concrete or Masonry.

An enclosure supported by embedment shall be identified as suitably protected from corrosion and securely embedded in concrete or masonry.

(H) Pendant Boxes.

An enclosure supported by a pendant shall comply with 314.23(H)(1) or (H)(2).

(1) Flexible Cord.

A box shall be supported from a multiconductor cord or cable in an approved manner that protects the conductors against strain. A connection to a box equipped with a hub shall be made with a listed cord grip attachment fitting marked for use with a threaded hub.

(2) Conduit.

A box supporting lampholders or luminaires, or wiring enclosures within luminaires used in lieu of boxes in accordance with 300.15(B), shall be supported by rigid or intermediate

metal conduit stems. For stems longer than 450 mm (18 in.), the stems shall be connected to the wiring system with listed swivel hangers suitable for the location. At the luminaire end, the conduit(s) shall be threaded wrenchtight into the box, wiring enclosure, or identified hubs.

Where supported by only a single conduit, the threaded joints shall be prevented from loosening by the use of set-screws or other effective means, or the luminaire, at any point, shall be at least 2.5 m (8 ft) above grade or standing area and at least 900 mm (3 ft) measured horizontally to the 2.5 m (8 ft) elevation from windows, doors, porches, fire escapes, or similar locations. A luminaire supported by a single conduit shall not exceed 300 mm (12 in.) in any horizontal direction from the point of conduit entry.

314.27 Outlet Boxes.

(A) Boxes at Luminaire or Lampholder Outlets.

Outlet boxes or fittings designed for the support of luminaires and lampholders, and installed as required by 314.23, shall be permitted to support a luminaire or lampholder.

(1) Vertical Surface Outlets.

Boxes used at luminaire or lampholder outlets in or on a vertical surface shall be identified and marked on the interior of the box to indicate the maximum weight of the luminaire that is permitted to be supported by the box if other than 23 kg (50 lb).

Exception: A vertically mounted luminaire or lampholder weighing not more than 3 kg (6 lb) shall be permitted to be supported on other boxes or plaster rings that are secured to other boxes, provided that the luminaire or its supporting yoke, or the lampholder, is secured to the box with no fewer than two No. 6 or larger screws.

(2) Ceiling Outlets.

At every outlet used exclusively for lighting, the box shall be designed or installed so that a luminaire or lampholder can be attached. Boxes shall be required to support a luminaire weighing a minimum of 23 kg (50 lb). A luminaire that weighs more than 23 kg (50 lb) shall be supported independently of the outlet box, unless the outlet box is listed for not less than the weight to be supported. The interior of the box shall be marked by the manufacturer to indicate the maximum weight the box shall be permitted to support.

(B) Floor Boxes.

Boxes listed specifically for this application shall be used for receptacles located in the floor.

Exception: Where the authority having jurisdiction judges them free from likely exposure to physical damage, moisture, and dirt, boxes located in elevated floors of show windows and similar locations shall be permitted to be other than those listed for floor applications. Receptacles and covers shall be listed as an assembly for this type of location.

(C) Boxes at Ceiling-Suspended (Paddle) Fan Outlets.

Outlet boxes or outlet box systems used as the sole support of a ceiling-suspended (paddle) fan shall be listed, shall be marked by their manufacturer on the interior of the box as suitable for this purpose, and shall not support ceiling-suspended (paddle) fans that weigh more than 32 kg (70 lb). For outlet boxes or outlet box systems designed to support ceiling-suspended (paddle) fans that weigh more than 16 kg (35 lb), the required marking shall include the maximum weight to be supported.

Outlet boxes mounted in the ceilings of habitable rooms of dwelling occupancies in a location acceptable for the installation of a ceiling-suspended (paddle) fan shall comply with one of the following:

- (1) Listed for the sole support of ceiling-suspended (paddle) fans
- (2) Installed so as to allow direct access through the box to structural framing capable of supporting a ceiling-suspended (paddle) fan without removing the box

(D) Utilization Equipment. Boxes used for the support of utilization equipment other than ceiling-suspended (paddle) fans shall meet the requirements of 314.27(A) for the support of a luminaire that is the same size and weight.

Exception: Utilization equipment weighing not more than 3 kg (6 lb) shall be permitted to be supported on other boxes or plaster rings that are secured to other boxes, provided the equipment or its supporting yoke is secured to the box with no fewer than two No. 6 or larger screws. (E) Weight-Supporting Ceiling Receptacles (WSCR) and Weight-Supporting Attachment Fittings (WSAF).

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(E) Weight-Supporting Ceiling Receptacles (WSCR) and Weight-Supporting Attachment Fittings (WSAF).

Outlet boxes required in 314.27 shall be permitted to support listed weight-supporting ceiling receptacles (WSCR). A WSCR shall be used in combination with compatible weight-supporting attachment fittings (WSAF) that are identified for the support of equipment within the weight and mounting orientation limits of the listing. Where the WSCR is installed, it shall be included in the box fill calculation covered in 314.16(B)(4).

Listed WSCR used in combination with compatible WSAF shall be permitted to be installed in outlet boxes for the sole support of ceiling-suspended (paddle) fans, in accordance with 314.27(C).

Informational Note: See ANSI/NEMA WD-6, American National Standard for Wiring Devices—Dimensional Specifications, for standard configurations of weight-supporting ceiling receptacles and weight-supporting attachment fittings.

314.28 Pull and Junction Boxes and Conduit Bodies.

Boxes and conduit bodies used as pull or junction boxes shall comply with 314.28(A) through (E).

Exception: Terminal housings supplied with motors shall comply with the provisions of 430.12.

(A) Minimum Size. For raceways containing conductors of 4 AWG or larger that are required to be insulated, and for cables containing conductors of 4 AWG or larger, the minimum dimensions of pull or junction boxes installed in a raceway or cable run shall comply with 314.28(A)(1) through (A)(3). Where an enclosure dimension is to be calculated based on the diameter of entering raceways, the diameter shall be the metric designator (trade size) expressed in the units of measurement employed.

(1) Straight Pulls.

In straight pulls, the length of the box or conduit body shall not be less than eight times the metric designator (trade size) of the largest raceway.

(2) Angle or U Pulls, or Splices.

Where splices or where angle or U pulls are made, the distance between each raceway entry inside the box or conduit body and the opposite wall of the box or conduit body shall not be less than six times the metric designator (trade size) of the largest raceway in a row. This distance shall be increased for additional entries by the amount of the sum of the diameters of all other raceway entries in the same row on the same wall of the box. Each row shall be calculated individually, and the single row that provides the maximum distance shall be used.

Exception: Where a raceway or cable entry is in the wall of a box or conduit body opposite a removable cover, the distance from that wall to the cover shall be permitted to comply with the distance required for one wire per terminal in Table 312.6(A).

The distance between raceway entries enclosing the same conductor shall not be less than six times the metric designator (trade size) of the larger raceway.

When transposing cable size into raceway size in 314.28(A)(1) and (A)(2), the minimum metric designator (trade size) raceway required for the number and size of conductors in the cable shall be used.

(3) Smaller Dimensions.

Listed boxes or listed conduit bodies of dimensions less than those required in 314.28(A)(1) and (A)(2) shall be permitted for installations of combinations of conductors that are less than the maximum conduit or tubing fill (of conduits or tubing being used) permitted by Table 1 of Chapter 9.

Listed conduit bodies of dimensions less than those required in 314.28(A)(2), and having a radius of the curve to the centerline not less than that indicated in Table 2 of Chapter 9 for one-shot and full-shoe benders, shall be permitted for installations of combinations of conductors permitted by Table 1 of Chapter 9. These conduit bodies shall be marked to show they have been specifically evaluated in accordance with this provision.

Where the permitted combinations of conductors for which the box or conduit body has been listed are less than the maximum conduit or tubing fill permitted by Table 1 of Chapter 9, the box or conduit body shall

be permanently marked with the maximum number and maximum size of conductors permitted. For other conductor sizes and combinations, the total cross-sectional area of the fill shall not exceed the cross-sectional area of the conductors specified in the marking, based on the type of conductor identified as part of the product listing.

Informational Note: Unless otherwise specified, the applicable product standards evaluate the fill markings covered here based on conductors with Type XHHW insulation.

(B) Conductors in Pull or Junction Boxes. In pull boxes or junction boxes having any dimension over 1.8 m (6 ft), all conductors shall be cabled or racked up in an approved manner.

(C) Covers. All pull boxes, junction boxes, and conduit bodies shall be provided with covers compatible with the box or conduit body construction and suitable for the conditions of use. Where used, metal covers shall comply with the grounding requirements of 250.110.

314.29 Boxes, Conduit Bodies, and Handhole Enclosures to Be Accessible.

Boxes, conduit bodies, and handhole enclosures shall be installed so that wiring and devices contained in the boxes, conduit bodies, or handhole enclosures can be rendered accessible in accordance with 314.29(A) and (B).

(A) In Buildings and Other Structures.

Boxes and conduit bodies shall be installed so the contained wiring and devices are accessible.

(B) Underground.

Underground boxes and handhole enclosures shall be installed so they are accessible without excavating sidewalks, paving, earth, or other substance that is to be used to establish the finished grade.

Exception: Listed boxes and handhole enclosures shall be permitted where covered by gravel, light aggregate, or noncohesive granulated soil if their location is effectively described and accessible for excavation. The location description shall be available to those authorized to access, maintain, or inspect the wiring.

406.9 Receptacles in Damp or Wet Locations.

(A) Damp Locations. A receptacle installed outdoors in a location protected from the weather or in other damp locations shall have an enclosure for the receptacle that is weatherproof when the receptacle is covered (attachment plug cap not inserted and receptacle covers closed).

An installation suitable for wet locations shall also be considered suitable for damp locations.

A receptacle shall be considered to be in a location protected from the weather where located under roofed open porches, canopies, marquees, and the like, and will not be subjected to a beating rain or water runoff. All 125- and 250-volt nonlocking receptacles shall be a listed weather-resistant type. Hinged covers of outlet box hoods shall be able to open at least 90 degrees, or fully open if the cover is not designed to open 90 degrees from the closed to open position, after installation.

Informational Note: See ANSI/NEMA WD 6–2016, *Wiring Devices — Dimensional Specifications*, for the types of receptacles covered by this requirement.

(B) Wet Locations.

(1) Receptacles of 15 Amperes and 20 Amperes in a Wet Location. Receptacles of 15 amperes and 20 amperes, 125 volts and 250 volts installed in a wet location shall have an enclosure that is weatherproof whether or not the attachment plug cap is inserted. An outlet box hood installed for this purpose shall be listed and shall be identified as extra-duty. Other listed products, enclosures, or assemblies providing weatherproof protection that do not utilize an outlet box hood need not be identified extra duty. Hinged covers of outlet box hoods shall be able to open at least 90 degrees, or fully open if the cover is not designed to open 90 degrees from the closed to open position, after installation.

Informational Note No. 1: See ANSI/UL 514D–2016, *Cover Plates for Flush-Mounted Wiring Devices*, for extra-duty outlet box hoods. Extra duty identification and requirements are not applicable to listed receptacles, faceplates, outlet boxes, enclosures, or assemblies that are identified as either being suitable for wet locations or rated as one of the outdoor enclosure-type numbers of Table 110.28 that does not utilize an outlet box hood.

Exception: 15- and 20-ampere, 125- through 250-volt receptacles installed in a wet location and subject to routine high-pressure spray washing shall be permitted to have an enclosure that is weatherproof when the attachment plug is removed.

All 15- and 20-ampere, 125- and 250-volt nonlocking-type receptacles shall be listed and so identified as the weather-resistant type.

Informational Note No. 2: See ANSI/NEMA WD 6–2016, *Wiring Devices — Dimensional Specifications*, for receptacle configurations. The configuration of weather-resistant receptacles covered by this requirement are identified as 5-15, 5-20, 6-15, and 6-20.

(2) Other Receptacles.

All other receptacles installed in a wet location shall be listed weather-

-resistant type, and installation shall comply with 406.9(B)(2)(a) or (B)(2)(b).

(a) A receptacle installed in a wet location where the product intended to be plugged into it is not attended while in use shall have an enclosure that is weatherproof with the attachment plug cap inserted or removed.

(b) A receptacle installed in a wet location where the product intended to be plugged into it will be attended while in use (e.g., portable tools) shall have an enclosure that is weatherproof when the attachment plug is removed.

(C) Bathtub and Shower Space. Receptacles shall not be installed inside of the tub or shower or within a zone measured 900 mm (3 ft) horizontally from any outside edge of the bathtub or shower stall, including the space outside the bathtub or shower stall space below the zone.

The zone also includes the space measured vertically from the floor to 2.5 m (8 ft) above the top of the bathtub rim or shower stall threshold. The identified zone is all-encompassing and shall include the space directly over the bathtub or shower stall and the space below this zone, but not the space separated by a floor, wall, ceiling, room door, window, or fixed barrier.

Exception No. 1: Receptacles installed in accordance with 680.73 shall be permitted.

Exception No. 2: In bathrooms with less than the required zone, the receptacle(s) required by 210.52(D) shall be permitted to be installed opposite the bathtub rim or shower stall threshold on the farthest wall within the room.

Exception No. 3: Weight supporting ceiling receptacles (WSCR) shall be permitted to be installed for listed luminaires that employ a weight supporting attachment fitting (WSAF) in damp locations complying with 410.10(D).

Exception No. 4: In a dwelling unit, a single receptacle shall be permitted for an electronic toilet or personal hygiene device such as an electronic bidet seat. The receptacle shall be readily accessible and not located in the space between the toilet and the bathtub or shower.

Informational Note No. 1: See 210.8(A)(1) for GFCI requirements in a bathroom.

Informational Note No. 2: See 210.11(C) for bathroom branch circuits.

Informational Note No. 3: See 210.21(B)(1) for single receptacle on an individual branch.

406.12 Tamper-Resistant Receptacles.

All 15- and 20-ampere, 125- and 250-volt nonlocking-type receptacles in the following locations shall be listed tamper-resistant receptacles:

- (1) All dwelling units, boathouses, mobile homes and manufactured homes, including their attached and detached garages, accessory buildings, and common areas
- (2) Guest rooms and guest suites of hotels, motels, and their common areas
- (3) Child care facilities
- (4) Preschools and education facilities
- (5) Within clinics, medical and dental offices, and outpatient facilities, the following spaces:
 - a. Business offices accessible to the general public
 - b. Lobbies, and waiting spaces

c. Spaces of nursing homes and limited care facilities covered in 517.10(B)(2)

- (6) Places of awaiting transportation, gymnasiums, skating rinks, fitness centers, and auditoriums
- (7) Dormitory units
- (8) Residential care/assisted living facilities, social and substance abuse rehabilitation facilities, and group homes
- (9) Foster care facilities, nursing homes, and psychiatric hospitals
- (10) Areas of agricultural buildings accessible to the general public and any common areas

Informational Note No. 1: See ANSI/NEMA WD 6-2016, Wiring Devices — Dimensional Specifications. This requirement would include receptacles identified as 5-15, 5-20, 6-15, and 6-20.

Informational Note No. 2: See NFPA 5000-2021, Building Construction and Safety Code, and the International Building Code (IBC)-2021 for more information on occupancy classifications for the types of facilities covered by this requirement.

Informational Note No. 3: Areas of agricultural building are frequently converted to hospitality areas. These areas can include petting zoos, stables, and buildings used for recreation or educational purposes where receptacles are installed.

Exception to (1) through (10):

Receptacles in the following locations shall not be required to be tamper resistant:

- (1) Receptacles located more than 1.7 m (5 1/2 ft) above the floor
- (2) Receptacles that are part of a luminaire or appliance
- (3) Where the receptacle outlet is installed within the space occupied by or designated for each appliance that, in normal use, is not easily moved from one place to another and is cord-and-plug-connected in accordance with 400.10(A)(6), (A)(7), or (A)(8) the following are permitted:
 - a. A single receptacle that is not readily accessible and supplies one appliance
 - b. A duplex receptacle that is not readily accessible and supplies two appliances
- (4) Nongrounding receptacles used for replacements as permitted in 406.4(D)(2)(a)

410.36 Means of Support.

(A) Luminaires Supported By Outlet Boxes. Luminaires shall be permitted to be supported by outlet boxes or fittings installed as required by 314.23. The installation shall comply with the following requirements:

- (1) The outlet boxes or fittings shall comply with 314.27(A)(1) and 314.27(A)(2).
- (2) Luminaires shall be permitted to be supported in accordance with 314.27(E).
- (3) Outlet boxes complying with 314.27(E) shall be considered lighting outlets as required by 210.70(A), (B), and (C).

(B) Suspended Ceilings. Framing members of suspended ceiling systems used to support luminaires shall be securely fastened to each other and shall be securely attached to the building structure at appropriate intervals. Luminaires shall be securely fastened to the ceiling framing member by mechanical means such as bolts, screws, or rivets. Listed clips identified for use with the type of ceiling framing member(s) and luminaire(s) shall also be permitted.

(C) Luminaire Studs. Luminaire studs that are not a part of outlet boxes, hickies, tripods, and crowfeet shall be made of steel, malleable iron, or other material suitable for the application.

680.52 Junction Boxes and Other Enclosures.

(A) General. Junction boxes and other enclosures used for other than underwater installation shall comply with 680.24.

(B) Underwater Junction Boxes and Other Underwater Enclosures. Junction boxes and other underwater enclosures shall meet the requirements of 680.52(B)(1) and (B)(2).

(1) Construction.

(a) Underwater enclosures shall be equipped with provisions for threaded conduit entries or compression glands or seals for cord entry.

(b) Underwater enclosures shall be listed and rated for prolonged submersion and made of copper, brass, or other corrosion-resistant material.

(2) Installation.

Underwater enclosure installations shall comply with 680.52(B)(2)(a) and (B)(2)(b).

(a) Underwater enclosures shall be filled with a listed potting compound to prevent the entry of moisture.

(b) Underwater enclosures shall be firmly attached to the supports or directly to the fountain surface and bonded as required. Where the junction box is supported only by conduits in accordance with 314.23(E) and (F), the conduits shall be of copper, brass, stainless steel, or other corrosion-resistant metal. Where the box is fed by nonmetallic conduit, it shall have additional supports and fasteners of copper, brass, or other corrosion-resistant material.