

NECA 130



Standard for Installing and Maintaining Wiring Devices

**Industry Review Draft
(Date TBD)**

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(This foreword is not a part of the standard)

Foreword

National Electrical Installation Standards[™] are designed to improve communication among specifiers, purchasers, and suppliers of electrical construction services. They define a minimum baseline of quality and workmanship for installing electrical products and systems. *NEIS*[®] are intended to be referenced in contract documents for electrical construction projects. The following language is recommended:

Wiring devices should be installed and maintained in accordance with NECA 130-2xxx, *Standard for Installing and Maintaining Wiring Devices* (ANSI).

Use of *NEIS* is voluntary, and the National Electrical Contractors Association assumes no obligation or liability to users of this publication. Existence of a standard shall not preclude any member or non-member of NECA from specifying or using alternate construction methods permitted by applicable regulations.

This publication is intended to comply with the National Electrical Code (NEC). Because they are quality standards, *NEIS* may in some instances go beyond the minimum safety requirements of the NEC. It is the responsibility of users of this publication to comply with state and local electrical codes when installing electrical products and systems.

Suggestions for revisions and improvements to this standard are welcome. They should be addressed to:

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1. Scope

This standard describes the installation and maintenance procedures for wiring devices.

1.1 Products and Applications Included

This standard covers the installation and maintenance of low-voltage wiring devices permanently installed on building premises wiring systems for residential, commercial, and industrial applications in non-classified locations. It applies to:

- a) Wiring devices rated 600V and less
- b) Receptacles
- c) Switches
- d) Timers
- e) Combination devices
- f) Coverplates
- g) Attachment plugs and plug connectors
- h) Occupancy sensors
- i) Dimmers
- j) Pin and sleeve connectors and receptacles
- k) Multi-outlet assemblies

1.2 Products and Applications Excluded

This standard does not cover wiring devices that are installed in hazardous locations or are temporary installations. It does not apply to:

- a) Arc-Fault Circuit Interrupters (AFCIs) and Ground-Fault Circuit Interrupters (GFCIs) – See NECA 169
- b) Floor service outlets
- c) Floor poke-through assemblies

1.3 Regulatory and Other Requirements

- a) All information in this publication is intended to conform to the National Electrical Code® (ANSI/NFPA Standard 70). Installers should always follow the NEC®, applicable state and local codes, and manufacturer's instructions when installing and maintaining wiring devices.
- b) Only qualified persons familiar with the construction and operation of wiring devices should perform the work described in this publication. All work should be performed in accordance with NFPA 70E, *Standard for Electrical Safety in the Workplace*.
- c) General requirements for installing electrical products and systems are described in NECA 1-2006, *Standard Practices for Good workmanship in Electrical Construction* (ANSI). Other *National Electrical Installation Standards* provide additional guidance for

installing particular types of electrical products and systems. A complete list of *NEIS* is provided in Annex B.

2. Definitions

Attachment Plug (Plug Cap). A device that, by insertion in a receptacle, establishes a connection between the conductors of the attached flexible cord and the conductors connected permanently to the receptacle.

Concealed. Rendered inaccessible by the structure or finish of the building. Wires in concealed raceways are considered concealed, even though they may become accessible by withdrawing them.

Device. A unit of an electrical system that carries or controls electric energy as its principal function.

Exposed (as applied to wiring methods). On or attached to the surface or behind panels designed to allow access.

Isolated Ground Receptacle. Receptacle outlet with the equipment ground contact and terminal electrically isolated from the receptacle mounting strap.

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

Multioutlet Assembly. A type of surface, flush, or freestanding raceway designed to hold conductors and receptacles, assembled in the field or at the factory.

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

Pigtail: Short lead used to connect a device to a branch-circuit conductor.

Receptacle. A receptacle is a contact device installed at the outlet for the connection of an attachment plug. 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.

Surge Protective Device (Receptacle). A protective device for limiting transient voltages by diverting or limiting surge current; it also prevents continued flow of current while remaining capable of repeating these functions.

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 recognized wiring methods.

Switch, Motor-Circuit. A switch rated in horsepower that is capable of interrupting the maximum operating overload current of a motor of the same horsepower rating as the switch at the rated voltage.

Tamper Resistant Receptacle. A personal protection device that inhibits the ability to insert foreign objects into the device. Primarily installed in residential and childcare facilities.

3. Receiving, Inspecting, Handling and Storage

3.1 Receiving and Inspecting

- A. Deliver wiring devices individually wrapped in factory-fabricated containers in unopened cartons or bundles as appropriate, clearly identified with manufacturer's name, Underwriter's or other approved label, and grade or identifying number.
- B. Visually inspect packaging upon delivery. Carefully unpack materials to inspect for concealed damage resulting from shipping and handling. If damage has occurred, notify the delivering carrier and the manufacturer in writing immediately, and note the condition of the shipment on all copies of the delivery receipt. Request a carrier inspection, and file a claim with the carrier.
- C. Compare components and accessories received with the bill of materials to verify that the shipment is complete. If the shipment is not complete, notify the manufacturer in writing immediately. Verify that equipment and accessories received conform to approved submittals and manufacturer quotations.
- D. If components and accessories are to be stored prior to installation, reuse the original packing materials. Leave the packing materials intact until wiring devices are ready for installation, when possible.

3.2 Handling

- A. Wiring devices and accessories are typically small components. Handle in accordance with manufacturer recommendations in order to avoid damage to components and accessories.
- B. Verify that the lifting capacity of the handling equipment when handling palletized shipments.
- C. Handle wiring devices carefully to avoid damage. Avoid dropping, impact, jolting,

jarring, rough handling, etc.

3.3 Storage

- A. Store wiring devices and accessories in a clean, warm, dry, well-ventilated room with a moderate temperature ranging between 40°F and 100°F.
- B. Provide suitable protection until final assembly is complete. Protect from weather, rain, snow, dirt, corrosive gases or fumes, dust, foreign objects, and rodents. Moisture in combination with cement dust is very corrosive to electrical and electronic equipment.
- C. Store components and accessories in a monitored area to discourage vandalism and theft, and out of the way of construction traffic.

4 Rough-In

4.1 General

- A. Determine the types of finish surfaces and construction materials used on the project. Verify that wiring methods, device and outlet boxes and supports are suitable for wiring devices, the type of construction and occupancy.
- B. Protect outlet and device boxes from plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other materials that may contaminate the raceway system, conductors, and cables during construction.
- C. Generally install wiring devices in multi-gang boxes when more than device is required in one location.
- D. Verify all door swings before rough-in.

4.2 Outlet and Device Boxes

- A. Carefully select outlet or device box, box and ring combination and box in compliance with applicable local Codes and the NEC considering box size, device size, branch circuit wire size, and how the box and device relate to applicable grounding or bonding provisions related to the type of outlet or device box used.
- B. Mount outlet and device boxes where required by applicable Codes. Generally comply with layout drawings for wiring device locations. Coordinate exact locations of all devices with equipment, millwork, counters, fin radiation, windows, etc., by reference to the general building drawings, by actual measurements during rough-in, and in consultation with the owner, engineer, general contractor, and constructor inspector.

Refer conflicts to the general contractor, engineer of record, and owner for resolution. Do not proceed until conflicts are resolved.

- C. Verify that device and outlet boxes are properly sized for the installation and wiring method, and allow adequate space for all conductors, connectors, clamps, wiring devices, and barriers, where required. All conductors within the box are counted towards conductor fill.
- D. Comply with NEC depth requirements for flush-mounted outlet and device boxes in combustible and non-combustible finish surfaces. Verify the finish surface details and set boxes and plaster, tile or extension rings to the proper depth for the surface finish. Generally set boxes perfectly flush to the finished surface to permit the wiring device yoke to seat firmly against both the box or plaster ring and the finished construction surface.
- E. Install boxes level and plumb, securely supported by structural or framing members. Do not install boxes back-to-back in walls.
- F. Ensure that boxes enclosing flush devices, such as switches and receptacles, are completely enclosed on the back and sides.
- G. Do not place wall finish materials over outlet and device boxes. Do not cut holes for boxes in finish materials with routers using the sides of the box as a guide.
- H. Mount outlet and device boxes not less than 2 inches and not more than 12 inches from the trim where installed near doors, corner walls, etc.
- I. Generally locate wall switches and dimmers at the latch side of doors with the edge of the outlet box approximately 3" from the door frame when possible. Avoid locating boxes behind open doors.
- J. Where surface-mounted wiring method are used, provide suitable surface outlet or device box or surface mounted box-and-cover combination.

4.2.1 Mounting Height

- A. Verify mounting heights when installing outlet and device boxes. The mounting height of wall-mounted outlet and device boxes is generally measured from the finished floor surface to the centerline of the box.
- B. Install outlet and device boxes on uniform surface finishes. Do not install boxes in locations with different finish surfaces at the box location. Coordinate mounting heights for boxes on walls with a wainscot or walls that are to be partially tiled. Mount boxes at a height that insures that the faceplates required for the installation will fit entirely on only

one type of finished surface. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.

- C. Mount outlet and device boxes in accordance with applicable Codes and contract documents. In the absence of mounting height requirements, mount boxes in accordance with the following:
- Mount exterior outlet boxes 24 inches above finished grade.
 - Mount interior outlet boxes 18 inches above the finished floor surface.
 - Mount device boxes for switches 48 inches above the finished floor surface.
 - Mount outlet boxes for wall-mounted clocks 96 inches above the finished floor surface when possible, or 6" below the ceiling when not possible. Center clock outlets located above doors between the ceiling and the top of the door trip.
 - Mount above counter outlet and junction boxes 8 inches above countertop surfaces or at backsplash level.
 - Coordinate the mounting height of specific-use receptacles with equipment and finishes. Install within 72" horizontally of the intended point of use, or as indicated on contract documents.

4.2 Wiring Methods

- A. Ensure that wiring methods are listed. Use suitable fittings that are designed and listed for use with that particular wiring method. Use wiring methods suitable for the environment for low-voltage occupancy sensor control wiring.
- B. Plan cable and raceway entrances into outlet and device boxes carefully, keeping in mind that unused openings in boxes must be effectively closed.
- C. Where possible, make up all branch circuit wiring prior to wall covering installation. Install pre-wired wiring device pigtail connectors during rough-in. Use conductors that meet minimum length requirements to terminate devices and form conductors for device installation in the box.
- D. Ensure that all phase, neutral, and grounding conductors of a circuit are grouped together in the same cable, raceway, or box opening when installed in metal conduit, tubing, or metallic cable assemblies.
- E. Ensure that the wiring method includes a grounding means that can be extended to switches when they are installed. Provide a grounded or neutral conductor for switches with a pilot light.

- F. Coordinate rough-in wiring in multi-gang boxes in the correct position for each device. In general, locate switches in multi-gang boxes closest to the loads that they control.
- G. Identify rough-in wiring. Label switched conductors used for three-way and four-way switching to prevent the inadvertent switching of a grounded or neutral conductor. Re-identify any white or gray conductors of cable assemblies used for switch-legs at all locations where the conductors are visible and at all accessible points. Label wiring and conductors in multi-gang boxes to simplify wiring device installation at a later date.

5 Installation

5.1 General

- A. Install electrical wiring devices in accordance with the installation instructions and listing for each device. Install wiring devices in strict accordance with approved shop drawings and with equipment manufacturer's recommendations.
- B. Verify that wiring devices are compatible with wiring methods, loads served, construction materials, fire ratings, type of occupancy, and installed environment. Ensure that wiring devices are rated for the nominal operating voltage of the branch circuit.
- C. Install wiring devices in boxes or assemblies that are designed for the purpose and that are securely fastened in place. Install wiring devices only in boxes that are clean and free from excess building materials, dirt, and debris.
- D. Install wiring devices and coverplates after all raceways, boxes and conductors are installed, and after all wall preparation, painting and finish work is complete.
- E. Verify that box gaps and setbacks comply with Code requirements:
 - Ensure that openings or gaps around device boxes or plaster rings are effectively closed with no more than 1/8-inch gap between the opening and the surface finish.
 - Ensure that the front edge of boxes, plaster rings, extension rings, or listed extenders that have flush-type coverplates are not set back from the finished surface more 1/4-inch in walls or ceilings constructed of noncombustible material, such as concrete, tile, gypsum, or plaster.
 - Ensure that the front edge of boxes, plaster rings, extension rings, or listed extenders that have flush-type coverplates are flush with or extend past the finished surface in walls or ceilings constructed of combustible material, such as wood.
- F. Use a torque screwdriver when a torque is recommended or required by the manufacturer.

- G. Coordinate wiring device colors with the owner.
- H. Test branch circuit wiring for short circuits and ground faults prior to energization and use. Test ground continuity. Correct wiring deficiencies.

5.2 Electrical Safety

- A. Neglecting fundamental installation and maintenance requirements may lead to personal injury or death, as well as damage to electrical equipment or other property. All work and actions must conform to the requirements of NFPA 70E-2009, Electrical Safety in the Workplace.
- B. Do not work on energized equipment. Do not enter equipment enclosures with components are energized. Electrically isolate conductors and equipment in accordance with established procedures and manufacturer's instructions and recommendations. Guard energized conductors and equipment in close proximity to work.
- C. Consider all ungrounded and grounded metal parts of equipment and devices to be energized at the highest voltage to which they are exposed unless they are de-energized and tested in accordance with OSHA requirements.
- D. De-energize conductors and equipment by opening source switching devices to completely isolate equipment and circuits from all power sources before exposing any conductors. Test conductors and equipment at both sources and equipment terminals to confirm that they are de-energized.
- E. Use appropriate Personal Protective Equipment (PPE) and established safety procedures when working on or near energized electrical equipment, or equipment that has not been de-energized in accordance with NFPA 70E-2009, Electrical Safety in the Workplace. Do not wear conductive articles such as watches, rings, etc.
- F. Use insulated hand tools when working on or around energized equipment. Use only properly rated tools for the energy present. Maintain tool inventories to ensure that all tools are removed from equipment prior to energizing.
- G. Use care in opening and closing doors to energized equipment. Conductors and terminations may be exposed and within reach of openings.
- H. Carefully inspect work area and remove any tools and objects left inside equipment before energizing. Install all devices, doors, covers, barriers, etc., before energizing equipment.

5.3 Conductors

- A. Terminate conductors to wiring devices in accordance with manufacturer instructions and listing requirements.
- B. Ensure that conductors are selected, coordinated and applied within the temperature ratings of the wiring device terminals.
- C. Follow manufacturer color-coding of conductors. Ensure that phase conductors are terminated on phase terminations, neutral conductors are terminated on neutral terminations, and ground conductors are terminated on ground terminations. Wiring device terminals are typically color-coded with the hot or phase terminal being brass in color, the grounded or neutral terminal being silver in color, and the equipment ground terminal being green in color. Many manufacturers also provide markings on the back of the device identifying terminals by name, such as hot or phase, neutral, and ground.
- D. Verify that conductors are compatible with terminations. Only install aluminum conductors or copper-clad aluminum conductors on wiring devices with terminals marked as suitable for such conductors. Terminate aluminum conductors in accordance with NECA 104, Standard for Installing Aluminum Building Wire and Cable.
- E. Ensure that conductors meet Code required minimum length after each wiring device is installed. Form lengths of conductor slack neatly near the back of the box before installing wiring devices. Form the slack in conductors to relieve stress and tension from wiring devices at terminations and connections. Do not use tools or instruments with sharp edges to form conductors.
- F. Do not strip insulation from conductors until just before they are spliced or terminated on devices. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
- G. Splice, connect, and terminate grounded or neutral conductors in such a manner as to be able to remove a device without interrupting continuity of the grounded or neutral conductor of multi-wire branch circuits, or single-phase circuits that share a common neutral conductor.
- H. Provide unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions. Do not install dimmers on multi-wire branch circuits, or single-phase circuits that share a common neutral conductor.
- I. Wiring device terminals are designed to bundle stranded wire. Ensure that all conductor strands are installed in wiring device terminals to prevent conductors and terminations from overheating.
- J. Tighten electrical connectors and terminals according to manufacturers published torque tightening values.

- K. Use 12 AWG pigtails to connect wiring devices to 15- and 20-A circuits when branch circuit conductors are larger than 12 AWG.
- L. Do not wrap electrical tape around wiring device terminals. Taping wiring device terminals will prevent heat dissipation from the wiring device.

5.3.1 *Terminating Conductors on Back-Wired Devices*

- A. Back-wired devices have a clamping plate tightened by a threaded terminal screw.
- B. Strip each conductor to expose the manufacturer's recommended length of bare conductor.
- C. Insert each stripped conductor through a wiring hole in the back of the wiring device.
- D. Ensure that the bare conductor is inserted between the clamping plate and the terminal.
- E. Tighten each terminal screw to the recommended torque value to secure the conductor to the wiring device.
- F. Tug on each conductor to confirm that each connection is tight.

5.3.2 *Terminating Conductors on Side-Wired Devices*

- A. Side-wired devices have terminal screws on the side of the device.
- B. Back out each terminal screw from each terminal far enough to allow the conductor to be placed between the screw head and the terminal plate.
- C. Strip each conductor to expose the manufacturer's recommended length of bare conductor using the strip gauge located on the back of the wiring device.
- D. Bend the conductor in a clockwise direction to form a loop to fit snugly approximately two-thirds to three-quarters of the way around the terminal screw. Looping the wire in a clockwise direction will tend to pull the wire more tightly around the terminal screw as it is tightened.
- M. Place the loop of conductor around the terminal screw and tighten the screw to the manufacturer's recommended torque value until the conductor is firmly held in place. Ensure that the conductor does not contact other metal parts of the wiring device. Ensure that all conductor strands of stranded conductors are installed in wiring device terminals to prevent conductors and terminations from overheating.

5.3.3 *Terminating Conductors on Speed-Wired Devices*

- A. Speed-wired devices have holes in the back of the device that are used to terminate stripped conductors. Speed-wired devices will only accept 14 AWG solid copper conductors, and are most commonly found on residential-grade wiring devices.
- B. Strip each conductor to expose the manufacturer's recommended length of bare conductor using the strip gauge located on the back of the wiring device.
- C. Insert the bare portion of the conductor into a terminal hole in the back of the device to secure the conductor to the wiring device.

5.3.4 *Connecting Pre-Wired Devices*

- A. Pre-wired devices have either factory-installed pigtails connected to the terminals of the wiring device, or have pigtail connectors that snap into the wiring device and are captively held or are secured with a screw or clamp, if provided.
- B. Connect the pre-wired wiring device pigtail conductors to the corresponding branch circuit conductors.
- C. For pre-wired devices with pigtail connectors, plug the pigtail connector into wiring device body. Twist the connector to lock into the wiring device, if so equipped. Tighten the mounting screw, if equipped.

5.4 *Grounding and Bonding*

- A. Permanently and effectively ground all wiring devices, boxes, raceways, cables and conductors in accordance with NEC requirements.
- B. Connect the grounding terminal of each wiring device to branch-circuit equipment grounding conductors, where provided, and to outlet and device boxes. Bond each switch in multi-gang boxes.
- C. Make equipment grounding conductor connections and splices so that the removal or disconnection of any wiring device does not interrupt the continuity of the branch circuit equipment grounding conductor.
- D. Use listed devices, such as ground clips or ground screws, to connect equipment grounding conductors to metal boxes and enclosures. Use identified wire connectors to splice or connect equipment grounding conductors. Do not use sheet metal screws, drywall screws, or any other fasteners that are not suitable for connecting grounding or

bonding conductors to enclosures including outlet and device boxes. Do not use a cable clamp screw for connecting equipment grounding conductors.

- E. For replacement switches only where an equipment-grounding means does not exist in the box or where the wiring method does not contain an equipment grounding conductor, a snap switch having a metal yoke is permitted to be installed without being grounded, and a nonmetallic coverplate must be used.
- F. Connect the ground terminal of isolated-ground receptacles only to the designated, insulated, isolated-ground conductor of the branch circuit. Bond the outlet box and raceway only to the branch circuit equipment grounding conductor of isolated-ground receptacles.

5.5 Installing Wiring Devices

- A. Install wiring devices in accordance with manufacturer's written instructions, with applicable requirements of NEC and ANSI, and with recognized industry practices to fulfill project requirements.
- B. Tighten unused terminal screws on wiring devices prior to installing wiring devices in outlet and device boxes
- C. Remove fiber or plastic washers used to hold mounting screws in wiring device yokes when installing wiring devices in metallic boxes to allow metal-to-metal contact.
- D. Remove the wiring device mounting ears only as necessary to mount wiring devices in surface-mounted boxes or “old-work” boxes to ensure proper seating of the wiring device to the front edge or face of the box and to ensure that no gap is left between the coverplate and the wall or ceiling surface.
- E. Provide permanently installed isolation barriers between adjacent wiring devices, and ensure that wiring methods enter outlet and device boxes in appropriate locations where the voltage between adjacent devices exceeds 300 volts.
- F. Install devices and assemblies level, plumb, and square with building lines. Align devices vertically and horizontally. Securely fasten devices into boxes.
- G. Ensure that wiring devices seat firmly against both the front edge, or face, of the box or plaster ring and the construction surface at the same time.

5.5.1 Switches, Timers, Dimmers and Occupancy Sensors

- A. Install switches, timers, dimmers and occupancy sensors in accordance the NEC and with manufacturer recommendations.

- B. Ensure that switches, timers and dimmers are used within their permitted ratings:
- Ensure that switches used for controlling tungsten-filament lamp loads are suitable for supplying tungsten-filament lamps or “T-Rated,” and that tungsten-filament lamps are limited to 120 Volts and do not exceed the ampere rating of the switch.
 - Ensure that motor loads do not exceed 80% of the ampere rating of the switch. Switches rated in horsepower are suitable for controlling motor loads within their ampere and voltage ratings.
 - De-rate ganged dimmers in accordance with manufacturer instructions.
 - General use AC snap switches are permitted to be used on resistive and inductive loads, tungsten-filament lamp loads, and motor loads. Ensure that the load does not exceed the ampere rating of the switch at the applied voltage. Ensure that inductive loads do not exceed 50% of the ampere rating of the switch at the applied voltage.
- C. Install wall switches with a consistent orientation so the same direction of operation will open and close circuits, generally up or to the left for the ON position. Install dimmers with a consistent orientation so the same direction of operation will brighten and dim the lights throughout the project, generally up for brightest position.
- D. Install illuminate switches and switches with pilot lights to provide a convenient means to visually locate lighting control in especially dark areas. Install switches with pilot lights to monitor loads that are remote or unseen from the switch location, such as a roof-mounted exhaust fan.
- E. Verify that dimmers are compatible with fluorescent ballasts. Verify that dimmers used for fan speed control are listed for that application.
- F. Adjust initial time delay and sensitivity settings of occupancy sensors in accordance with manufacturer recommendations.

5.5.2 Receptacles

- A. Install receptacles in accordance with their ratings. A single receptacle installed on an individual branch circuit and receptacles rated greater than 50 amperes must be rated not less than the overcurrent device protecting the branch circuit.
- B. Install grounding-type receptacles on grounded branch circuits. Provide non-grounding-type receptacles for ungrounded, two-wire branch circuits.

- C. Install receptacles so the mounting strap or yoke contacts the finished wall surface where boxes are set back slightly from the finished wall surface, or contacts both the finished wall surface and the box, plaster ring, or raised cover that projects from the finished surface where the box is installed flush with the finished surface.
- D. For exposed wiring methods, install receptacles in a cover and held against the cover by more than one screw or be installed in a cover identified for securing by only a single screw.
- E. Install receptacles with a consistent orientation, whether with the ground pole on top or bottom for receptacles installed vertically, or with the ground pole to right or left for receptacles installed horizontally.
- F. Install hospital grade receptacles in patient bed locations in general patient care and critical care areas. Connect the grounding terminal of hospital grade receptacles to an insulated copper branch circuit equipment-grounding conductor.

5.5.3 Attachment Plugs and Connectors

- A. Install attachment plugs and connectors in accordance with the NEC. Ensure that cord plugs are listed for the installed environment.
- B. Terminate conductors and assemble plugs in accordance with manufacturer instructions.
- C. Match NEMA wiring device configuration, voltage and current ratings and number of conductors to equipment requirements for plugs and receptacles for cord-and-plug connected equipment. See Annex A.
- D. Remove tinned leads of equipment pigtails prior to terminating on plugs and connectors to prevent “cold flow” loosening of wiring device terminations with tinned copper conductors.
- E. Tighten terminations to manufacturer-recommended torque values.
- F. Ensure that cord plug removable inserts are used in compliance with manufacturer recommendations, and are removed when installing larger diameter cords. Tighten plug cord grips in accordance with manufacturer recommendations to prevent conductor shearing and cord pull-out. Provide external strain relief for pendant cord outlets.
- G. Do not install right-angle plugs on equipment that is frequently plugged and unplugged. Improper removal of right-angle plugs places greater strain on the plug and the receptacle than straight plugs.

5.5.4 Replacing Non-Grounding Receptacles

- A. Replace non-grounding receptacles installed on ungrounded two-wire branch circuits with non-grounding receptacles.
- B. Replace non-grounding receptacles installed on ungrounded two-wire branch circuits with grounding-type receptacles in accordance with the NEC. Connect the equipment grounding terminal of the grounding-type receptacle to any accessible point on the grounding electrode system, to an accessible point on the grounding electrode conductor, or to the equipment grounding terminal bar within the enclosure where the branch circuit for the receptacle or branch circuit originates.
- C. Replace non-grounding receptacles installed on ungrounded two-wire branch circuits with ground-fault circuit interrupter (GFCI) receptacles in accordance with the NEC and NECA 169. Label such receptacles “no equipment ground.” Such GFCI receptacles are permitted to protect grounding-type receptacles that are labeled “no equipment ground” and “GFCI protected.”

5.6 Coverplates

- A. Install coverplates that are suitable for the intended purpose and the installed environment. Install gasketed weatherproof enclosures and covers for wiring devices installed outdoors in a damp or wet location. Do not install coverplates intended for flush-mounted boxes on surface-mounted boxes.
- B. Install coverplates level, plumb and parallel to adjacent surfaces or trim. Align coverplates vertically to within 1/16 inch.
- C. Ensure that coverplates completely cover openings and seat firmly against the finished surface of the wall or ceiling. Repair finishes and remount boxes when standard coverplates do not fit flush or do not cover rough wall openings. Do not use oversized or extra-deep plates.
- D. Generally, provide coverplates to match the color of wiring devices with metal mounting screws with head color to match coverplate finish, unless otherwise indicated on contract documents, or where color selection is by the owner.
- E. Provide a common coverplate for wiring devices installed in multi-gang boxes.
- F. Align coverplate mounting screw slots in the same direction, either vertical or horizontal. Do not overtighten coverplate mounting screws. Overtightening can cause the coverplate to warp, dimple, bend, and in the case of plastic faceplates, crack or break.

5.7 Identification

- A. Provide circuit identification labels or engraved the coverplate for each wiring device when required by contract documents. Label coverplates to identify the source panelboard and branch circuit number. Label coverplates to identify the loads that are being controlled, such as switches for exhaust fans, motors, equipment systems, etc., or areas being lighted where switches control devices that are out of sight, or where three or more switches are gang-mounted.

5.8 Testing Wiring Devices

- A. Follow recommended safe work practices when testing branch circuit wiring and wiring devices. See Section 5.2.
- B. After energizing, test wiring devices for proper voltage, polarity and ground continuity. Correct circuit conditions, remove malfunctioning wiring devices and replace with new ones, and retest.
- C. Check specialty switches and receptacles equipped with indicating lights for normal operation. Test timers for appropriate time delay operation.
- D. Test dimmers per manufacturer's instructions. Verify that dimmers function as intended. Operate dimmers connected to fluorescent fixtures at full brightness for the full burn-in period as specified or recommended by the lamp manufacturer.
- E. Shake attachment plugs, listening for sounds such as rattling that may indicate loose screws. Disassemble plugs as necessary to inspect and correct problems.
- F. Replace stained or improperly painted wiring devices and coverplates. Replace defective wiring devices, and wiring devices and coverplates damaged during construction.

6. Maintenance

6.1 General

- A. Replace wiring devices that are misapplied, improperly installed, damaged, or that show any sign of alterations of a blade or connection slot.
- B. Remove plugs by the plug housing. Do not remove plugs from receptacles by pulling the cord.

6.2 Inspections and Testing

- A. Ensure that wiring devices are listed for the installed environment and are compatible with device ratings and configurations.

- B. Verify that wiring devices are securely fastened to outlet and device boxes. Verify that appropriate coverplates are installed and secure, and contact the finished surface on all edges.
- C. Check receptacles for firm contact grip of the inserted plug blades each time equipment is connected or disconnected from the device.
- D. Visually inspect wiring devices for evidence of physical or thermal damage annually. Inspect wiring devices for signs of alteration to achieve unintended connectability. Replace damaged or modified wiring devices.
- E. Test ground continuity of isolated ground receptacles annually.
- F. Inspect cords, plugs, and connectors for physical and thermal damage annually. Coordinate with annual equipment inspections, where required. Test ground continuity and shake plugs, listening for sounds such as rattling that may indicate loose screws. Inspect crimp-type cord grips for broken conductor strands. Disassemble plugs as necessary to inspect and correct problems.
- G. Verify that strain relief clamps of plugs and connectors properly grip cord jackets tightly across the full width and depth of the clamp.

(This annex is not part of the standard)

Annex A: NEMA Wiring Device Configuration Chart

(This annex is not part of the standard)

Annex B: Reference Standards