# UL 498

## STANDARD FOR SAFETY

Attachment Plugs and Receptacles

UL Standard for Safety for Attachment Plugs and Receptacles, UL 498

Sixteenth Edition, Dated April 28, 2017

***SUMMARY OF TOPICS***

***This revision of ANSI/UL 498 dated September 21, 2021 includes the following:***

***– Revision to Spring Action Terminals requirements; 12.6.1, 12.6.4, 20.3.2, Section 25A, Table 59.1, Table 59.3, Section 77A, Section 99A, Table 193.1, Table 193.3***

***– Alternative terminal identifier for the connection of the grounded conductor; Table 193.1, Table 193.3, Table 193.4, Table 193.5, Table 194.1***

***– Revision to Weather-Resistant (WR) requirements; SD1.2***

***– Revision to Marking for products with USB type outlets; SE15.1***

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The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated July 16, 2021.

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# UL 498

## Standard for Attachment Plugs and Receptacles

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This ANSI/UL Standard for Safety consists of the Sixteenth Edition including revisions through September 21, 2021.

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The Department of Defense (DoD) has adopted UL 498 on August 17, 1981. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at https://csds.ul.com.

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## INTRODUCTION

### 1 Scope

1.1 These requirements cover attachment plugs, receptacles, cord connectors, inlets, current taps provided with wiring terminals for flexible cord, and flatiron and appliance plugs – all intended for connection to a branch circuit for use in accordance with the National Electrical Code, ANSI/NFPA 70.

1.2 These requirements do not cover devices rated at more than 200 A or for more than 600 V. See 6.1.

1.3 This Standard does not directly apply to, but supplements the following standards:

a) Devices produced integrally with flexible cord or cable, covered by the Standard for Cord Sets and Power-Supply Cords, UL 817;

b) Current taps and adapters not provided with wiring terminals for flexible cord covered by the Standard for Current Taps and Adapters, UL 498A;

c) Devices employing male or female screwshells, covered by the Standard for Lampholders, UL 496;

d) Devices solely intended for direct connection to the branch circuit in accordance with the National Electrical Code, ANSI/NFPA 70, that are provided with contacts of the pin and sleeve type, covered by the Standard for Plugs, Receptacles and Cable Connectors of the Pin-and-Sleeve Type, UL 1682;

e) Single and multipole connectors intended for factory assembly to copper or copper alloy conductors or printed wiring boards for use in data, signal, control and power applications within and between electrical equipment, covered by the Standard for Component Connectors for Use in Data, Signal, Control and Power Applications, UL 1977;

f) Devices intended for installation and use in hazardous (classified) locations in accordance with the National Electrical Code, ANSI/NFPA 70, covered by the Standard for Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations, UL 1203;

g) Devices intended for use with telecommunications networks, covered by the Standard for Information Technology Equipment – Safety – Part 1: General Requirements, UL 60950-1, or the Standard for Communications Circuit Accessories, UL 1863;

h) Devices incorporating ground-fault circuit interruption circuitry, covered by the Standard for Ground-Fault Circuit Interrupters, UL 943;

i) Single- or two-outlet direct plug-in devices incorporating transient voltage surge suppression circuitry, covered by the Standard for Surge Protective Devices, UL 1449;

j) Single- or two-outlet direct plug-in devices incorporating electromagnetic interference filter circuitry, covered by the Standard for Electromagnetic Interference Filters, UL 1283;

k) Cord-connected, relocatable power taps intended only for indoor use as a temporary extension of a grounding alternating-current branch circuit for general use, covered by the Standard for Relocatable Power Taps, UL 1363; or

l) Single pole locking-type separable connectors, covered by the Standard for Single Pole Locking-Type Separable Connectors, UL 1691.

1.4 This Standard contains the following supplements:

a) Supplement SA – Enclosure Types for Environmental Protection

b) Supplement SB – Marine Shore Power Inlets

c) Supplement SC – Hospital Grade Devices

d) Supplement SD – Weather-Resistant Receptacles

e) Supplement SE – Receptacles with Integral Power Supply with Class 2 Output Connectors

f) Supplement SF – Recessed Outlet Kit Assembly

## 2 Glossary

2.1 For the purposes of this Standard, the following definitions apply.

2.2 APPLIANCE COUPLER – A single-outlet, female contact device for attachment to a flexible cord as part of a detachable power-supply cord to be connected to an inlet (motor attachment plug).

2.3 APPLIANCE PLUG – An appliance coupler type of device having a cord guard and a slot configuration specified for use with heating or cooking appliances.

2.3.1 ATTACHMENT FITTING – A male (load connected only) component device intended solely for factory assembly to utilization equipment for the purpose of connection to a luminaire and/or ceiling-suspended fan support receptacle.

2.4 ATTACHMENT PLUG – A male contact device for the temporary connection of a flexible cord or cable to a receptacle, cord connector, flanged equipment power outlet, or other outlet device.

2.5 BULK SHIPMENT – Any packaging container having more than one receptacle not provided with a unit container.

2.5.1 CONFIGURABLE PLUG – A male contact device employing repositionable blades, intended for the temporary connection of a flexible cord or cable to a receptacle, cord connector, or power outlet, of the corresponding mating device configuration.

2.6 CONFIGURATION, LOCKING – A device having a configuration that requires a motion other than a straight push or pull to connect or separate it when used with its mating part.

2.7 CORD CONNECTOR – A female contact device to be wired on flexible cord for use as an extension from an outlet to make a detachable electrical connection to an attachment plug or, as an appliance coupler, to an equipment inlet.

2.8 CURRENT TAP – A device provided with one set of male blades, one or two female outlets, and wiring terminals for flexible cord intended either for factory or field wiring.

2.9 ELECTRICAL (FUNCTIONAL) INSULATION – The insulation necessary for the proper functioning of the product and for basic protection against electrical shock. This includes all parts relied upon to support live parts in place, all internal barriers necessary to maintain spacings, and the outlet face portion of all female devices.

2.10 ENCLOSURE – That part of the device that renders inaccessible all or any parts of the device that may otherwise present a risk of electric shock, retards propagation of flame initiated by electrical disturbances occurring within, or both.

2.11 FIXTURE, EQUIPMENT, OR APPLIANCE OUTLET – A receptacle outlet device for mounting on utilization equipment.

2.12 FLATIRON PLUG – An appliance coupler type of a device having a cord guard and a slot configuration specified for use with heating or cooking appliances.

2.13 GROUNDING-CONDUCTOR PATH – A path between the grounding pin, blade, or contact and the grounding terminal or, if the device has no grounding terminal, the point at which the path makes contact with a part of the metal raceway system, such as a box, box cover, or the raceway itself.

2.14 GROUNDING DEVICE – A device having a 5-15, 5-20, 5-30, 5-50, 6-15, 6-20, 6-30, 6-50, 7-15, 7-20, 7-30, 7-50, 14-15, 14-20, 14-30, 14-50, 14-60, 15-15, 15-20, 15-30, 15-50, 15-60, L5-15, L5-20, L5-30, L6-15, L6-20, L6-30, L7-15, L7-20, L7-30, L8-20, L8-30, L9-20, L9-30, L14-20, L14-30, L15-20, L15-30, L16-20, L16-30, L17-30, L21-20, L21-30, L22-20, L22-30, L23-20, L23-30, TT-R, or ML-2R configuration, the standard configuration illustrated in Figure C1.1 of the Standard for Wiring Device Configurations, UL 1681, or a nonstandard configuration that employs one blade, pin, or contact exclusively for grounding.

2.15 HOUSING ADAPTER, ANGLE – A part that is intended to replace a portion of an attachment plug or cord connector housing so that the flexible cord exits the strain relief in the same plane as the face of the device.

2.16 HOUSING ADAPTER, SHROUD – A part that is intended to be assembled onto an attachment plug or cord connector to extend the housing beyond the plane of the face of the device.

2.17 INLET – (Motor Attachment Plug) A male contact device to be mounted on utilization equipment to provide an integral blade configuration for the connection of an appliance coupler or cord connector.

2.18 POLARIZED DEVICE – A device constructed for connection to a mating device only in the position that connects related poles of an electrical circuit.

2.18.1 RECEPTACLE, CEILING-SUSPENDED FAN SUPPORT – A type of receptacle intended to be secured to a ceiling outlet box. Provides electrical connection and mechanical support of a ceiling-suspended fan by a factory installed attachment fitting secured to a ceiling-suspended fan.

2.19 RECEPTACLE, CLOCK – A flush receptacle having a recessed cord-storage space in an integral flush-device cover plate, commonly used with wall clocks.

2.20 RECEPTACLE, DISPLAY – A flush receptacle provided with a flush device plate or outlet box cover and closure plug or plugs that is intended for use in show window floors and similar locations where the device is not likely to be subjected to scrub water.

2.21 RECEPTACLE, DUPLEX – A receptacle having two contact devices on a single mounting yoke for flush mounting in a plane surface.

2.22 RECEPTACLE, FLUSH – A receptacle which is intended for mounting in or on an outlet box, an outlet-box cover, or a flush-device cover plate for fixed installation on a branch circuit.

2.23 RECEPTACLE, INTERCHANGEABLE or MODULAR – A flush receptacle which is assembled as a single, duplex or triplex outlet in the field from a system of individual outlet modules, mounting yokes, or flush device cover plates.

2.24 RECEPTACLE, ISOLATED GROUND – A receptacle having the grounding terminal electrically isolated from the system ground when installed in a metallic outlet box or raceway system.

2.24.1 RECEPTACLE, LIGHTED – A receptacle employing an integral lens (jewel) and electrical or electronic components that produce light. Two basic types:

a) Power Indicator type – Illuminates to indicate power is on.

b) Illuminated/Nightlight – Illuminates when power is on and may not when controlled by a photoelectric sensor.

2.24.2 RECEPTACLE, LUMINAIRE SUPPORT – A type of receptacle intended to be secured to a ceiling outlet box. Provides electrical connection and mechanical support of a luminaire by a factory installed attachment fitting secured to the luminaire.

2.25 RECEPTACLE, PENDANT – Pendant receptacles include an enclosure with cover plate and strain relief means, intended to be assembled at the end of flexible cord, for use in branch circuit applications.

2.26 RECEPTACLE, POP-OUT – A retractable flush mount receptacle intended for mounting in or on an outlet box, an outlet-box cover, or a flush device plate for fixed installation on a branch circuit and is only intended to be installed in a wall and other vertical surfaces.

2.27 RECEPTACLE, POP-UP ASSEMBLY – An assembly consisting of a retractable flush mount receptacle, outlet box and flush device cover plate intended for fixed installation on a branch circuit. A pop-up receptacle assembly is suitable for installation in a kitchen or bathroom countertop. They are provided with one or more receptacle outlets. The outlets are retractable for storage below the counter surface.

2.28 RECEPTACLE, SELF-CONTAINED – A receptacle which includes an enclosure and mounting means intended for flush mounting without the use of a separate flush-device or other outlet box and for connection to one or more nonmetallic sheathed cables containing copper conductors in accordance with National Electrical Code, ANSI/NFPA 70. A self-contained receptacle is primarily used in mobile homes, recreational vehicles, manufactured buildings, and on-site frame construction.

2.29 RECEPTACLE, SELF-GROUNDING – A receptacle which includes a spring clip or other part to provide for electrical continuity between the grounded device yoke and the mounting screw.

2.30 RECEPTACLE, SPLIT – A duplex receptacle having line terminals which are capable of being electrically separated.

2.31 RECEPTACLE, SURFACE-MOUNT – A receptacle which includes an enclosure and mounting means intended for surface mounting without the use of a separate outlet box in accordance with the National Electrical Code, ANSI/NFPA 70.

2.32 RECEPTACLE, TAMPER-RESISTANT – A receptacle which by its construction is intended to limit improper access to its energized contacts in accordance with the National Electrical Code, ANSI/NFPA 70.

2.33 RECEPTACLE, WEATHER-RESISTANT – A flush-type receptacle which by its construction is intended to provide resistance to the effects of outdoor exposure when installed in accordance with Article 406 of the National Electrical Code, ANSI/NFPA 70.

2.34 SELF-HINGE – A thin molded portion of an enclosure intended to bend during the assembly of a wiring device to a flexible cord.

2.35 TABLE TAP – A cord connector having more than one outlet and intended to rest on a horizontal surface while in use.

2.36 TERMINAL, INSULATION-DISPLACEMENT – A terminal having a contacting member that forces the conductor insulation aside and presses against the side of the conductor to make contact.

2.37 TERMINAL, PIN-TYPE (INSULATION-PIERCING) – A terminal having a contact pin that punctures the conductor insulation to contact the current-carrying conductor.

2.38 TERMINAL, PRESSURE-WIRE – A terminal which establishes a connection between one or more conductors and a terminal plate by means of mechanical pressure without the use of solder. A pressure-wire terminal may be either of the following types:

a) Clamp-Type – A pressure-wire terminal in which the conductor is held under a pressure plate or saddle clamp by one or more screws. This type of terminal may be provided in combination with a wire-binding screw terminal.

b) Setscrew-Type – A pressure-wire terminal in which the pressure is applied by the end of the screw bearing on the conductor, either directly or through a wire-protecting pad.

c) Combination Wire Binding/Pressure-Type – A wire binding screw with an integrally machined pressure ring. Pressure ring terminals accept both single and multiple conductors that are captured under the machine formed pressure ring. These terminals may be wired with a single conductor using the conventional 3/4 loop around the wire-binding screw.

2.39 TERMINAL, PUSH-IN – A terminal where the stripped end of a conductor is pushed into the terminal and the clamping pressure is maintained by a spring mechanism, without the use of screws.

2.39.1 TERMINAL, SPRING ACTION CLAMP – A terminal where the stripped end of a conductor is inserted into the terminal and a manually operated integral lever applies clamping pressure to a spring mechanism, without the use of screws.

2.40 TERMINAL, WIRE-BINDING SCREW – A terminal in which the conductor is bent around the screw and is clamped directly under the head of the screw when it is tightened.

2.41 TERMINAL ASSEMBLY, SEPARABLE – A two-piece terminal assembly provided with an integral mechanical latching mechanism(s). It consists of permanently attached pins or tabs located on the body of the receptacle and is capable of receiving a special purpose connector with leads for connection to the branch circuit.

2.42 THROUGH-WIRING – A wiring method which permits a group of receptacles to be wired in parallel to a common branch circuit.

2.43 UNIT CONTAINER – The smallest carton, package, or container, in which a receptacle is packaged. A unit container may contain more than one receptacle if they are not intended to be removed from the container for individual sale.

## 3 Components

3.1 Except as indicated in 3.2, a component of a product covered by this Standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components generally used in the products covered by this Standard.

3.2 A component is not required to comply with a specific requirement that:

a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard, or

b) Is superseded by a requirement in this standard.

3.3 A component shall be used in accordance with its rating established for the intended conditions of use.

3.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

## 4 Units of Measurement

4.1 When a value for measurement is followed by a value in other units in parentheses, the first stated value is the requirement.

## 5 References

5.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

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## 6 General

6.1 The ratings mentioned throughout this Standard including those mentioned in Table 192.1 represent maximum ampacity and maximum operating potential in volts for receptacles and other outlet devices such as cord connectors or current taps.

6.2 A device is considered to be for use on either alternating or direct current unless the rating includes the letters "ac" to restrict the use to alternating current.

## 7 Configurations

7.1 The NEMA configurations of various attachment plug and receptacle combinations referenced in this Standard are in accordance with Wiring Devices – Dimensional Specifications, ANSI/NEMA WD6, and are included in Appendix B for ease of reference. The figures referenced as Section C1 contain non-NEMA configurations and are found in the Standard for Wiring Device Configurations, UL 1681.

7.2 The PLASA configurations of various attachment plugs and receptacle combinations referenced in this Standard are in accordance with Entertainment Technology Dimensional Requirements for Stage Pin Connectors, ANSI/ESTA E1.24.

## 8 Insulating Materials

### 8.1 General

8.1.1 All parts that act as the electrical insulation or enclosure of a device shall be made of an insulating material intended for the particular application and shall comply with the requirements in 8.2.1 – 8.4.1. Hard rubber shall not be employed.

*Exception No. 1: The internal insulating systems of components where component requirements exist are not required to comply with the requirements in 8.2.1 – 8.4.1.*

*Exception No. 2: A small part meeting all of the following criteria is not required to comply with the requirements in 8.2.1 – 8.4.1:*

*a) Its volume does not exceed 0.122 cubic inch (2 $cm^3$),*

*b) Its maximum dimension does not exceed 1.18 inches (3 cm), and*

*c) Its location is such that it cannot propagate flame from one area to another or act as a bridge between a possible source of ignition and other ignitable parts.*

*Exception No. 3: Fiber or similar material that is equal to or less than 0.010 inch (0.25 mm) thick is not required to comply with the requirements in 8.2.1 – 8.4.1.*

8.1.2 A polymeric material used for electrical insulation or enclosure of live parts shall be fabricated in accordance with the Standard for Polymeric Materials – Fabricated Parts, UL 746D.

*Exception: A polymeric material that is fabricated in the same location where final assembly takes place and where no blending or compounding operations are involved is not required to comply with this requirement.*

### 8.2 Flammability

8.2.1 A polymeric material used for electrical insulation or enclosure of live parts shall have a flame class rating of HB, V-2, V-1, V-0, VTM-2, VTM-1, or VTM-0 in accordance with the requirements of the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94. The flame class rating of the material shall be judged at the minimum thickness employed at the walls and barriers in the device which are critical to the functioning of the insulation or enclosure of the device.

*Exception No. 1: Insulating materials employed in a self-contained receptacle shall instead comply with 40.1.*

*Exception No. 2: A polymeric material that complies with either the 12 mm or 20 mm (3/4-inch) flame flammability test described in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, need not have a flammability class rating.*

### 8.3 Electrical properties

8.3.1 A polymeric material used for electrical insulation or enclosure of live parts shall have a Comparative Tracking Index (CTI) rating of 175 V or greater or a performance level class of at least 3.

*Exception No. 1: A polymeric material used for electrical insulation or enclosure of live parts is not required to comply with this requirement if it complies with the Comparative Tracking Index Test, Section 60.*

*Exception No. 2: A polymeric material used in an enclosure that is separated through air by more than 1/32 inches (0.8 mm) from uninsulated live parts and more than 1/2 inch (12.7 mm) from arcing parts is not required to comply with this requirement.*

8.3.2 A polymeric material used for electrical insulation or enclosure of live parts shall have Hot Wire Ignition (HWI) and High-Current Arc Resistance to Ignition (HAI) ratings or performance level classes of at least those shown in Table 8.1 for the flame class rating determined in accordance with 8.2.1. For materials with other than VTM flammability classifications, the HWI and HAI ratings of the material shall be evaluated using the specimen thickness employed in the end product or nominal 1/8 inch (3.2 mm) thickness, whichever is greater.

*Exception No. 1: A polymeric material used for electrical insulation or enclosure of live parts is not required to comply with the HWI requirements if it complies with the Glow Wire Test, Section 61.*

*Exception No. 2: A polymeric material used for electrical insulation or enclosure of live parts is not required to comply with the HAI requirements if it complies with the High-Current Arc Resistance to Ignition Test, Section 62.*

*Exception No. 3: A polymeric material used in an enclosure of an attachment plug or cord connector which does not enclose live parts, or which encloses insulated live parts where the insulation thickness is greater than 0.028 inches (0.71 mm), is not required to comply with the HWI requirements.*

*Exception No. 4: A polymeric material used in an enclosure that is separated through air by more than 1/32 inches (0.8 mm) from uninsulated live parts and more than 1/2 inch (12.7 mm) from arcing parts is not required to comply with the HWI and HAI requirements.*

*Exception No. 5: Insulating materials employed in a self-contained receptacle shall instead comply with 40.1.*

**Table 8.1**
**Hot wire ignition (HWI) and high-current arc resistance to ignition (HAI) ratings of insulating materials**

| Flammability classification[a] | HWI[b,d] | | HAI[c,d] | |
|---|---|---|---|---|
| | Mean ignition time (sec) | PLC | Mean no. of arcs | PLC |
| V-0, VTM-0 | 7 and up to 15 | 4 | 15 and up to 30 | 3 |
| V-1, VTM-1[e] | 15 and up to 30 | 3 | 15 and up to 30 | 3 |
| V-2, VTM-2 | 15 and up to 30 | 3 | 15 and up to 30 | 3 |
| HB | 30 or more | 2 | 60 or more | 1 |

[a] Flammability classification – Described in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

[b] Hot Wire Resistance to Ignition – Described in the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A.

[c] High-Current Arc Resistance to Ignition – Described in UL 746A.

[d] Mean ignition time and mean no. of arcs to be used to evaluate Filament Wound Tubing, Industrial Laminates, Vulcanized Fiber, and similar polymeric materials only. All other materials are to be judged using the performance level class values.

[e] polymeric material subjected to the flammability test with either the 12 mm or 20 mm (3/4-inch) flame in accordance with Exception No. 2 to 8.2.1 shall comply with the PLC for a V-1 rating.

## 8.4 Thermal properties

8.4.1 A polymeric material used for electrical insulation or enclosure of live parts shall have the relative thermal index ratings shown in Table 8.2 for the specific application of the insulating material. For materials with other than VTM flammability classifications, the material shall be evaluated using the specimen thickness employed in the end product or nominal 1/8 inch (3.2 mm)thickness, whichever is greater.

*Exception: The following generic materials having readings of 65 or less on the Shore Durometer D scale (when measured for 5 seconds at an ambient temperature of 23.0 ±2.0°C (73.4 ±3.6°F)) are acceptable for use at 60°C (140°F) based on their successful completion of the appropriate accelerated aging test described in Accelerated Aging Tests, Section 66:*

*a) Ethylene/Propylene/Diene (EPDM)*

*b) Natural Rubber (NR)*

*c) Neoprene (Chloroprene Butadiene) Rubber (CBR)*

*d) Nitrile Rubber (NBR)*

*e) Polyvinyl Chloride (PVC) and its copolymers*

*f) Silicone Rubber (SIR)*

*g) Styrene (Butadiene) Rubber (SBR)*

*h) Thermo Elastomeric [TEE; includes Thermoplastic Elastomers (TPE) and Ethylene Propylene Thermoplastic Rubber (EPTR)]*

**Table 8.2**
**Minimum relative thermal indices of insulating materials used in insulation and enclosure applications**

| Application | Minimum relative thermal index[a], Degrees C | | |
|---|---|---|---|
| | Electrical | Mechanical with impact[b] | Mechanical without impact |
| Permanently-wired devices (including appliance, fixture and equipment outlets, inlets, and receptacles | 80[c] | 60[c] | 80[c] |
| Cord-connected devices (including attachment plugs, cord connectors, and current taps) | 60[c] | 60[c] | 60[c] |

[a] Relative Thermal Index – Described in the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B.

[b] For industrial laminates, vulcanized fiber, and similar polymeric materials, the material's minimum RTI for Mechanical shall be evaluated using the values specified for Mechanical Without Impact.

[c] For devices containing fuses, the minimum thermal indices shall be the values shown above or the temperature measured on the insulating material during the Fuseholder Temperature Test, whichever is greater. See Sections 78, 88, 99, and 121.

## 8.5 Vulcanized fiber

8.5.1 Vulcanized fiber is not prohibited from being used for insulating washers, separators, and barriers, but shall not be used as the sole support of live parts.

8.5.2 Vulcanized fiber shall comply with the requirements in 8.2.1 – 8.4.1 and shall be moisture-resistant in accordance with 64.1 and 64.2.

## 8.6 Sealing compounds

8.6.1 A sealing compound shall be insulating, waterproof, and shall not soften at a temperature of 65°C (149°F). The softening point is to be determined using the Standard Test Methods for Softening Point of Resins Derived from Naval Stores by Ring-and-Ball Apparatus, ASTM E28.

8.6.2 Sulphur shall not be employed as a sealing compound.

## 8.7 Fuse enclosures

8.7.1 A fuse enclosure shall be of a moisture-resistant material in accordance with 64.1 and 64.2. Fiber and similar absorptive materials shall not be used for the enclosure of a fuse.

8.7.2 A polymeric material classified as Type V-0, V-1, or V-2 is considered as having flammability properties acceptable for use as the enclosure of a fuse.

## 9 Enclosure

### 9.1 General

9.1.1 A device shall have live parts protected against exposure to contact by persons when fully assembled using all essential parts (described in 9.1.5) and installed in the intended manner.

*Exception No. 1: Male blades which are energized only when mated with the corresponding outlet are not required to comply with this requirement.*

*Exception No. 2: Exposed wiring terminals or other live parts enclosed within equipment or within an outlet box when the device is installed in the intended manner are not required to comply with this requirement.*

9.1.2 Accessible dead-metal parts of a grounding device shall be conductively connected to the grounding-conductor path through the device.

*Exception: Accessible dead-metal parts electrically insulated from current-carrying parts are not required to comply with this requirement.*

9.1.3 Accessible dead-metal parts of a nongrounding device shall be electrically insulated from live parts and wiring other than the complete flexible cord so that they are unable to be energized by stray strands, failure of wiring terminals (such as loosening of screws), or damaged or broken wiring. When the stray strand length affects whether a device complies with this requirement, the device shall be marked in accordance with Reference No. 3 to Table 193.1. See 9.1.7.

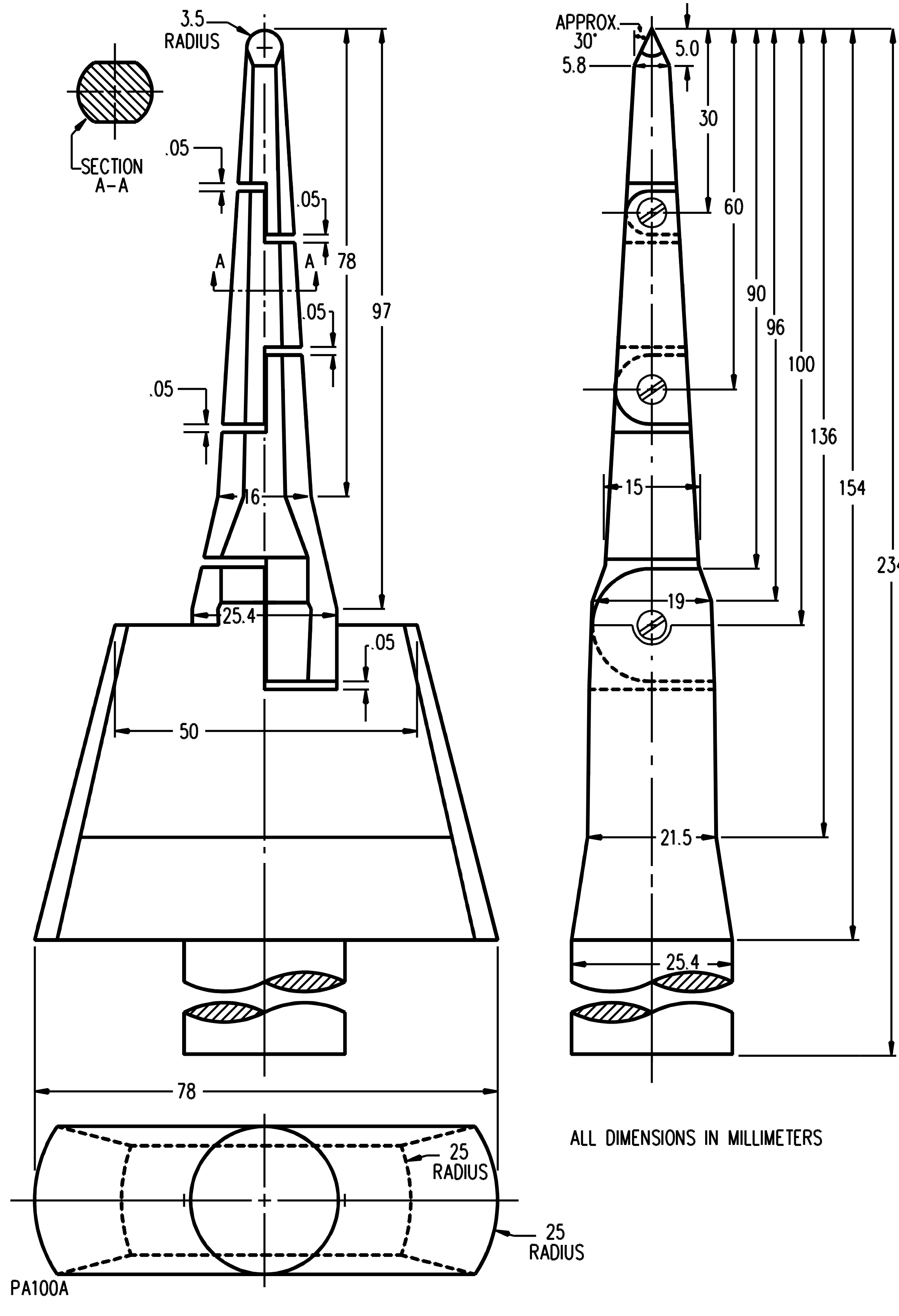
9.1.4 In order to judge the accessibility of a live or dead-metal part, the device is to be wired and assembled in accordance with the manufacturer's instructions, except that any nonessential parts (described in 9.1.6) that are able to be opened or removed by the user without using a tool are to be opened or removed. The probe shown in Figure 9.1 is to be applied with a force of not more than 3 lbf (13.3 N) to any depth that recessing will permit. The probe is to be rotated, changed in configuration, or angled before, during, and after application to any position that is necessary to examine the device. A live or dead-metal part is determined to be accessible when:

a) The part is contacted by the probe, or

b) The part is located in a hole larger than 7.1 mm (9/32 inch) in diameter and recessed less than 4.8 mm (3/16 inch).

**Figure 9.1**

**Articulate probe with web stop**



9.1.5 A separable part is considered essential for the operation of the device if it employs a latch or detent or requires use of a tool to remove, and if it performs any of the following functions:

a) Encloses or completes the enclosure of current-carrying parts other than those on the male face of an attachment plug or current tap;

b) Encloses or completes the enclosure of the flexible cord from which the jacket has been removed for wiring;

c) Mechanically secures flexible cord to pin-type terminals; or

d) Provides for the placement and removal of a fuse.

9.1.6 A separable part (such as an insulating face cover, disc or strain relief clamp) is not considered essential for the operation of the device if it can be removed without the use of a tool or without defeating a latch or detent and if it performs any of the following functions:

a) Provides strain relief;

b) Encloses wiring terminals that would otherwise be exposed on the male face of an attachment plug or current tap; or

c) Provides access to a fuse through the male face of an attachment plug or current tap.

9.1.7 With respect to 9.1.5(b), the enclosure of a flexible cord is not considered to be complete where two insulated conductors of a parallel-type cord are split apart or where the jacket is removed from the insulated conductors of a jacketed-type cord.

### 9.2 Male faces and wire terminations

9.2.1 The wire terminations of a 15 or 20 A attachment plug or current tap shall be completely enclosed when the device is wired on flexible cord and assembled as intended, using only those parts essential for the operation of the device (dead-front construction). See 9.1.5 and 9.1.6.

9.2.2 An exposed live part on the face of an attachment plug or current tap rated other than 15 or 20 A shall be provided with an insulating disc or face cover that is at least 0.028 inch (0.71 mm) thick and completely covers all exposed live parts. Any unfilled openings on a face cover or disc provided with multiple clearance openings to enable its use with a number of blade arrangements are to be located opposite the anticipated insulating face of the corresponding outlet device.

9.2.3 An insulating disc or face cover intended to be opened or removed to provide access to the wiring terminals shall be mechanically secured after wiring by one or more screws, latches, or detents that cannot be unintentionally opened or removed. A cover that is held in place by only friction without any positive detent action is not considered mechanically secured and is to be subjected to the Secureness-Of-Cover Test described in Section 72.

9.2.4 An insulating disc or face cover shall enclose the wiring terminal compartments with a fit at the periphery that will not permit the entrance of a 0.030 inch diameter (0.76 mm) probe.

*Exception: A notch may be provided in the cover to facilitate removal but only in areas remote from wiring terminals so that unclamped live strands cannot reach the opening. The notch is to comply with all of the following:*

*a) It shall not be deeper than 1/8 inch (3.2 mm) from the periphery;*

*b) It shall not be wider than 3/8 inch (9.5 mm) along the periphery of the cover; and* *c) It shall not be located within 3/8 inch (9.5 mm) of the binding screw head as measured from the closest point in the notch periphery.*

9.2.5 A device with a separable face cover shall be capable of being properly wired with the maximum size of the heaviest-duty type of flexible cord intended without inhibiting the full seating of the cover. The flexible cord used to determine compliance shall either:

a) Have an ampacity at least equal to the rating of the device configuration;

b) Be of the type and size marked on the device; or

c) Be of the maximum size that can be accommodated by the cord-entrance opening into the device.

9.2.6 An attachment plug or current tap with a separable face cover or disc shall be shipped with the cover attached to the device but not necessarily mechanically secured.

## 10 Current-Carrying Parts

### 10.1 General

10.1.1 Iron or steel, plated or unplated, shall not be used for parts that are depended upon to carry current.

*Exception No. 1: Stainless steel may be employed for a part not subject to arcing.*

*Exception No. 2: A steel that is corrosion-resistant (stainless) or is protected against corrosion by cadmium plating, zinc plating, or an equivalent protective coating, may be used for wire-binding nuts and screws if these parts are not depended upon to carry current.*

*Exception No. 3: Iron or steel current-carrying parts employed on a flatiron or appliance plug are not prohibited when protected against corrosion by a metallic plating or other metal coating. See 52.1.*

10.1.2 A current-carrying part shall be restricted from turning relative to the surface on which it is mounted if such turning would adversely affect the performance of the device.

10.1.3 Uninsulated live parts shall be secured in place so that a reduction in the spacings below those required in 14.1 is not likely.

### 10.2 Contacts

10.2.1 Female contacts and associated live parts in the contact opening of an outlet device that can be touched by the probe illustrated in Figure 10.1 shall be recessed from the plane of the opening a distance not less than 1/4 of the maximum straight-line dimension of the opening, or 3/64 inch (1.2 mm), whichever is larger. That plane nearest the face of the device having the minimum opening for the pin or blade clearance is to be used to determine the minimum recess. Bevels, tapers, or other expansions of the opening to the face of the device do not affect the measurement. The probe in Figure 10.1 is to be inserted point first as far as possible in the opening without distorting the perimeter of the opening. The maximum straight-line dimension is the maximum-length straight-line that will fit within the opening at the plane of measurement.

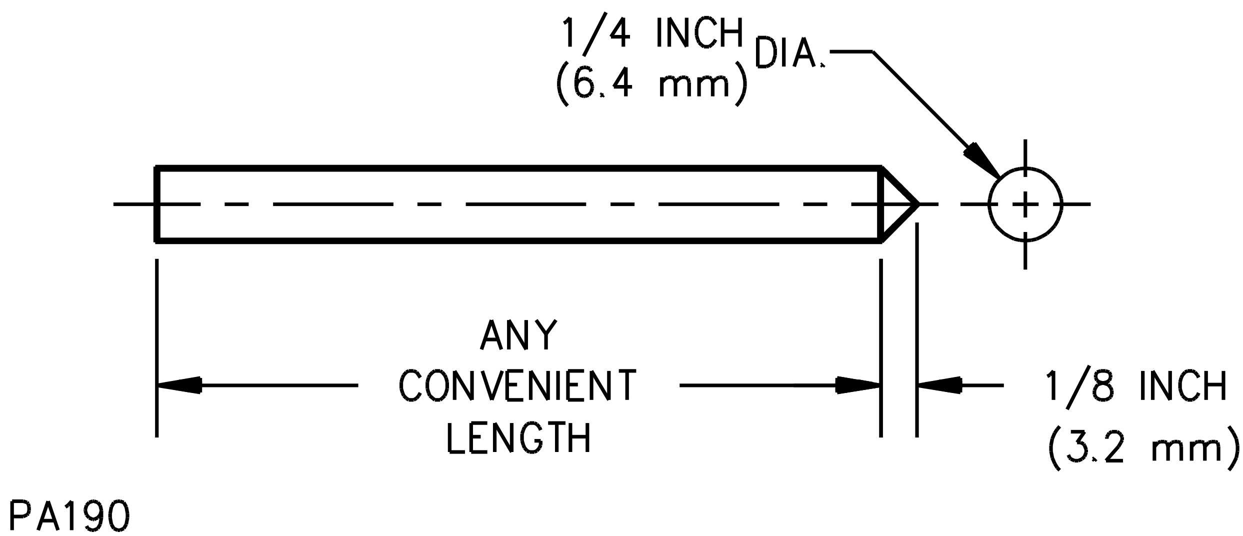
*Exception No. 1: A cord-connector having a 1-15R configuration shall comply with 23.1.1.*

*Exception No. 2: Devices having openings that close upon removal of the attachment plug are not required to comply with this requirement.*

*Exception No. 3: Specific-purpose devices intended only for disconnecting use (see 192.6), are not required to comply with this requirement.*

**Figure 10.1**

**Probe**




## 11 Grounding and Dead Metal Parts

11.1 The following grounding parts shall be of copper or of a copper-base alloy:

a) The grounding pin, blade, or contact,

b) The grounding-conductor path through an attachment plug, current tap or cord connector, except for a metal housing or armor, and

c) The grounding-conductor path through a receptacle up to the strap, yoke, or other mounting means.

*Exception: A rivet, bolt, or clamp that is used to secure parts in the grounding-conductor path, but which is not an essential conductor in the grounding-conductor path, may be of steel or its equivalent.*

11.2 A copper-base-alloy rivet that is used to secure parts in the grounding-conductor path, or that forms a part of the grounding-conductor path, shall not contain less than 80 percent copper.

11.3 The grounding-conductor path connections in a grounding device shall be secured by riveting, bolting, welding, or equivalent means.

*Exception: Another form of connection employed in a cord connector is not prohibited when the connection complies with the requirement in Potential Drop in Grounding Connections Test, Section 101.*

11.4 The grounding pin, blade, or contact, of a grounding device shall be permanently attached to the body of the device.

*Exception: A device in which the grounding member is mounted in soft rubber or similarly flexible material is not precluded by this requirement. The requirement contemplates that the element is to be secured in a manner so that it is not readily removable or movable.*

11.5 Grounding and other dead metal parts shall be secured in place so that a reduction in spacings below those required in 14.1 is not likely.

11.6 The grounding terminal of a grounding device shall be connected to the contact that is intended for use for equipment grounding. For devices having one of the standard grounding configurations, the grounding contact is identified by the letter "G" in the corresponding figure in Wiring Devices – Dimensional Specifications, ANSI/NEMA WD6, and in the Standard for Wiring Device Configurations, UL 1681. The grounding terminal shall be permanently identified in accordance with 194.1.1 in a manner that is readily recognizable during installation. See also 19.1, 24.1, 29.1.2, and Section 194, Identification and Marking of Terminals.

11.7 Dead-metal parts of a grounding device shall be conductively connected to the grounding-conductor path through the device. See 9.1.2.

*Exception: Dead-metal parts isolated from current-carrying parts and wiring other than complete flexible cords (see 9.1.7) are not required to comply with this requirement.*

11.8 A conductive connection between a blade, pin, or contact, and an exposed dead-metal part capable of being grounded in service, such as the mounting strap, yoke, or body armor, shall be provided only in a grounding device. A nongrounding device with exposed dead-metal parts shall not be provided with a wiring terminal identified for an equipment grounding conductor. See also 19.4 and 24.2.

*Exception: A nonstandard-configuration device that does not employ a dedicated grounding blade, pin, or contact, but which uses body armor or similar exposed metal parts as an equipment grounding conductor is not prohibited from being provided with an equipment grounding terminal only when the conductive connection between the grounding terminal and the exposed metal parts is obvious to the installer.*

11.9 Dead metal parts of a device for use in nongrounding applications shall be insulated from live parts and wiring other than the complete flexible cord so that stray strands, failure of wiring terminals, or failure of wiring shall not energize accessible dead metal parts. See 9.1.3.

11.10 Iron or steel other than machine screws, washers, nuts, and stainless steel parts shall be protected against corrosion.

*Exception: Parts determined to comply with 31.2.4 and 52.1, are not required to comply with this requirement.*

## 12 Terminals

### 12.1 General

12.1.1 When a device is intended for the connection of conductors, a means shall be provided for connection such as a wire-binding screw or pressure-wire type wiring terminal, or a lead that is factory-assembled by means of soldering, welding, riveting or crimping. A wire-binding screw terminal shall not be used for the connection of circuit wires to a device rated more than 30 A and intended for connection to conductors greater than 10 AWG (5.3 $mm^2$).

*Exception: Other forms of construction, such as push-in or insulation-displacement terminals, may be accepted if the mechanical features and current-carrying capability are equivalent to those of the connections mentioned above. See also 20.1.1, 25.1, 30.2.1, and 30.3.1.*

12.1.2 A terminal provided for the field connection of a grounding conductor shall employ a mechanical clamping means that does not depend upon solder for the connection of the wire.

### 12.2 Wire-binding screw terminals

12.2.1 A wiring terminal that involves a wire-binding screw shall have upturned lugs, or the equivalent, to hold a wire under the head of the screw.

12.2.2 A terminal plate that has a tapped hole for a wire-binding screw shall be of 0.030 inch (0.76 mm) or thicker metal and shall not have fewer than two full threads in the metal. A binding screw that has 32 or more threads per inch (per 25.4 mm) with a terminal plate formed from stock 0.030 inch (0.76 mm) thick, may have the metal extruded at the tapped hole to provide two full threads for the binding screw.

12.2.3 A wire-binding screw shall thread into metal.

12.2.4 The minimum size and maximum number of threads per inch (per 25.4 mm) for a wire-binding screw shall be as indicated in Table 12.1.

**Table 12.1**
**Sizes of terminal screws**

| Rating of device in amperes | Minimum size of screw | Maximum number of threads per inch (per 25.4 mm) |
|---|---|---|
| 15 or less | 6[a] | 36[c] |
| 20 | 8[b] | 32[c] |
| 30 | 8 | 32 |

[a] No. 5-40 screws may be used on devices intended only for other than outlet-box use.

[b] No. 6-36 screws with a 0.296 inch diameter (7.52 mm) or larger head may be used for terminals on attachment plugs and cord connectors. On the device with a 5-20 configuration, the terminal screw that is used for connecting the grounding conductor to the outlet box shall not be smaller than No. 6-36.

[c] No. 8 or larger screws having more than the number of threads per inch (per 25.4 mm) indicated may be used for terminals when the assembly complies with the Tightening Torque Test, Section 69.

12.2.5 A receptacle or inlet rated 30 A or less and employing wire-binding screw terminals for connection to copper branch circuit conductors only, shall comply with the general performance requirements for receptacles, Sections 110 – 125, or the general performance requirements for inlets, Sections 85 – 88, as applicable.

12.2.6 In addition to the requirements in Sections 110 – 125, a receptacle rated 15 or 20 A and employing wire-binding screw terminals for connection to copper and/or aluminum branch circuit conductors shall comply with the CO/ALR Type requirements contained in 35.1.

12.2.7 The tightening torque for the wire-binding screw terminals shall be specified by the device manufacturer and shall be marked as described in Reference No. 4 of Table 193.2 for inlets and Reference No. 18 of Table 193.4 for receptacles.

## 12.3 Soldering lugs

12.3.1 A terminal plate for a soldering lug shall be at least 0.050 in (1.27 mm) thick and shall not have fewer than two full threads in the metal for a terminal screw.

## 12.4 Pressure-wire terminals

12.4.1 A terminal plate for a pressure-wire terminal shall be at least 0.030 inch (0.76 mm) thick and shall not have fewer than two full threads in the metal for a terminal screw.

12.4.2 A pressure-wire terminal intended for the connection of branch circuit conductors to an inlet or receptacle shall be investigated in accordance with Table 12.2.

**Table 12.2**
**Pressure-wire terminals used in receptacles and inlets**

| Use | Current rating | Pressure-wire terminal type | Reference paragraphs |
|---|---|---|---|
| Copper wire only | <30A | Clamp | 89.2, 126.3 |
| | | Setscrew | 12.4.3, 89.1, 126.2 |
| | ≥35A | Clamp | 12.4.3, 89.1, 126.3 |
| | | Setscrew | 12.4.3, 89.1, 126.3 |
| Copper or aluminum wire | All | All | 12.4.3, 36.1, 126.1 |

12.4.3 The tightening torque for the pressure-wire terminals designated in Table 12.2 shall be specified by the device manufacturer and shall be marked as described in Reference No. 4 of Table 193.2 for inlets and Reference No. 18 of Table 193.4 for receptacles. The specified tightening torque shall not be less than 90 percent of the value employed in the static heating test in the Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors, UL 486E, for the maximum wire size corresponding to the ampere rating of the device.

*Exception: A lesser torque value is not prohibited when the connector is investigated in accordance with the Standard for Wire Connectors, UL 486A-486B or UL 486E using the lesser assigned torque value.*

## 12.5 Combination wire binding/pressure-wire terminals

12.5.1 A receptacle or inlet employing a combination wire binding/pressure-type terminal shall be limited to 10, 12 or 14 AWG conductors. The terminals shall comply with the applicable performance requirements as specified in the Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors, UL 486E.

12.5.2 A receptacle or inlet employing a combination wire binding/pressure-wire terminal for connection to copper branch circuit conductors only, shall comply with the general performance requirements for receptacles, as specified in Sections 110 – 125 and 90, Combination Wire Binding/Pressure Wire-Type Terminals, or the general performance requirements for inlets, Sections 85 – 88, and 90 as applicable.

12.5.3 In addition to the requirements in 12.5.2, a receptacle rated 15 or 20 A and employing a combination wire binding/pressure-type terminal for connection to aluminum branch circuit conductors shall also comply with the CO/ALR Type requirements contained in 35.1.

## 12.6 Spring action clamp terminals

12.6.1 In addition to the requirements contained in this standard, a device employing a spring action clamp terminal shall also comply with the applicable requirements, as specified in the Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors, UL 486E. All tests shall be investigated with minimum and maximum conductor AWG size and for each type of conductor (solid and stranded), for each device construction.

12.6.2 A receptacle or inlet employing spring action clamp terminals are intended for either stranded or solid or both, copper wire only.

12.6.3 A receptacle or inlet employing spring action clamp terminals are intended for the connection of a single conductor only.

12.6.4 An attachment plug or cord connector employing spring action clamp terminals are intended for the connection to flexible cord only.

## 12.7 Attachment fitting

12.7.1 An attachment fitting may only be factory assembled to utilization equipment for the purpose of connection to a luminaire and/or ceiling-suspended fan support receptacle of the same manufacturer.

12.7.2 An attachment fitting shall have securement redundancy when inserted into either a luminaire and/or ceiling-suspended fan. Compliance is checked by visual inspection.

12.7.3 An attachment fitting when fully inserted as intended into either a luminaire or ceiling-suspended fan receptacle shall bond all dead metal to the receptacle grounding terminal.

12.7.4 An attachment fitting shall be configured in such a manner as to prevent interchangeability with differently rated receptacles. It shall not be possible to mate an attachment fitting with either a luminaire or ceiling-suspended fan support receptacle having a lower rating as identified in Table 12.3.

**Table 12.3**
**Attachment fitting load rating**

| Attachment fitting load rating | Intended receptacle | Receptacle rating |
|---|---|---|
| 50 lb.<br>Luminaire Support | Luminaire Support Receptacle | Luminaire/Fixture 50 lb Minimum |
| 35 lb.<br>Fan Support | Ceiling-suspended Fan Support Receptacle [a] | Fan Support 35 lb. Minimum Luminaire/Fixture 50 lb. Minimum |
| 50 lb.<br>Fan Support | Ceiling-suspended Fan Support Receptacle [a] | Fan Support 50 lb. Minimum Luminaire/Fixture 50 lb. Minimum |
| 70 lb.<br>Fan Support | Ceiling-suspended Fan Support Receptacle [a] | Fan Support 70 lb. Minimum Luminaire/Fixture 70 lb. Minimum |

[a] Identified load rating shall be specified by the manufacturer and so marked. See Table 193.1 and Table 193.4 for marking details.

12.7.5 An attachment fitting and luminaire or ceiling-suspended fan support receptacle which utilizes slip-ring contacts shall comply with the slip-ring connection requirements in accordance with the UL 335, Standard for Cord Reels. Slip-ring testing shall be performed on the complete assembly consisting of the attachment fitting and luminaire or a ceiling-suspended fan support receptacle.

12.7.6 An attachment fitting shall comply with the applicable attachment plug requirements contained in this standard. The attachment plug fitting shall also comply with the UL 514A, Standard for Metallic Outlet Boxes as a component of either a luminaire or ceiling-suspended fan support receptacle.

## 13 Cord Entry and Strain Relief

13.1 A device intended for connection to flexible cord shall be provided with a means of strain relief so that a pull on the flexible cord will not be transmitted directly to the wiring terminations. Acceptability of the strain relief means shall be determined by the test described in Integrity of Assembly Test, Sections 75 or 102.

*Exception: The strain relief provided on a device intended solely for factory assembly to the conductors of a flexible cord shall be subjected to the Integrity of Assembly Test, Sections 71 or 98, but is not required to restrict a pull on the flexible cord from being transmitted directly to the wiring terminations when the conductors are terminated as described in 13.2(a).*

13.2 A device intended solely for factory assembly to the conductors of a flexible cord is to be connected to the conductors by:

a) Welding, riveting, crimping, or the equivalent, or

b) Soldering, when an offset or one or more right-angle bends in the conductor are employed so that a pull on the conductor will not be transmitted directly to the connection.

13.3 A device intended for use with Type SP, SPT, or other parallel-conductor flexible cord, shall be provided with one of the following means for securing the individual conductor insulation:

a) An integral strain relief, not external to the body of the device,

b) A means for snubbing, or

c) Space within the device for a strain-relief knot. If a knot is to be used, all surfaces on which the knot may bear shall be smooth and well-rounded.

13.4 The diameter of a round cord-entry hole or the minor axis of an oblong cord-entry hole provided on a device intended for use on Type SP, SPT, or other parallel-conductor flexible cord shall not be longer than 1/4 inch (6.4 mm).

13.5 A metal-covered device intended for connection to a flexible cord shall be provided with an insulating bushing of porcelain, phenolic or cold-molded composition, or other insulating material with equivalent properties.

*Exception No. 1: Hard fiber is acceptable for the bushing if the fiber is not less than 3/64 inch (1.2 mm) thick, and it is so formed and secured in place that it will not be affected by ordinary conditions of moisture.*

*Exception No. 2: If the metal covering (armor) of a device is not in proximity to the cord-entry hole, and the insulating material of which the plug is made serves as a smooth, well-rounded bushing for a flexible cord, a separate insulating bushing is not required.*

*Exception No. 3: A metal-covered device with a metal cord grip intended specifically for use with a jacketed type of flexible cord, such as Type S or SJ is not required to have an insulating bushing.*

## 14 Spacings

14.1 The spacings maintained through air or over surface shall be a minimum 3/64 inch (1.2 mm) for a device rated 250 V or less, and a minimum 1/8 inch (3.2 mm) for a device rated more than 250 V, between the following:

a) Uninsulated live parts of opposite polarity;

b) An uninsulated live part and a dead-metal part that is likely to be grounded or exposed to contact by persons when the device is installed as intended, including a metal surface on which the device is mounted in the intended manner or a metal face plate used with a flush receptacle.

*Exception No. 1: The grounding terminal of a flush receptacle shall instead comply with the spacing requirements in 31.2.1.*

*Exception No. 2: A self-contained receptacle shall instead comply with the spacing requirements in 44.1.*

*Exception No. 3: A dead-metal screw head, rivet, or the like, which is located in a hole not larger than 9/32 inch (7.1 mm) in diameter and recessed not less than 3/16 inch (4.8 mm) is not considered to be exposed to contact by persons after the device is installed in the intended manner.*

14.2 In measuring a spacing, an isolated dead-metal part interposed between live parts of opposite polarity, or between a live part and a grounded or exposed dead-metal part, is considered to reduce the spacing by an amount equal to the dimension of the isolated dead-metal part in the direction of the measurement.

## 15 Assembly

### 15.1 General

15.1.1 A device shall be capable of being readily wired as intended.

15.1.2 Electrical contact shall be reliably maintained at any point at which a connection is made between current-carrying parts.

15.1.3 An outlet device shall have live parts protected against exposure to contact by persons when the outlet is assembled and installed as intended.

15.1.4 When internal connections exist in a multiple-outlet device, similar and corresponding contacts of individual outlets shall be connected together.

15.1.5 A device having female contacts shall be constructed so that a standard attachment plug of the same configuration and with maximum length blades is capable of seating properly without exposure of the blades between the plane of the face of the plug and the plane of the rim of the female contact device.

*Exception: Exposure of the wide side of the blade for a distance of 1/32 inch (0.8 mm) or less (measured along the length of the blade) is acceptable, and exposure of the narrow side of the blade is acceptable if the exposed area is recessed for a distance not shorter than the length (measured along the blade) of the exposed area.*

### 15.2 Grounding and polarization

15.2.1 A grounding outlet device shall be so constructed that the grounding member of the corresponding attachment plug cannot be inserted by hand into any outlet slot to touch the live contact.

15.2.2 A device consisting of two or more pieces shall be such that polarization cannot be defeated by improper assembly during installation.

15.2.3 A cord connector or current tap having a 1-15R nonpolarized configuration shall not accommodate an attachment plug having polarized blades to the extent that the wider (polarized) blade can make electrical contact with either outlet device contact. Compliance shall be determined by the test described in Improper Insertion Test, Section 100.

15.2.4 A cord connector or current tap having a 1-15R polarized configuration shall not accommodate an attachment plug having polarized blades in other than the intended orientation to the extent that the wider (polarized) blade can make electrical contact with the contact of the narrower (non-polarized) slot. Compliance shall be determined by the test described in Improper Insertion Test, Section 100.

### 15.3 Mating and interchangeability

15.3.1 A general-use device, including any configuration illustrated in Wiring Devices – Dimensional Specifications, ANSI/NEMA WD6, the Standard for Wiring Device Configurations, UL 1681, or the Entertainment Technology Dimensional Requirements for Stage Pin Connectors, ANSI/ESTA E1.24, shall be constructed so that electrical continuity between respective and similarly marked terminals is established automatically when the mating plug and outlet device are connected together.

*Exception No. 1: A 2-pole non-polarized device is not required to comply with this requirement*

*Exception No. 2: A special-purpose device for use in equipment where intermixed connections do not increase the risk of fire, electric shock, injury to persons, or damage to equipment, is not required to comply with this requirement.*

15.3.2 An outlet device shall not accommodate an attachment plug other than one that is specifically intended for use with the outlet.

15.3.3 A male or female device that is capable of making a conductive connection with a female or male device of an established general-use design shall be constructed and rated for complete and correct interchangeability with the established design. An established general-use design is considered to include any of the following:

a) Any of the configurations outlined in Wiring Devices – Dimensional Specifications, ANSI/NEMA WD6;

b) Any of the configurations outlined in the Standard for Wiring Device Configurations, UL 1681;

c) Any of the configurations identified in Entertainment Technology Dimensional Requirements for Stage Pin Connectors, ANSI/ESTA E1.24;

d) Another configuration that is an American National Standard configuration; or

e) A special-purpose configuration that is acceptable for use in one of the wiring systems that complies with the National Electrical Code, ANSI/NFPA 70.

*Exception: A special-purpose receptacle configuration that will not accept any standard general-use plugs shall be permitted to accept a modified general-use plug that will also be accepted by the mating general-use receptacle. (For example, a receptacle for use in a hazardous location that is intended to supply hazardous-location equipment provided with a modified plug that may be used in either an ordinary or hazardous location.)*

15.3.4 A male or female device of an established general-use design shall comply with the dimensions, spacings, and the relative arrangement of blade and contact slots required by one of the following:

a) Wiring Devices – Dimensional Specifications, ANSI/NEMA WD6;

b) The Standard for Wiring Device Configurations, UL 1681;

c) Entertainment Technology Dimensional Requirements for Stage Pin Connectors, ANSI/ESTA E1.24; or

d) Other American National Standard.

15.3.5 Attachment plugs, cord connectors, current taps, and receptacles that have different electrical ratings shall not be interchangeable with one another.

*Exception No. 1: A 20-A outlet device is not prohibited from accommodating a 15-A attachment plug for a single and identical voltage rating only.*

*Exception No. 2: A special-purpose configuration that will not mate with a standard general-use configuration shall be permitted to have multiple current and voltage ratings if the device is intended for installation in facilities where it will be serviced only by qualified personnel, and where the configuration will be used on circuits with one of the device's rated currents, voltages and frequencies throughout the facility.*

*Exception No. 3: Plugs, cord connectors, and current taps for use on flexible cords, or that are provided with fuses, that have a lower current rating, as described in Exception No. 1 to 192.1, are not prohibited from mating with corresponding devices with the standard current rating and the identical voltage rating.*

*Exception No. 4: Devices of the ANSI/ESTA E1.24 Standard, Type 5 configurations (5T20, 5T30, 5T60 and 5T100) are identified as dual-rated voltage devices ("125 – 250 V"). These configurations are only intended for use on grounded-neutral electrical circuits.*

15.3.6 An outlet device having a nongrounding configuration shall not accept a grounding-type attachment plug.

*Exception: The locking grounding device illustrated in Standard for Wiring Device Configurations, UL 1681 Figure C1.1 and marked "Hospital Only" shall be permitted to be interchangeable with other nongrounding general-use devices which are not so marked.*

### 15.4 Fuseholders

15.4.1 An enclosure shall be provided for the fuse or fuses in a device intended to accommodate such components.

15.4.2 A fuse enclosure shall reduce the risk of persons unintentionally contacting uninsulated live parts of the fuse and fuseholder.

15.4.3 A fuse enclosure shall confine the effects of a fuse rupture to the interior of the enclosure.

15.4.4 A device intended for use with a branch-circuit type fuse shall not be capable of accommodating a fuse or fuses that have a rating lower than the maximum rating in volts for the device.

15.4.5 In a fusible device, there shall be provision for a fuse in each ungrounded conductor, but there shall be no provision for a fuse in any other conductor.

15.4.6 The construction of a fusible device that has male pins or blades shall be such that the fuse or fuses will not be removable when the pins or blades are in a receptacle.

*Exception: A fusible attachment plug having a configuration that is not illustrated in Wiring Devices – Dimensional Specifications, ANSI/NEMA WD6, or in the Standard for Wiring Device Configurations, UL 1681, may be provided with a fuse or fuses which is removable when the pins or blades are in a receptacle when the attachment plug is marked in accordance with Reference No. 12 of Table 193.1.*

15.4.7 A fusible outlet device, such as a receptacle or a cord connector, shall not have live parts exposed to contact by persons when a fuse is being removed or replaced.

### 15.5 Switches

15.5.1 A switch provided as a part of a wiring device shall comply with the Standard for General-Use Snap Switches, UL 20. A switch provided as part of a device intended for factory assembly as a component of end-use equipment shall comply with the Standard for Switches for Appliances – Part 1: General Requirements, UL 61058-1.

ATTACHMENT PLUGS AND INLETS

## 16 Insulating Materials

16.1 An insulating plate employed for the backing of an inlet shall not be less than 1/32 inch (0.8 mm) thick and shall be moisture-resistant in accordance with 64.1 and 64.2. Phenolic composition or a similar material is acceptable for the insulating plate. Fiber may be employed if it is not less than 1/16 inch (1.6 mm) thick, is impregnated to resist the absorption of moisture in accordance with 64.1 and 64.2, and is not depended upon (by itself) to hold contacts or other live parts in place.

## 17 Enclosure

### 17.1 General

17.1.1 A general-use attachment plug shall not be provided with more than one cord-outlet hole.

17.1.2 A 2-pole attachment plug shall have a 2-inch (51-mm) or shorter overall length measured from the face of the plug to include any handle grip.

*Exception: A 2-5/8 inch (66.7 mm) (maximum) overall length is acceptable for an attachment plug or current tap if the device:*

*a) Weighs less than 6 oz (170 g),*

*b) Is torsionally balanced about an axis that is perpendicular to the pin face and that is centered between the blades or pins, and*

*c) Has a center of gravity located on this axis no further than 1 inch (25.4 mm) from the pin face.*

17.1.3 A 50-A attachment plug with a molded phenolic shell enclosing the wiring terminals is not acceptable in an application in which the attachment plug is likely to be subject to severe mechanical abuse.

17.1.4 The body of an inlet employing a combination wire binding/pressure wire-type terminal shall employ integrally formed channels/guides within the body to:

a) Properly position individual conductor; and

b) Provide a means to reduce the likelihood of the conductor(s) being displaced from under the terminal ring when conductor(s) are to be installed.

Compliance shall be determined by the Terminal Strength Test, Section 123.

### 17.2 Grip

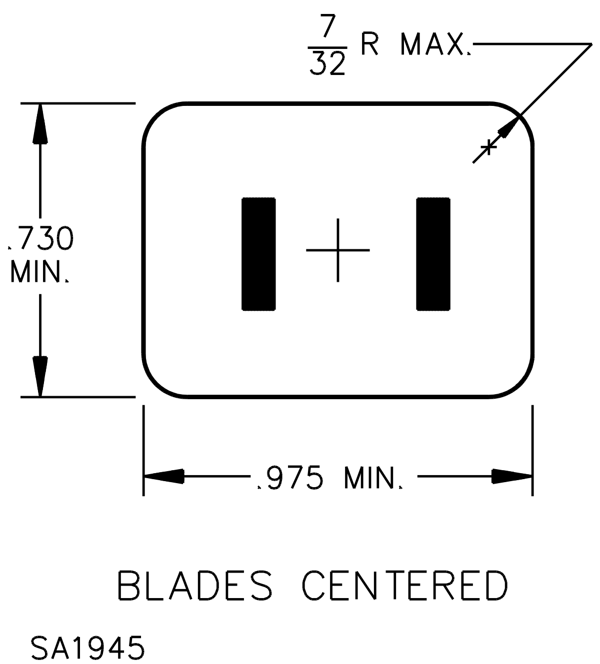
17.2.1 An attachment plug having a 1-15P configuration for use on parallel or vacuum cleaner (SV, SVO, SVOO, SVT, SVTO, SVTOO, SVE, SVEO, and SVEOO) type flexible cord shall have a surface that facilitates gripping between the thumb and forefinger or some equivalent finger gripping means independent of the cord to provide for easy insertion and withdrawal from an outlet. See Attachment Plug Grip Tests, Section 74.

### 17.3 Face size

17.3.1 The perimeter of the face of an attachment plug having a 1-15P configuration shall encompass an area equal to or larger than that indicated in Figure 17.1.

**Figure 17.1**

**Minimum attachment plug face dimensions**




| inch | 7/32 | 0.730 | 0.975 |
|---|---|---|---|
| mm | 5.6 | 18.5 | 24.8 |

### 17.4 Configurable Plug

17.4.1 A configurable attachment plug may only be of the Standard for Wiring Devices – Dimensional Specifications, ANSI/NEMA WD6 configurations as shown in Table 17.1.

**Table 17.1**
**Configurable Attachment Plug Configurations**

| ANSI/NEMA WD6 Configuration | No. of Poles | No. of Wires | Ampere, A | Voltage, V |
|---|---|---|---|---|
| 5-30P/5-50P | 2 | 3 | 30/50 | 125 |
| 6-30P/6-50P | 2 | 3 | 30/50 | 250 |
| 10-30P/10-50P | 3 | 3 | 30/50 | 125/250 |
| 14-30P/14-50P/14-60P | 3 | 4 | 30/50/60 | 125/250 |
| 15-30P/15-50P/15-60P | 3 | 4 | 30/50/60 | 250 V, 3-ph |
| 18-30P/18-50P/18-60P | 4 | 4 | 30/50/60 | 120/208 V, 3-ph Y |

17.4.2 A configurable attachment plug shall comply with all dimensions identified in ANSI/NEMA WD6 for the configuration(s) as specified by the manufacturer.

17.4.3 Blades and associated terminals of a configurable attachment plug shall be uniquely keyed and identified to prevent interchangeability of blades into positions reserved exclusively for either the grounded or grounding terminal and blade/pin profile.

17.4.4 A configurable attachment plug shall have live parts protected against exposure when fully assembled using all essential parts when fully inserted into a mating contact device for each identified configuration.

17.4.5 If a configurable attachment plug identified by the manufacturer includes both grounded configurations (“L”-shaped and flat-shaped) blades and/or configurations for grounding, it shall include all necessary terminals and blade/pin construction for the identified configuration(s).

17.4.6 A configurable attachment plug shall be marked with the electrical rating and blade (ANSI/NEMA) configuration, for each identified configuration. It shall not be possible to misassemble the device with an incorrect rating for the configured blades. In the case where a separable face disk is used, each individual face disk shall be marked with the electrical rating, configuration identifier (i.e. ANSI/NEMA 14-50P), and be individually configured to the specific blade profile for each configuration. Each face disk shall be provided with a mechanical means (i.e. screw) for securement to the plug face enclosure. Adhesives are not permitted.

17.4.7 The enclosure (housing) of a configurable attachment plug that is secured to the terminal housing by a threading action shall not be relied upon to hold the blade/pin terminals in position.

## 18 Current-Carrying Parts

18.1 The folded-over blades of 15- or 20-A attachment plugs shall be formed from stock that is 0.028 – 0.032 inches (0.71 – 0.81 mm) thick.

*Exception: Folded-over blades may be formed from stock less than 0.028 inches (0.71 mm) thick provided the stock is not less than 0.020 inch (0.51 mm) thick and both ends of the blade are securely retained within the body of the device, such that the overall thickness is maintained.*

18.2 The profiles of the blades employed in an attachment plug having a 1-15P, 2-15P, 2-20P, 5-15P, 5-20P, 6-15P, or 6-20P configuration shall comply with the dimensional requirements of the Standard for Attachment Plug Blades for Use in Cord Sets and Power-Supply Cords, UL 1659.

## 19 Grounding and Dead Metal Parts

19.1 The grounding terminal mentioned in 11.6 and its corresponding contact shall be conductively connected to the mounting means (yoke or strap) of a flanged inlet and to the armor of an armored attachment plug.

*Exception: The conductive connection is not required to be provided in a flanged inlet provided all of the following conditions are met:*

*a) The mounting bracket, yoke, strap, or flange is constructed of an insulating material.*

*b) The lack of grounding continuity to the mounting means is obvious to the installer.*

*c) The device is plainly marked in accordance with Reference No. 3 of Table 193.2.*

19.2 For a grounding device, the blade to be used for grounding (G in the figures) shall be longer (see respective figures) than the other blades. For an attachment plug with a nonstandard configuration, the construction of the plug shall be such that, when the plug is inserted into its corresponding receptacle, contact between the grounding blade and the corresponding outlet contact will be made before contact between the other blades and their corresponding contacts.

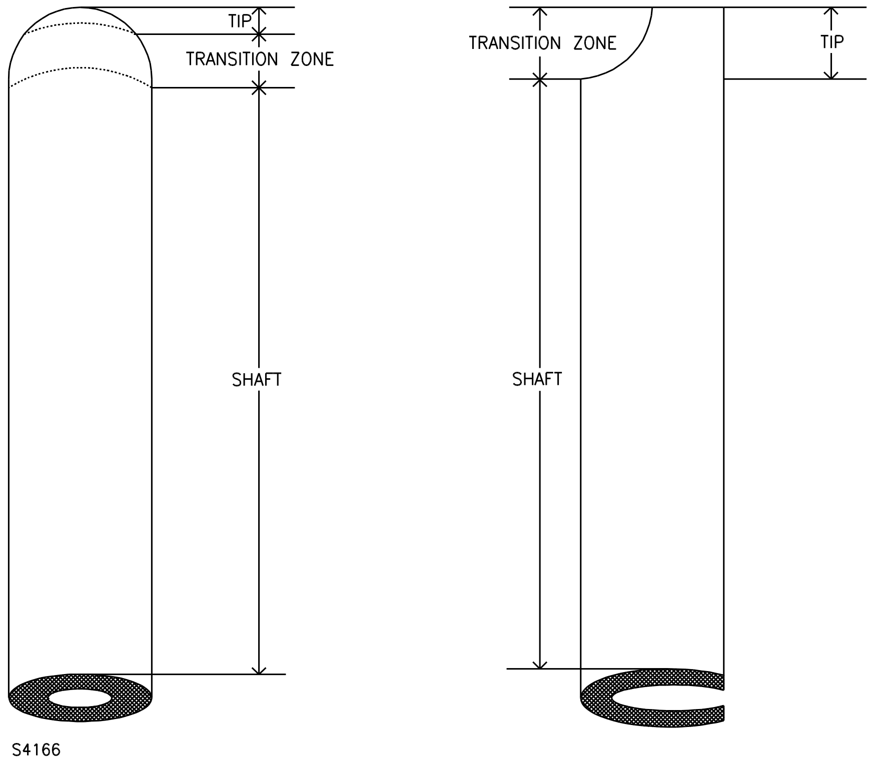
19.3 A grounding blade or pin of a 15- or 20-A nonlocking type attachment plug shall not contain surface discontinuities that would tend to interfere with insertion or withdrawal from a grounding contact of an outlet device. Abrupt surface transitions such as gaps, steps, offsets, detents, holes or sharp chamfers are specifically prohibited in the following areas shown in Figure 19.1:

a) The shaft, and

b) The transition zone between the tip and the shaft which is likely to engage the grounding contact during insertion or withdrawal.

**Figure 19.1**

**Grounding pin profiles**




19.4 For a three- or four-pole attachment plug that requires the connection of a grounding conductor, a wiring terminal for the grounding blade or contact is necessary if the device is intended for use with flexible cord.

*Exception: If the device is intended for use with armored cable, and if the grounding pin or blade is conductively connected to the armor, no wiring terminal is necessary. If on such a device the armor of the attachment plug is conductively connected to the grounding pin or blade (whether or not a wiring terminal is provided), the electrical connection between the armor and the pin or blade is to be readily visible, or the dead metal of the device is to be marked in accordance with Reference No. 3 of Table 193.2.*

19.5 The grounding pin of an attachment plug shall be secured rigidly and perpendicular to the plane of the face. The grounding pin shall not incorporate, or be provided with, a means to pivot, deflect, or bend after being inserted into a mating outlet device. Compliance is checked by visual inspection.

## 20 Terminals and Leads

### 20.1 Terminals

20.1.1 A pin-type terminal of an attachment plug intended for field assembly on a flexible cord may be accepted for a current-carrying connection only if it complies with the requirements in Sections 80 – 84. An attachment plug with pin-type terminals shall have a 1-15P configuration. See Reference No. 5 to Table 193.1.

20.1.2 If an attachment plug is not provided with wire-binding-screw terminals, and employs a soft-rubber compound molded around the blades and attached conductors, the conductors shall be soldered or welded to the blades or attached by means of pressure-wire connectors.

*Exception: If tinsel cord is employed, the conductors may be secured to the blades under the heads of rivets or by an equivalent means.*

### 20.2 Leads

20.2.1 Integral grounding and circuit conductor leads of an inlet shall be of copper and shall be:

a) Type RH or TW wire or an equivalent rubber- or thermoplastic-insulated wire for a general-use device and Type SF, SFF, or an equivalent type of wire for a device intended for use in a fixture, and

b) Not smaller in size than indicated in Table 20.1.

**Table 20.1**
**Smallest acceptable sizes of inlet leads**

| Current rating of inlet | Copper circuit leads – AWG ($mm^2$) | Copper grounding leads – AWG ($mm^2$) |
|---|---|---|
| 15A | 16[a] or 14 (1.3[a] or 2.1) | 16[a] or 14 (1.3[a] or 2.1) |
| 20 | 12 (3.3) | 12 (3.3) |
| 30 | 10 (5.3) | 10 (5.3) |
| 50 | 6 (13.3) | 10 (5.3) |
| 60 | 4 (21.1) | 10 (5.3) |

[a] 16 AWG circuit and grounding leads are acceptable only if the inlet is intended for mounting in an appliance.

20.2.2 For an inlet:

a) An integral grounding pigtail lead shall not be shorter than 6 inches (152 mm), and

b) Integral circuit leads shall not be shorter than 4 inches (102 mm).

*Exception: For an inlet intended for mounting in an electric lighting fixture or appliance, the length of integral leads is not specified.*

### 20.3 Attachment plug and inlet with spring action clamp terminal

20.3.1 An inlet that is provided with spring action clamp terminal shall be provided with a positive means to prevent unintentional separation of the conductor from the terminal and shall comply with the Spring Action Clamp Terminal Pull Test described in Section 91A.

20.3.2 An attachment plug that is provided with spring action clamp terminal shall be provided with a positive means to prevent unintentional separation of the conductor from the terminal and shall comply with the Spring Action Clamp Terminal Pull Test described in Section 77A.

## 21 Assembly

21.1 Blades and terminals shall be held securely in place. If they are mounted on a disc of insulating material separate from the rubber compound, the disc shall be:

a) Of a material acceptable for the mounting of current-carrying parts,

b) Not less than 1/16 inch (1.6 mm) thick, and

c) Acceptably secured in the plug.

21.2 Means shall be provided for securely attaching the body of an inlet to the supporting base of an inlet. When assembled, the body shall be restricted from turning with respect to the base.

21.3 A supporting base of an inlet intended for surface mounting shall be provided with no fewer than two holes for mounting screws.

21.4 Live screw heads or nuts on the underside of a base intended for surface mounting shall be spaced 1/2 inch (12.7 mm) or more through air from the mounting surface and staked, upset, or otherwise restricted from loosening.

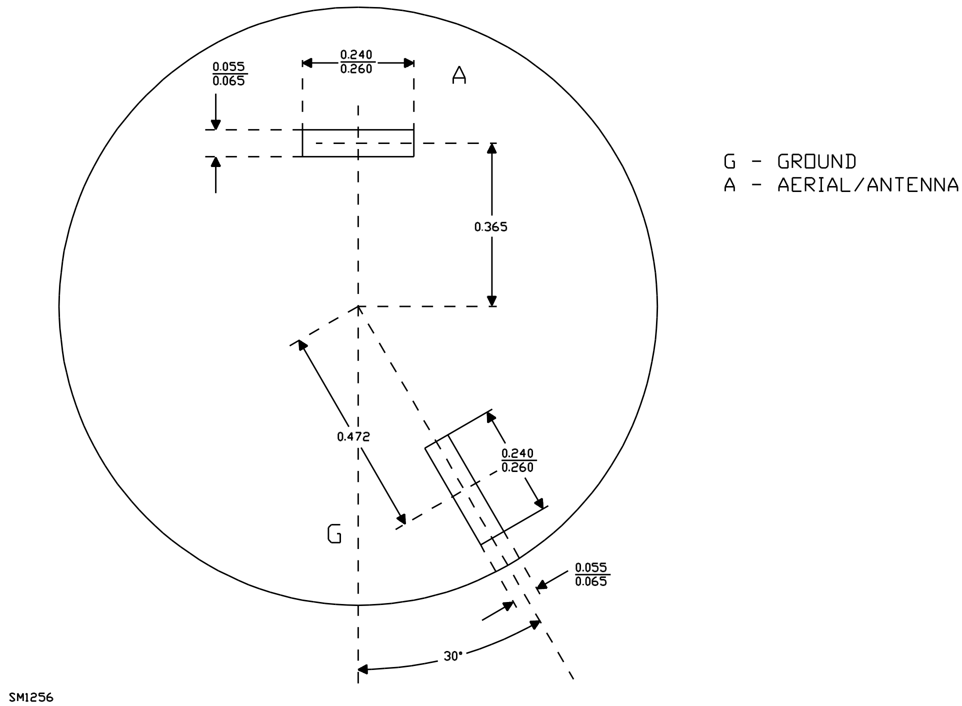
*Exception No. 1: Live parts that are countersunk not less than 1/8 inch (3.2 mm) and then covered with a sealing compound that complies with 8.6.1 and 8.6.2 are not required to comply with this requirement.*

*Exception No. 2: Live parts that are countersunk not less than 1/8 inch (3.2 mm) and then covered with a minimum of 1/16 inch (1.6 mm) thick sealing compound, where the sealing compound complies with 8.6.1 and 8.6.2 and the underside of the supporting base is recessed so that the sealing compound will not contact the surface upon which the receptacle is mounted, are not required to comply with this requirement.*

21.5 An attachment plug intended for connections to radio-antenna, ground, or both shall be such that the blades cannot be inserted to touch the live contacts of a conventional outlet device not intended for use with such a plug. See Figure 21.1 for an example of a radio-antenna plug configuration.

**Figure 21.1**

**Example of a radio-antenna plug configuration**




| inch | 0.055 | 0.065 | 0.240 | 0.260 | 0.365 | 0.472 |
|---|---|---|---|---|---|---|
| mm | 1.4 | 1.7 | 6.1 | 6.6 | 9.3 | 12.0 |

## 22 Weatherproof Type

22.1 Fiber and similar absorptive materials shall not be used in a weatherproof attachment plug.

22.2 A lead wire provided as part of a weatherproof attachment plug, and intended to be exposed after installation, shall be:

a) A stranded RH, RHW, TW, or an equivalent type of wire,

b) Not smaller than 14 AWG (2.1 $mm^2$), and

c) Not less than 4-1/2 inches (114 mm) long.

CORD CONNECTORS

## 23 Enclosure

### 23.1 General

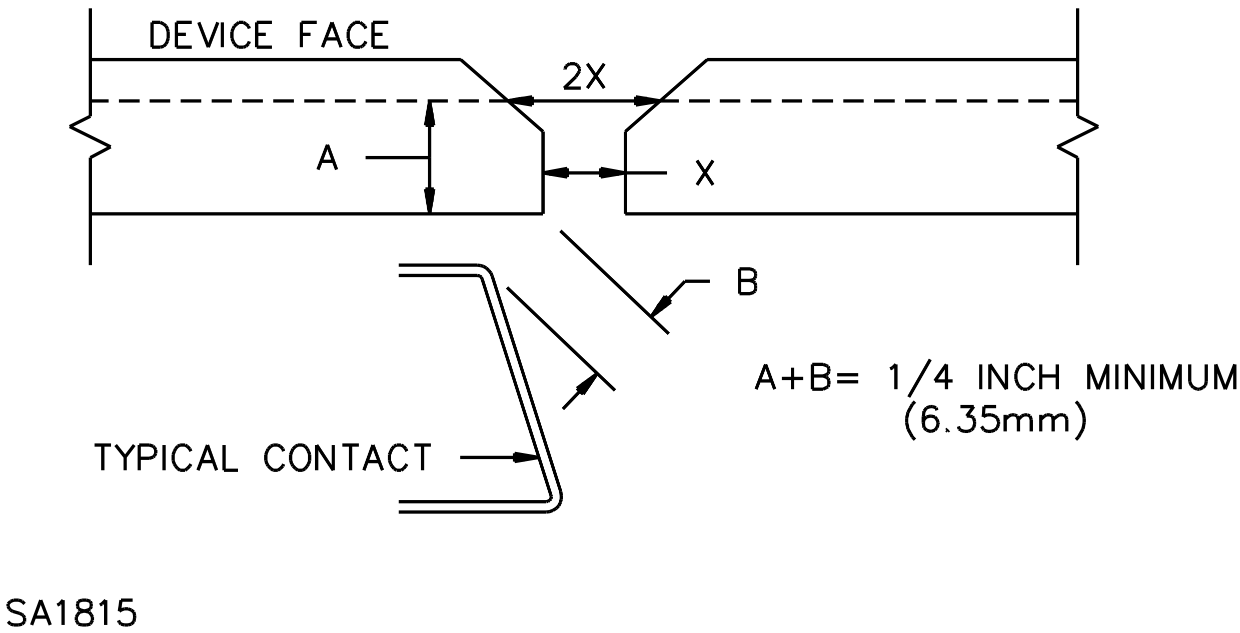
23.1.1 A cord connector having a 1-15R configuration intended for use on general-use cord sets employing parallel or vacuum cleaner (SV, SVT, SVO, SVE, SVEO, SVEOO, SVOO, SVTO, and SVTOO) type flexible cord shall have their contacts and other live parts spaced not less than 1/4 inch (6.35 mm) behind the face when measured from the plane of each slot opening through air and over insulating surfaces. The plane of the slot opening is defined as follows:

a) For slot openings that are bevelled to facilitate the entrance of a plug blade, the plane of the slot opening is that plane nearest the face of the device in which the minor dimensions of the slots are no more than twice the value specified for the 1-15R slot configuration, as shown in Figure 23.1.

b) For slot openings without bevels, the plane of the slot opening is the plane of the cord connector face.

**Figure 23.1**

**Typical slot cross section (with bevel)**




## 23.2 Face size

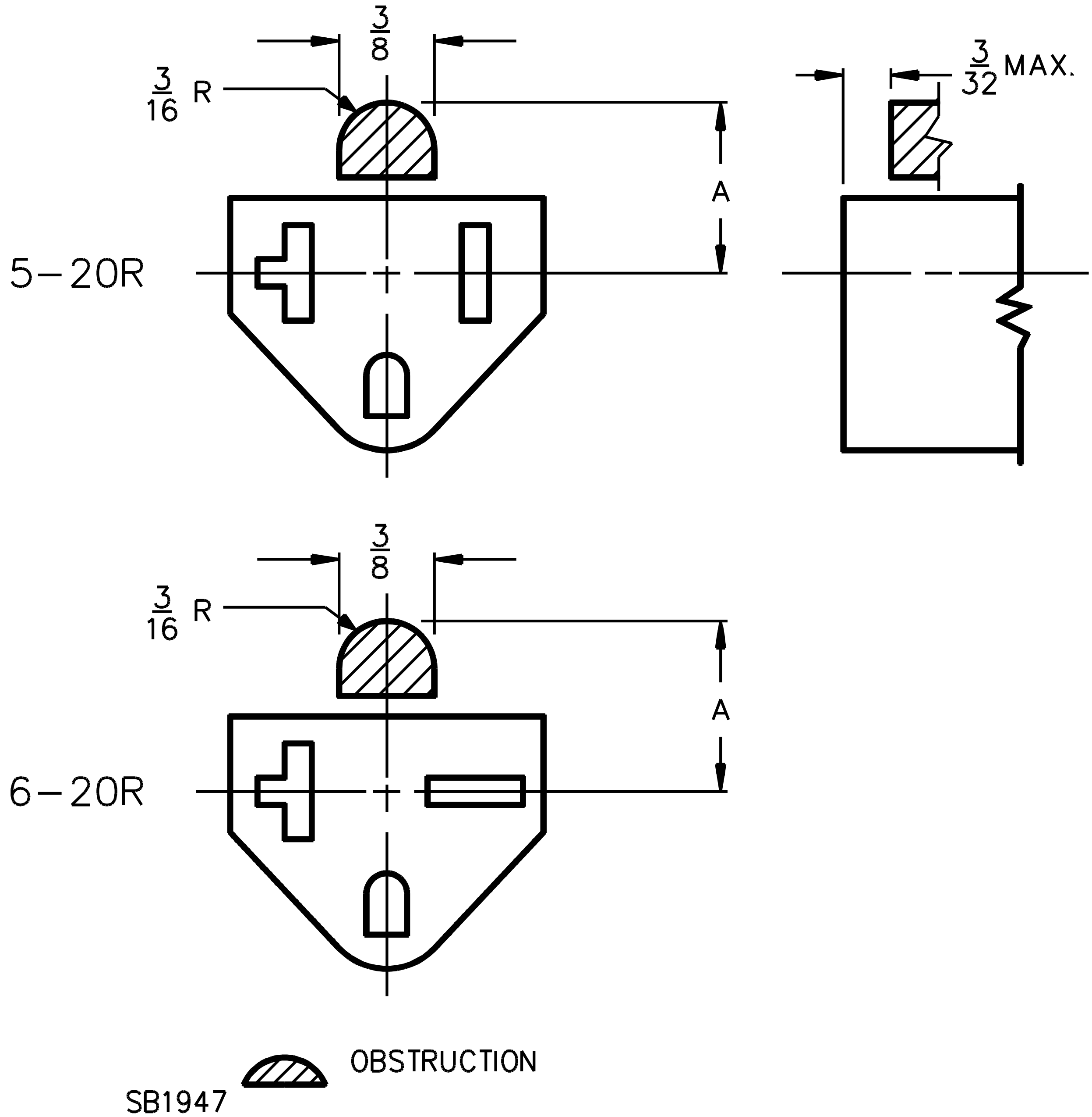
23.2.1 The outlet face of a cord connector having a 5-20R or 6-20R configuration shall obstruct the insertion of an attachment plug having a 6-20P or 5-20P configuration, respectively, to the extent that the indicated devices cannot be mated by deliberate manual force including manipulation to deflect the ground pin to the outside of the face when attempting to insert the line blades. The obstruction shall:

a) Have the minimum size and shape indicated as the shaded portions of Figure 23.2. The "A" dimension shall be at least 0.531 inch (13.5 mm) for a cord connector molded of a material having a hardness of 90 or greater, and at least 0.625 inch (15.9 mm) for a cord connector molded of a material having a hardness of less than 90, where the material hardness is measured using the "A" scale on a Shore Durometer; and

b) Be coplanar with the face or recessed by not more than 3/32 inch (2.4 mm).

**Figure 23.2**

**Faces of outlet devices showing locations and minimum dimensions of obstructions**




| inch | 3/32 | 3/16 | 3/8 |
|---|---|---|---|
| mm | 2.4 | 4.8 | 9.5 |

| **Dimension A inch (mm)** | **Shore durometer hardness (scale A)** |
|---|---|
| 0.625 (15.9) | less than 90 |
| 0.531 (13.5) | 90 or more |

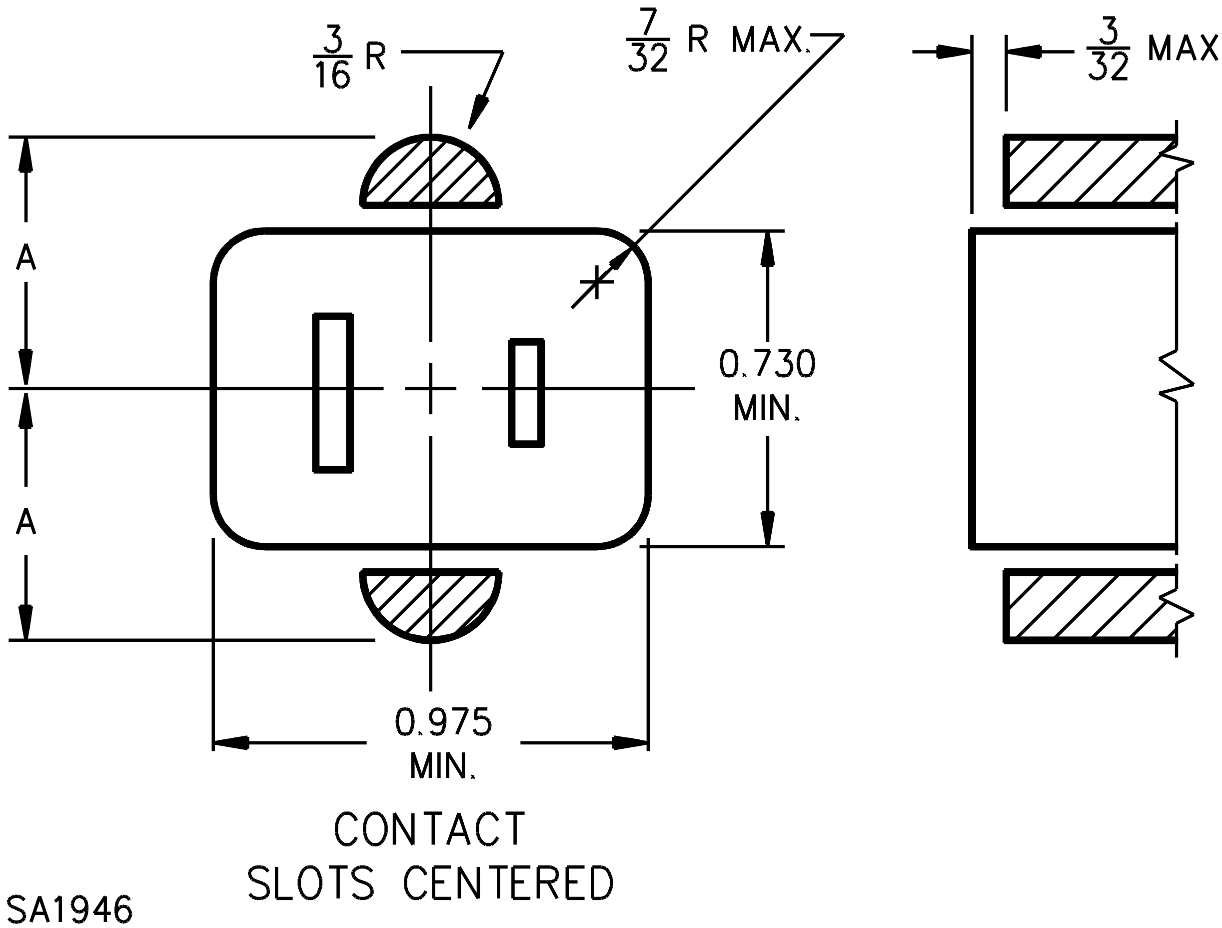
23.2.2 The outlet face of a cord connector having a 1-15R configuration shall have a perimeter that encompasses an area equal to or larger than that indicated in Figure 23.3, and shall obstruct the insertion of an attachment plug having a 5-15P configuration to the extent that the grounding attachment plug cannot be mated by deliberate manual force including manipulation to deflect the ground pin to the outside of the face when attempting to insert the line blades. The obstruction shall:

a) Have the minimum size and shape indicated as the shaded portions of Figure 23.2. The "A" dimension shall be at least 0.531 inch (13.5 mm) for a cord connector molded of a material having a hardness of 90 or greater, and at least 0.625 inch (15.9 mm) for a cord connector molded of a material having a hardness of less than 90, where the material hardness is measured using the "A" scale on a Shore Durometer; and

b) Be coplanar with the face or recessed by not more than 3/32 inch (2.4 mm).

**Figure 23.3**

**Minimum outlet face dimensions**




| inch | 3/32 | 3/16 | 7/32 | 0.730 | 0.975 |
|---|---|---|---|---|---|
| mm | 2.4 | 4.8 | 5.6 | 18.5 | 24.8 |

| **Dimension A inch (mm)** | **Shore durometer hardness (scale A)** |
|---|---|
| 0.625 (15.9) | less than 90 |
| 0.531 (13.5) | 90 or more |

## 24 Grounding and Dead Metal Parts

24.1 The grounding terminal mentioned in 11.6 and 24.2 and its corresponding contact shall be conductively connected to the armor of an armored cord connector.

24.2 For a three- or four-pole cord connector that requires the connection of a grounding conductor, a wiring terminal for the grounding blade or contact is necessary if the device is intended for use with flexible cord.

*Exception: If the device is intended for use with armored cable, and if the grounding contact is conductively connected to the armor, a wiring terminal is not required. If on such a device the armor of the cord connector is conductively connected to the grounding contact (whether or not a wiring terminal is provided), the electrical connection between the armor and the contact is to be readily visible, or the dead metal of the device is to be marked in accordance with Reference No. 11 of Table 193.3.*

24.3 The grounding contact in a grounding-type cord connector shall be located and formed so that the path of electrical continuity to the grounding pin or blade of a mating attachment plug is completed before continuity is established between any other contact and its respective pin or blade on the attachment plug. This grounding path shall be substantial when the attachment plug is properly seated in the cord connector.

## 25 Terminals

25.1 A pin-type terminal of a cord connector intended for field assembly on a flexible cord may be accepted for a current-carrying connection only if it complies with the requirements in Sections 105 – 109. A cord connector with pin-type terminals shall have a 1-15R configuration.

## 25A Cord Connector with Spring Action Clamp Terminal

25A.1 A cord connector that is provided with spring action clamp terminal shall be provided with a positive means to prevent unintentional separation of the conductor from the terminal and shall comply with the Spring Action Clamp Terminal Pull Test described in Section 99A.

## 26 Assembly

### 26.1 General

26.1.1 In a cord connector, an assembly screw, rivet, or the like that is visible and is electrically connected to any live part shall be located in a hole not larger than 9/32 inch (7.1 mm) in diameter and recessed not less than 3/16 inch (4.8 mm).

26.1.2 When internal connections exist in a multiple-outlet cord connector, similar and corresponding contacts of individual outlets shall be connected together.

26.1.3 A cord connector shall not accommodate an attachment plug other than one that is specifically intended for use with the outlet.

26.1.4 The construction of a cord connector intended for use on a household appliance shall be such that the set of pins described in 55.1 and Table 55.1 cannot, without distortion or forcing, be made to seat properly in the female contacts.

*Exception: A conventional flatiron or appliance plug for use on a household heating appliance is not precluded by this requirement.*

26.1.5 A general-use cord connector including a table tap, shall be constructed with only one hole or breakout for the cord (not for through-cord wiring).

26.1.6 A cord connector shall not be provided with more than three outlets and shall not employ any screw shell outlets.

26.1.7 A table tap shall not be provided with an assembly-screw hole extending through the device from front to back, a mounting-screw hole, or other means by which it can be mounted permanently. If binding-screw terminals are employed, only one set shall be provided, and there shall be means provided for gaining access to them.

26.1.8 A cord connector shall comply with the requirements in 13.1 – 13.5 for strain relief, bushings, and cord grips.

### 26.2 Outlet separation

26.2.1 Cord connectors having two or more outlets of the 1-15R configuration shall provide for the full insertion of attachment plugs in all outlets simultaneously using plugs having the face size indicated in Figure 17.1.

RECEPTACLES

## 26A General

26A.1 15 and 20 amp straight blade receptacles are suitable for use in an ambient temperature up to 50ºC.

## 27 Insulating Materials

27.1 A surface-type 50-A receptacle with an enclosure of insulating material is not acceptable for use in an application in which the receptacle is likely to be subject to severe mechanical abuse.

27.2 An insulating plate employed for the backing of a receptacle used to form all or a part of the enclosure shall employ insulating materials that comply with 8.2.1 – 8.4.1. The material shall not be less than 1/32 inch (0.8 mm) thick and shall be moisture-resistant in accordance with 64.1 and 64.2. Fiber may be employed in an insulating plate if it is not less than 1/16 inch (1.6 mm) thick, is impregnated to resist the absorption of moisture in accordance with 64.1 and 64.2 and is not depended upon (by itself) to hold contacts or other live parts in place.

## 28 Enclosure

28.1 If the dimensions of a 1-15R, 2-15R, or 2-20R receptacle face are smaller than shown in Figure 28.1 for the particular configuration used, the receptacle face shall not project more than 3/16 inch (4.8 mm) beyond the flush mounting surface for which it is intended, or less than 3/32 inch (2.4 mm) when the mounting surface is of metal.

28.2 The body of a receptacle employing a combination wire binding/pressure wire-type terminal shall employ integrally formed channels/guides within the body to:

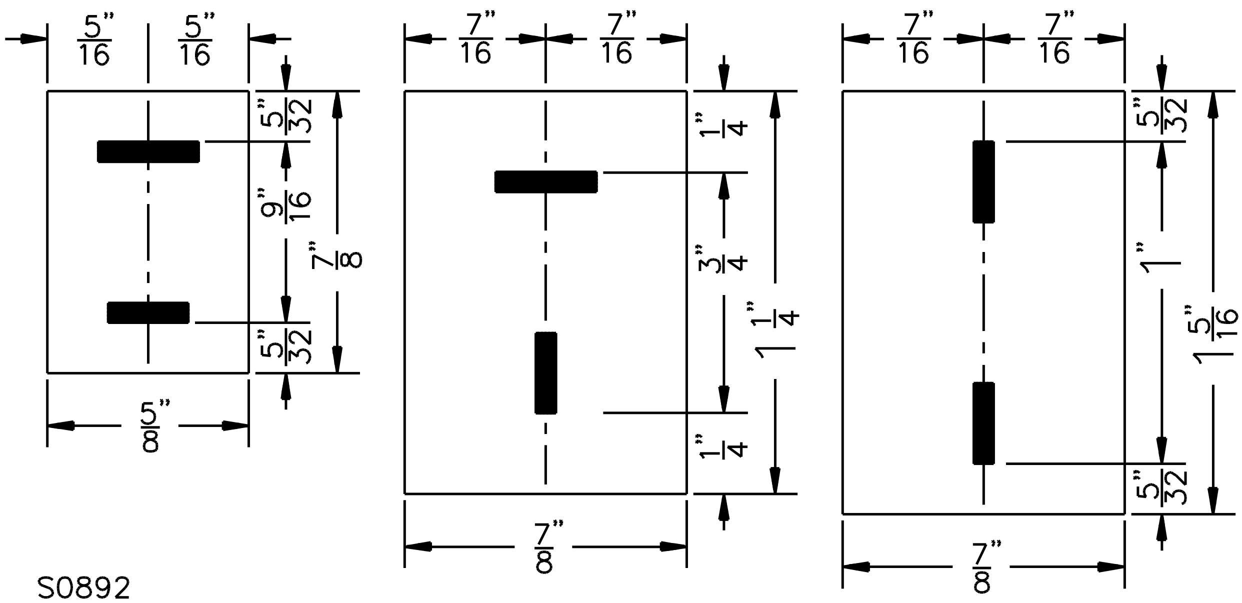
a) Properly position individual conductor; and

b) Provide a means to reduce the likelihood of the conductor(s) being displaced from under the terminal ring when conductor(s) are to be installed.

Compliance shall be determined by the Terminal Strength Test, Section 123.

**Figure 28.1**

**Dimensional limits for the face of a receptacle**




| inch | 5/32 | 1/4 | 5/16 | 9/16 | 5/8 | 3/4 | 7/8 | 1 | 1-1/4 | 1-5/16 |
|---|---|---|---|---|---|---|---|---|---|---|
| mm | 4.0 | 6.4 | 7.9 | 14.3 | 15.9 | 19.1 | 22.2 | 25.4 | 31.8 | 33.3 |

## 29 Grounding and Dead Metal Parts

### 29.1 General

29.1.1 The requirement in 11.6 does not preclude the acceptance of a flush receptacle that does not include a grounding terminal provided:

a) The receptacle can be used only in a metallic wiring system (such as with rigid metal conduit, electrical metallic tubing, surface metal raceway, or the like); and

b) The connection between the grounding contact and the metal raceway is automatically completed as the receptacle is installed.

29.1.2 The grounding terminal mentioned in 11.6 and its corresponding contact shall be conductively connected to the mounting means (yoke or strap) of a receptacle.

*Exception No. 1: The conductive connection is not required to be provided in an appliance or fixture outlet or a flush receptacle if all the following conditions are met:*

*a) The mounting means is formed of an insulating material;*

*b) The lack of grounding continuity to the mounting means is obvious to the installer; and*

*c) The device is marked in accordance with Reference No. 8 of Table 193.4.*

*Exception No. 2: The conductive connection is not required to be provided in an isolated ground receptacle if it is marked in accordance with Reference No. 9 of Table 193.4.*

*Exception No. 3: The conductive connection is not required to be provided in surface-mount receptacles, self-contained receptacles, or any other receptacles for use only with a nonmetallic wiring system (not adaptable to a metallic wiring system).*

29.1.3 The grounding contact in a grounding-type receptacle shall be located and formed so that the path of electrical continuity to the grounding pin or blade of a mating attachment plug is completed before continuity is established between any other contact and its respective pin or blade on the attachment plug. This grounding path shall be substantial when the attachment plug is properly seated in the receptacle.

29.1.4 Only one grounding terminal shall be provided on a grounding-type receptacle.

*Exception No. 1: A surface-mount or self-contained receptacle of the 5-15R configuration may be provided with two grounding terminals to permit through-wiring of the equipment grounding conductor if the removal of the device also disconnects the power to the downstream circuits.*

*Exception No. 2: Each outlet module of an interchangeable or modular receptacle may be provided with its own grounding terminal.*

29.1.5 "Push-In" grounding terminations shall not be used.

### 29.2 Flush receptacles

29.2.1 All dead-metal parts of a flush receptacle, including the grounding terminal, shall not have sharp edges or points that may be forced against the wiring during installation in an outlet box.

29.2.2 A flush receptacle shall be constructed so that a metal flush plate will be bonded to the metal outlet box or the receptacle grounding terminal when the receptacle is installed as intended.

*Exception: A receptacle with an integral nonmetallic flush plate that cannot be replaced with a metal flush plate is not required to comply with this requirement.*

## 30 Terminals and Leads

### 30.1 General

30.1.1 The line wiring terminals of a receptacle intended for mounting in an outlet box shall be located or protected so that, upon installation, they will not be forced against the wiring in the box. See also 29.2.1.

*Exception: Exposed wiring terminals on a receptacle intended solely for mounting in a box intended to be supported by rigid conduit may be located on the back of the receptacle.*

30.1.2 A receptacle shall provide a substantial clearance between each terminal and the metal of a standard box of the type in which it is intended to be installed.

### 30.2 Push-in terminals

30.2.1 A push-in terminal may be accepted for a current-carrying connection in a 5-15R or 6-15R receptacle only if it meets the tests described in Pullout Test, Section 132, and Temperature Test, Section 133, for factory-wired devices and Sections 134 – 137 for field-wired devices.

30.2.2 A flush receptacle having a 5-15R or 6-15R configuration employing "Push-In" line terminations intended for field wiring shall accept a 14 AWG (2.1 $mm^2$) solid conductor and shall reject a 12 AWG (3.3 $mm^2$) solid conductor. The opening provided for the conductor shall reject a No. 48 drill rod, 0.076 ±0.0003 inch (1.981 ±0.0076 mm) in diameter. The rod is to be applied with 5 lbf (22 N). The receptacle shall be marked in accordance with Reference No. 23 of Table 193.4.

30.2.3 A "Push-In" terminal shall not be used with stranded wire.

30.2.4 A flush receptacle having a 5-15R or 6-15R configuration employing "Push-In" terminations for field wiring and provided with a means to release the conductors shall not permit entry of a 14 AWG (2.1 $mm^2$) or larger solid conductor into any opening in the insulating body provided to engage the release mechanism behind the plane of the mounting means. The wire release means, if provided, shall be subjected to the tests in Temperature Test, Push-In Terminals, Section 137.

30.2.5 A release mechanism shall be located or guarded so that it cannot be unintentionally actuated during installation. The release mechanism may be guarded by recessing, ribs, barriers, or the like.

### 30.3 Pin-type or insulation-displacement terminals

30.3.1 A pin-type or insulation-displacement terminal of a fixture, equipment, or appliance outlet intended for factory assembly on copper conductors may be accepted for a current-carrying connection only if it complies with the requirements described in the Heat Cycling and Vibration Tests, Section 151.

### 30.4 Open wiring on insulators

30.4.1 Circuit wires entering a receptacle intended for open wiring on insulators:

a) Shall not be closer than 1/2 inch (12.7 mm) to the surface wired over if the device is rated 250 V less, and

b) Shall not be closer than 1 inch (25.4 mm) to the surface wired over if the device is rated more than 250 V.

### 30.5 Leads

30.5.1 Integral grounding- and supply-conductor leads of a receptacle shall be of copper and shall be:

a) Type RH or TW wire or an equivalent rubber- or thermoplastic-insulated wire for a general-use receptacle and Type SF, SFF, or an equivalent type of wire for a fixture type of receptacle, and

b) Not smaller in size than indicated in Table 30.1 for a receptacle that employs other than a separable terminal assembly and not smaller than 12 AWG for a receptacle that employs a separable terminal assembly.

**Table 30.1**
**Smallest acceptable sizes of receptacle leads**

| Current rating of receptacle | Copper supply leads – AWG ($mm^2$) | Copper grounding leads – AWG ($mm^2$) |
|---|---|---|
| 15A | 16[a] or 14 (1.3[a] or 2.1) | 16[a] or 14 (1.3[a] or 2.1) |
| 20 | 12 (3.3) | 12 (3.3) |

**Table 30.1 Continued on Next Page**

**Table 30.1 Continued**

| Current rating of receptacle | Copper supply leads – AWG ($mm^2$) | Copper grounding leads – AWG ($mm^2$) |
|---|---|---|
| 30 | 10 (5.3) | 10 (5.3) |
| 50 | 6 (13.3) | 10 (5.3) |
| 60 | 4 (21.1) | 10 (5.3) |

[a] 16 AWG supply and grounding leads are acceptable only if the receptacle is intended for mounting in an appliance.

30.5.2 For a general-use receptacle:

a) An integral grounding pigtail lead shall not be shorter than 6 inches (152 mm), and

b) Integral supply leads shall not be shorter than 4 inches (102 mm).

*Exception: For an appliance or fixture receptacle outlet, the length of integral leads is not specified.*

### 30.6 Separable terminal assembly

30.6.1 A separable terminal assembly shall consist of permanently attached pins or tabs located on the body of the receptacle and shall be capable of receiving a special purpose connector with leads for connection to the branch circuit.

30.6.2 A separable terminal assembly shall:

a) Be provided with a mechanical means such as a lock, latch or similar means, which prohibits unintentional separation when in the mated condition, and shall comply with the Latching Mechanism Test described in Section 159,

b) Be reliably keyed by a physical or mechanical means to maintain correct polarity and voltage consistent with the intended use. The terminals shall be marked identifying the terminal positions and identifying the unidentified (hot), grounded (neutral) and grounding terminal. Color-coding of integral wire leads is an acceptable means of terminal identification,

c) Be reliably keyed to limit interconnection to only like voltage, and

d) The grounding-conductor terminals shall connect before mating supply conductor terminals connect when two or more connectors are mated as intended. During disconnection of mating connectors, the supply-conductor terminals shall disconnect before the grounding-conductor terminal disconnects.

30.6.3 The contacts of the special purpose connector, when not mated to a receptacle, shall not be accessible to contact by the probe in Figure 9.1.

### 30.7 Receptacle with spring action clamp terminal

30.7.1 A receptacle that is provided with spring action clamp terminal shall be provided with a positive means to prevent unintentional separation of the conductor from the terminal and shall comply with the Spring Action Clamp Terminal Pull Test described in Section 128A.

## 31 Assembly

### 31.1 General

31.1.1 When internal connections exist in a multiple-outlet receptacle, similar and corresponding contacts of individual outlets shall be connected together.

31.1.2 For a duplex receptacle that includes a break-off jumper between the two halves of a set of unidentified terminals, to provide for a separation that would enable the connection of each outlet to one of the respective ungrounded conductors, and to the grounded conductor of a 3-wire branch circuit, a minimum spacing, based on the maximum potential of the branch circuit (for example, 250 V for 125 V receptacle), is to exist between parts of opposite polarity that are present when the jumper is removed for such use. See 14.1.

31.1.3 A receptacle having a 1-15R configuration that is intended for fixed installation in a wiring system that is in accordance with the National Electrical Code, ANSI/NFPA 70, shall be of the polarized type shown in the 1-15R configuration illustrated in Wiring Devices – Dimensional Specifications, ANSI/NEMA WD6.

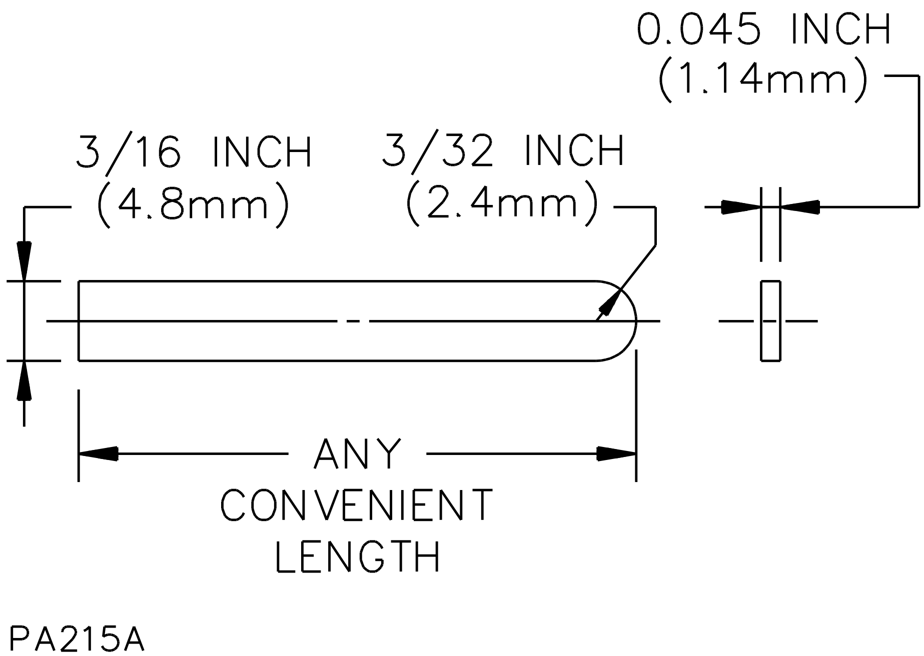
31.1.4 A receptacle shall be such that the blades of a radio-attachment plug cannot be inserted to touch the contacts of a receptacle other than one specifically intended for use with such a plug. See Figure 21.1 for an example of a radio-antenna plug configuration.

### 31.2 Flush receptacles

31.2.1 The grounding terminal of a grounding-type flush receptacle shall be spaced at least 1/4 inch (6.4 mm) from any ungrounded live part (associated with other than a white grounded terminal) exposed to contact by a grounding conductor in the outlet box. Live parts accessible from within the cavity of an outlet box are considered exposed to contact by a grounding conductor if they can be contacted by the probe illustrated in Figure 31.1. The spacings shall be measured through air and over both insulating and conductive surfaces with the receptacle wired as intended with the maximum anticipated conductor size. They shall be measured from any point on the grounding terminal that may contact the clamped grounding conductor as in the case of a wire-binding screw terminal, or from any point on the perimeter of an opening to receive a grounding conductor in the case of an enclosed terminal.

**Figure 31.1**

**Flat probe**




| inch | 0.045 | 3/32 | 3/16 |
|---|---|---|---|
| mm | 1.14 | 2.4 | 4.8 |

31.2.2 A flush receptacle shall be provided with means for mounting in a standard flush-device box or on a standard outlet box cover.

31.2.3 A yoke, strap, or mounting ears shall be formed of steel that is a minimum 0.040 inch (1.02 mm) thick.

*Exception No. 1: The minimum thickness at scores or perforations provided so that extension plaster ears may be broken off when not needed is not required to comply with this requirement.*

*Exception No. 2: If nonferrous metal is used, it shall provide mechanical strength and rigidity equal to that of 0.040 inch thick (1.02 mm) steel.*

31.2.4 A steel yoke, strap, or mounting ears shall be protected against corrosion by a copper-plated or oxidized finish.

*Exception: A zinc or cadmium coating not less than 0.00015 inch (0.0038 mm) thick as determined in accordance with the requirements in the Standard for Metallic Outlet Boxes, UL 514A, or other coatings determined to possess equivalent corrosion protection properties are not required to comply with this requirement.*

31.2.5 A screw provided with a receptacle for use in mounting the device to an outlet box or other enclosure shall not project more than 7/8 inch (22.2 mm) beyond the strap or cover and shall have a flat or blunt end. The end of the screw may have thread-cleaning slots or grooves but shall not have any burrs, fins, or other sharp edges that could damage wiring.

31.2.6 A receptacle that is provided with an adjustable screw, or screws if more than one is provided, or any other adjustment hardware shall not project more than 7/8 inch (22.2 mm) beyond the plane of the mounting yoke where secured to the outlet box. The end of the adjustable hardware shall have a flat or blunt end. If an adjustment screw is provided, it may have thread-cleaning slots or grooves but shall not have any burrs, fins, or other sharp edges that could damage wiring.

31.2.7 The adjustment means of an adjustable receptacle shall not permit installation in an application where the front edge of the installed outlet box, plaster ring, extension ring, or outlet box extender is set back from the finished surface (e.g. drywall) more than a 1/4 inch (6.0 mm). Compliance is checked by measurement.

### 31.3 Surface-mount receptacles

31.3.1 In a surface receptacle, an assembly screw, rivet, or the like that is visible and is electrically connected to any live part shall be located in a hole not larger than 9/32 inch (7.1 mm) in diameter and recessed not less than 3/16 inch (4.8 mm).

31.3.2 Means shall be provided for securely attaching the body of a surface-mount receptacle to the supporting base. When assembled, the body shall be restricted from turning with respect to the base.

31.3.3 A supporting base intended for surface mounting shall be provided with no fewer than two holes for mounting screws.

31.3.4 Live screw heads or nuts on the underside of a base intended for surface mounting shall be spaced 1/2 inch (12.7 mm) or more through air from the mounting surface and staked, upset, or otherwise restricted from loosening.

*Exception No. 1: Live parts that are countersunk not less than 1/8 inch (3.2 mm) and then covered with a minimum of 1/8 inch (3.2 mm) thick sealing compound that complies with 8.6.1 and 8.6.2 are not required to comply with this requirement.*

*Exception No. 2: Live parts that are countersunk not less than 1/8 inch (3.2 mm) and then covered with a minimum of 1/16 inch (1.6 mm) thick sealing compound, where the sealing compound complies with 8.6.1 and 8.6.2 and the underside of the supporting base is recessed so that the sealing compound will not contact the surface upon which the receptacle is mounted, are not required to comply with this requirement.*

## 32 Flush Plates

32.1 A flush plate provided as an integral part of a receptacle shall comply with the requirements for flush plates in the Standard for Metallic Outlet Boxes, UL 514A, or the Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers, UL 514C.

## 33 Self-Grounding Receptacles

33.1 A self-grounding receptacle shall not be rated greater than 30 A or 150 V to ground and shall comply with the Fault Current Test, Section 130.

## 34 Isolated-Ground Receptacles

34.1 An isolated-ground receptacle shall be identified in accordance with the marking and instruction requirements for isolated-ground receptacles specified in Reference No. 9 of Table 193.4.

## 35 CO/ALR Type

35.1 A receptacle rated 15 or 20 A and which is intended for use with both copper and aluminum conductors shall:

a) Have only wire-binding screw terminals,

b) Be intended for mounting in an outlet box,

c) Be marked in accordance with Reference No. 12 of Table 193.4, and

d) Meet the performance requirements for receptacles and switches in the Standard for Receptacles and Switches Intended for Use with Aluminum Wire, UL 1567, in addition to the applicable requirements in this Standard.

## 36 AL-CU Type

36.1 A receptacle rated 30 A or greater and which is intended for use with both copper and aluminum conductors shall comply with the Temperature Test, Section 118, the general performance requirements for receptacles employing pressure-wire terminals contained in Section 126, and either of the following marking requirements as applicable:

a) Reference No. 13 of Table 193.4 for conductors rated 60°C (140°F), or

b) Reference No. 14 of Table 193.4 for conductors rated 75°C (167°F).

## 37 Tamper-Resistant Receptacles

37.1 A tamper-resistant receptacle shall be marked in accordance with Reference No. 16 of Table 193.4 and comply with the requirements in Sections 139 – 142, and with all other applicable requirements in this Standard.

## 38 Weather-Resistant Receptacles

38.1 A weather-resistant receptacle shall comply with the requirements in Supplement SD and with all other applicable requirements in this Standard.

## 39 Pendant Receptacles

39.1 The enclosure and cover plate of a pendent receptacle shall be non-metallic only and comply with the requirements of the Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers, UL 514C, in addition to the applicable requirements in this Standard.

39.2 The strain relief means of a pendant receptacle shall be non-metallic only and comply with the requirements for the Standard for Conduit, Tubing, and Cable Fittings, UL 514B, in addition to the applicable requirements in this Standard.

39.3 A pendant receptacle shall have no more than four outlets (2-duplex receptacles) per each enclosure.

39.4 A pendant receptacle shall be capable of assembly to the flexible cords with which it is intended to be used without damage to the housing, terminals, or any other damage that may increase the risk of fire or electric shock.

## 40 Pop-Out Receptacle

40.1 A pop-out receptacle shall be marked in accordance with Reference No. 34 of Table 193.4 and comply with the Mechanical Endurance and Mechanical Loading Tests in Sections 147 and 148, and with all other applicable requirements in this Standard.

## 41 Pop-Up Receptacle Assembly

41.1 A pop-up receptacle assembly shall comply with the Mechanical Endurance and Spill Tests in Sections 147 and 149, and with all other applicable requirements in this Standard.

## 42 Rotatable Outlets

42.1 A receptacle that is provided with a rotatable outlet or outlets shall be provided with a flush device cover plate or outlet box cover that complies with the Standard for Metallic Outlet Boxes, UL 514A, or the Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers, UL 514C.

*Exception: A flush device cover plate or outlet box cover is not required to be provided with the receptacle when a suitable coverplate is commercially available and the receptacle is marked as identified in 193.1.10.*

## 42A Lighted Receptacle

42A.1 A lighted receptacle shall additionally comply with 42A.2 through 42A.4.

42A.2 The lens (jewel) of a lighted receptacle shall comply with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, Resistance to Impact testing, conditioned to -35 °C, followed by the Dielectric Voltage Withstand test.

*Exception No. 1: A lighted receptacle when conditioned to a temperature of 0°C shall be marked as described in Table 193.4 Reference No. 39 ("Indoor Use Only").*

*Exception No. 2: A lighted receptacle where removal of all lens (jewel) material complies with 9.1.4 is not required to comply with this requirement.*

42A.3 Conductor leads of a lamp, resistor/lamp combination, or leads from a printed circuit board shall be mechanically secured. The conductor leads shall be positioned within the receptacle enclosure so that spacings described in Section 14 (Spacings) are not reduced.

42A.4 Conductor leads shall not be connected to any dead metal or any part of the grounding terminal or contact.

42A.5 When a printed wiring board is used, shall comply with the Standard for Printed-Wiring Boards, UL 796, having a maximum operating temperature of at least 105°C and a minimum flammability rating of HB as determined by the applicable tests in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

## 42B Luminaire or Fan Support Receptacle

42B.1 A luminaire or ceiling-suspended fan support receptacle shall comply with the applicable receptacle requirements contained in this standard.

42B.2 Additionally, a luminaire or ceiling-suspended fan support receptacle shall also comply with applicable requirements contained in the UL 514A Standard for Metallic Outlet Boxes.

42B.3 An attachment fitting and luminaire or ceiling-suspended fan support receptacle shall be subjected to the loading test as described in the UL 514A Standard for Metallic Outlet Boxes, except as modified below.

**Table 42B.1**
**Luminaire or ceiling-suspended fan loading test**

| Type of load (luminaire or ceiling-suspended fan)[a] | UL 514A, Sections | Applied load lbf (N) |
|---|---|---|
| Luminaire or Ceiling-suspended fan support | 12.17,12.5 | See UL 514A, Paragraphs 12.14.1.1 Table 10 and 12.5.4 for applied loads |
| [a] See Table 193.1 and Table 193.4 for marking details. | | |

42B.4 At the conclusion of the load test identified in Table 42B.1, there shall be no cracking, breaking, or any visible damage to either the attachment fitting or luminaire and/or ceiling-suspended fan support receptacle.

42B.5 Testing shall be performed on three complete assemblies of an attachment fitting and/or luminaire or ceiling-suspended fan support receptacle.

42B.6 The luminaire and/or a ceiling-suspended fan support receptacle shall be installed using a suitable outlet box attached to an appropriate bar hanger having a suitable applied load rating.

### 42C Ceiling-Suspended Fan Test

42C.1 An attachment fitting and ceiling-suspended fan support receptacle shall also comply with the UL 514A, Standard for Metallic Outlet Boxes, ceiling-suspended fan support test.

42C.2 The attachment fitting and ceiling-suspended fan support receptacle shall be investigated with a fan weighing either 35 lb. (15.9 kg), or 50 lb. (23 kg), or 70 lb. (32 kg) as specified by the manufacturer and so marked.

42C.3 The ceiling-suspended fan support test shall be performed on three complete assemblies consisting of an attachment fitting and ceiling-suspended fan support receptacle.

42C.4 The ceiling-suspended fan support receptacle shall be installed in a suitable outlet box attached to an appropriate bar hanger having a suitable applied load rating.

42C.5 At the conclusion of the ceiling-suspended fan support test there shall be no cracking, breaking, or any visible damage to either the attachment fitting or luminaire or a ceiling-suspended fan support receptacle.

### 42D Receptacle Installation Instructions

42D.1 Installation Instructions shall be provided and include procedure for proper installation and use including a list of compatible mating attachment fittings(plugs) if not supplied with the receptacle. Required outlet box rating shall be specified based on receptacle rating, identified in Table 42D.1.

**Table 42D.1**
**Receptacle and outlet box rating**

| Receptacle rating | Outlet box rating |
|---|---|
| Luminaire support – 50 lb. | Luminaire support 50 lb. Minimum |
| Fan Support – 35 lb. | Fan Support – 35 lb. Minimum |
| Fan Support – 50 lb. | Fan Support – 50 lb. Minimum |
| Fan Support – 70 lb. | Fan Support – 70 lb. Minimum |

SELF-CONTAINED RECEPTACLES FOR USE WITHOUT A SEPARATE OUTLET BOX

## 43 General

43.1 The requirements in Sections 43 – 49 and 168 – 180 are applicable to self-contained general-use receptacles rated 15 and 20 A, 125 and 250 V.

43.2 Self-contained receptacles shall comply with the applicable construction requirements of this Standard as modified by the requirements in Sections 44 – 49.

## 44 Spacings

44.1 The spacings maintained between live parts of opposite polarity and between live parts and grounded metal parts shall be at least 1/16 inch (1.59 mm) through air and 1/8 inch (3.18 mm) over surfaces.

## 45 Insulating Materials

45.1 The material used for the support, insulation, and overall enclosure of live parts and cable from which any part of the cable covering has been removed shall be either:

a) Molded phenolic or urea formaldehyde that complies with 8.2.1, 8.3.1 and 8.3.2, or

b) Another insulating material determined to be acceptable by means of an appropriate investigation which shall include all of the following requirements:

1) The material shall have a minimum V-2 flammability classification or comply with the requirements of the Specimen Flammability Test, Section 180. The flame class rating of the material shall be judged at the nominal minimum thickness employed at the walls and barriers in the device which are critical to the functioning of the insulation or enclosure of the device.

2) The material shall have a high-ampere arc ignition (HAI) performance level category of 2 or better (at least 30 arcs).

3) The material shall have a hot-wire ignition (HWI) performance level category of 3 or better (at least 15 seconds).

4) The material shall comply with the relative thermal index requirements in 8.4.1.

## 46 Enclosures

46.1 All current carrying parts and that part of the cable from which any part of the covering has been removed shall be fully enclosed in the insulating body. This does not preclude:

a) Slot openings for the receptacle outlet,

b) Cable openings to be filled in use, or

c) Assembly joints designed to butt.

46.2 The overall insulating enclosure shall be at least 0.100 inches (2.54 mm) thick.

*Exception No. 1: An enclosure less than 0.100 inches (2.54 mm) thick in the receptacle outlet face or internal barriers that do not form part of the enclosure that is equivalent to an outlet box or flush device cover plate is not prohibited.*

*Exception No. 2: An enclosure less than 0.100 inches (2.54 mm) thick in the areas that form part of the enclosure that is equivalent to an outlet box or flush device cover plate is not prohibited when it complies with the 3/4 inch-flame outlet box flammability test in Non-Metallic Outlet Boxes, Flush-Device Boxes, and Covers, UL 514C.*

*Exception No. 3: Knockouts to be removed for the installation of cable that have a reduced thickness are not prohibited when they comply with the test described in Knockouts Test, Section 177.*

*Exception No. 4: An enclosure less than 0.100 inches (2.54 mm) thick in the areas that form part of the enclosure that is equivalent to an outlet box or flush device cover plate is not prohibited when it complies with the Flame Penetration and Flammability tests in the Standard for Cover Plates for Flush-Mounted Wiring Devices, UL 514D. The Flame Penetration and Flammability tests shall be conducted with 102 × 102 mm (4 × 4 in) square or 114 mm (4.5 in) diameter specimens of the enclosure material. The thickness of the specimens shall be equal to the minimum thickness of the enclosure in the areas that form the part of the enclosure that is equivalent to an outlet box or flush device cover plate.*

## 47 Mounting Means

47.1 A self-contained receptacle shall be provided with a means for mounting to walls or to frame construction brackets.

47.2 Brackets for mounting a self-contained receptacle shall not have holes located such that a standard flush device may be readily mounted to the bracket.

47.3 Self-contained receptacles shall be constructed so that they cannot readily be mounted in a standard flush device box using the two threaded openings in the box provided for mounting conventional flush devices.

47.4 A mounting bracket for fastening a self-contained receptacle to a structural member in the walls of frame construction shall either be:

a) Constructed integral with the device, or

b) Packaged with the device along with installation instructions.

See Frame-Construction Mounting Brackets, Section 48, for requirements for mounting brackets.

## 48 Frame-Construction Mounting Brackets

48.1 Mounting brackets used to fasten self-contained receptacles to studs or joists of frame construction shall comply with all of the following provisions:

a) The support or mounting means shall be outside the enclosed interior of the insulating body of the self-contained receptacle.

b) Ferrous material other than stainless steel shall be protected against corrosion with a cadmium or zinc coating having a minimum thickness of 0.0005 inch (0.013 mm) or its equivalent. Cut edges and tapped openings are not required to be protected.

c) A means shall be provided for the temporary retention of the nonmetallic sheathed cable at the bracket so that the cable will be accessible during installation of the self-contained receptacle. Clips or open hooks integral with the bracket are acceptable.

48.2 The mounting bracket shall also comply with the Mounting Strength Test, Section 172.

## 49 Field Replacement

49.1 Self-contained receptacles marketed as replacement devices shall be capable of installation without the use of special tools.

49.2 Those self-contained receptacles which require replacement with specific devices of similar design shall be marked in accordance with Reference No. 17 of Table 193.4.

CURRENT TAPS

## 50 General

50.1 In addition to the requirements described in this section, a current tap wired to flexible cord shall comply with the requirements for attachment plugs and cord connectors located elsewhere in this Standard and specified in Table 50.1.

**Table 50.1**
**Construction requirements for current taps**

| Construction requirement | Reference |
|---|---|
| Male face size | 17.3.1 |
| Current-carrying parts | 18.1, 18.2 |
| Grounding and dead-metal parts | 11.6, 19.1, 19.2, 19.3, 24.1, 24.3 |
| Terminals | 20.1.1, 20.1.2, 25.1 |
| Assembly | 21.1 |
| Recess of live parts | 23.1.1 |
| Female face size | 23.2.1, 23.2.2 |

50.2 A current tap wired to flexible cord shall not accommodate more than two plugs.

50.3 A current tap shall employ blades on the line side only.

50.4 When internal connections exist in a multiple-outlet current tap, similar and corresponding contacts of individual outlets shall be connected together.

50.5 Current taps having 2 outlets of the 1-15R configuration shall provide for the full insertion of attachment plugs in all outlets simultaneously using plugs having the face size indicated in Figure 17.1.

50.6 When the outlet contacts of a current tap are polarized, the blades shall be polarized and the internal connections between the blades and the contacts shall maintain the polarization.

FLATIRON AND APPLIANCE PLUGS

## 51 General

51.1 The requirements in Sections 52 – 58 and Sections 183 – 191 are applicable to flatiron and appliance plugs rated 15 and 20 A, 125 and 250 V.

51.2 Flatiron and appliance plugs shall comply with the applicable construction requirements of this Standard as modified by the requirements in Sections 52 – 58.

## 52 Current-Carrying Parts

52.1 Iron or steel current-carrying parts of a flatiron or appliance plug shall be protected against corrosion by a metallic plating or other metal coating. Copper coating and oxidized finishes are not prohibited for use on contacts and their integral screw terminals on flatiron and appliance plugs. Steel is not prohibited for use on contacts and wiring terminals that are integral with the steel contacts.

*Exception: Steel shall not be used for current-carrying parts of a switching mechanism or for wiring terminals in a flatiron or appliance plug that includes a switching mechanism*

## 53 Cord Guard

53.1 A helical wire spring or an equivalently protective part shall be provided at the cord-entrance hole of a flatiron or appliance plug to protect the heater cord from any sharp edges, burrs, or the like that may abrade the cord. The guard shall be held securely in place in the assembled plug. If a separate grommet or bushing is employed, it shall be held securely in place in the guard.

53.2 The guard shall extend from 1-1/2 to 2-1/2 inches (38.1 – 63.5 mm) from the flatiron or appliance plug body. The wireway in the guard shall be large enough in diameter to accommodate the cord without restriction or unnecessary looseness. A smooth metal grommet or an equivalent bushing is acceptable at the free end of a spring guard.

53.3 The guard supplied with a flatiron or appliance plug shall be flexible so as to conform to the motion of the cord in service without producing a sharp bend at or near the point of attachment to the plug. See 191.1.

*Exception: A rigid guard is acceptable if it demonstrates protection equivalent to a flexible cord guard. See 191.1.*

## 54 Strain Relief

54.1 The construction of a flatiron or appliance plug shall be such that a force exerted on the flexible cord will not be transmitted to binding-screw terminals or wiring connections. All parts of the plug with which the cord may come in contact shall be smooth and well rounded.

## 55 Female Contacts

55.1 Female contacts shall be held securely, but not necessarily rigidly, within the flatiron or appliance plug body. The configuration and dimensions of the contacts shall be such that the pins detailed in Table 55.1 are accommodated.

**Table 55.1**
**Pins of appliances and flatiron plugs**

| Type and rating of plug that accommodates the pins | Configuration of pins | | | Dimensions of pins | |
|---|---|---|---|---|---|
| | Number | Arrangement | Spacing between centers, inch (mm) | Diameter, inch (mm) | Length, inch (mm) |
| Appliance plug rated 5 A at 250 V and 10 A at 125 V | 2 | In line | 1/2 (12.7) | 0.156 ±0.005 (4.0 ±0.13) | 9/16 – 5/8 (14.3 – 15.9) |
| Flatiron plug rated 5 A at 250 V and 10 A at 125 V | 2 | In line | 11/16 (17.5) | 0.188 ±0.005 (4.8 ±0.13) | 3/4 – 7/8 (19.0 – 22.2) |
| Jumbo appliance plug rated 10 A at 250 V and 15 A at 125 V | 2 | In line | 1-1/16 (27.0) | 0.188 ±0.005 (4.8 ±0.13) | 3/4 – 7/8 (19.0 – 22.2) |
| Reversible plug (for two-heat control) rated 10 A at 250 V and 15 A at 125 V[a] | 3 | In line | 7/8 (22.2) | 0.188 ±0.005 (4.8 ±0.13) | 3/4 – 7/8 (19.0 – 22.2) |
| Reversible plug (for two- or three-heat control) rated 10 A at 250 V and 15 A at 125 V[a] | 3 | One pin at apex of an equilateral triangle | 7/8 (22.2) | 0.188 ±0.005 (4.8 ±0.13) | 3/4 – 7/8 (19.0 – 22.2) |

[a] Usually this plug is made without a contact in one of the holes.

55.2 Contacts are not required to be rigidly attached to the flatiron or appliance plug body; a slight amount of floating is acceptable so that the contacts may be somewhat self-aligning with respect to their fit with male pins.

55.3 In a flatiron or appliance plug body, holes for female contacts shall be no larger than necessary to accommodate the male pins.

## 56 Terminals

56.1 A flatiron or appliance plug shall be provided with wiring terminals that will accommodate the following size stranded conductors:

a) 18 AWG (0.82 $mm^2$) if the maximum current rating of the plug is 10 A, and

b) 16 AWG (1.3 $mm^2$) if the rating is 15 A.

*Exception: A plug that is intended for factory assembly to a flexible cord is not required to be provided with wiring terminals.*

56.2 A wire-binding screw shall not be smaller than No. 5 (3.2 mm in diameter) with no more than 40 threads per inch (per 25.4 mm).

## 57 Spacings

57.1 There shall be a 3/64 inch (1.2 mm) or larger spacing through air or over the surface between:

a) Uninsulated live parts of opposite polarity,

b) An uninsulated live part and a dead-metal part that is likely to be grounded or exposed to contact by persons while the device is being used as intended, and

c) An uninsulated live part and any exterior surface of the flatiron or appliance plug.

57.2 A dead-metal screw head, rivet, or the like is not considered exposed to contact by persons after the device has been installed in the intended manner if the dead metal is located in a hole not larger in diameter than 9/32 inch (7.1 mm) and is recessed not less than 3/16 inch (4.8 mm).

57.3 In measuring a spacing, an isolated dead-metal part interposed between live parts of opposite polarity or between a live part and a grounded or exposed dead-metal part reduces the spacing by an amount equal to the dimension of the isolated dead-metal part in the direction of the measurement.

### 58 Assembly

58.1 Electrical contact shall be maintained at each connection between current-carrying parts.

58.2 A metal band, guard, assembly plate, or other sheet-metal part on the outside of the molded composition body of a flatiron or appliance plug shall not be closer at any point than 1/16 inch (1.6 mm) to the plane of the end of the plug at which the female contacts are located.

## PERFORMANCE

## GENERAL

### 59 Representative Devices

59.1 Unless stated otherwise, six representative devices are to be used for each test.

59.2 Attachment plugs are to be subjected to the appropriate tests outlined in Table 59.1.

59.3 Inlets (motor attachment plugs) are to be subjected to the appropriate tests outlined in Table 59.2.

59.4 Cord connectors are to be subject to the appropriate tests outlined in Table 59.3.

59.5 Receptacles are to be subjected to the appropriate tests outlined in Table 59.4 and Table 59.5.

59.6 Current taps intended to be wired to flexible cord are to be subjected to the appropriate tests outlined in Table 59.6.

59.7 Flatiron and appliance plugs are to be subjected to the tests outlined in Table 59.7.

**Table 59.1**
**Summary of tests**
**General grade attachment plugs**

| Section | Test Sequences | No. of devices[a] | Details |
|---|---|---|---|
| 60 | Comparative Tracking Index | 5 | Materials to be evaluated in accordance with Exception No. 1 to 8.3.1. |
| 61 | Glow Wire | 3 | Materials to be evaluated in accordance with Exception No. 1 to 8.3.2. |

**Table 59.1 Continued on Next Page**

## Table 59.1 Continued

| Section | Test Sequences | No. of devices[a] | Details |
|---|---|---|---|
| 62 | High-Current Arc Resistance to Ignition | 3 | Materials to be evaluated in accordance with Exception No. 2 to 8.3.2. |
| 65<br>63<br>65 | Dielectric Voltage-Withstand<br>Mold Stress Relief<br>Dielectric Voltage-Withstand (Repeated) | 6 | All plugs.<br>Plugs employing thermoplastic material.<br>Plugs subjected to Mold Stress Relief Test. |
| 64 | Moisture Absorption Resistance | 3 | Conducted on vulcanized fibre, fuseholders and insulating backplates. Use insulating material portion of device only. |
| 66<br>71 | Accelerated Aging<br>Security of Blades | 6 | Materials to be evaluated in accordance with the Exception to 8.4.1.<br>Plugs rated 15 A or less and 250 V or less. |
| 67 | Insulation Resistance | 6 | Conducted on devices molded of rubber or similar materials, or any material containing enough free carbon to render the material grey or black. |
| 68 | Conductor Secureness | 6 | Plugs employing wire leads only. |
| 69 | Tightening Torque | 6 | Plugs with wire-binding screws with pitch greater than that specified in Table 12.1. |
| 71 | Security of Blades | 6 | Plugs rated 15 A or less and 250 V or less that are not subjected to the Accelerated Aging Test. |
| 72 | Secureness of Cover | 6 | Plugs with separable face covers as described in Enclosure, Section 9. |
| 73 | Crushing | 6 | Plugs having a 1-15P, 2-15P, 5-15P, or 6-15P configuration only. |
| 74 | Attachment Plug Grip | 3 | Plugs having a 1-15P configuration for use on parallel or vacuum cleaner type cord as specified in 17.2.1. |
| 75 | Integrity of Assembly | 6 | Not conducted on Hospital Grade plugs or plugs employing pin terminals, strain-relief knots, or certain strain relief constructions. See test description. |
| 76 | Self-Hinge Flexing | 18 | Plugs employing self-hinges in the enclosure. |
| 77 | Terminal Temperature | 6 | Not conducted on plugs with soldered, brazed. or welded cord connections or with wire-binding, pressure-wire or solder terminals. |
| 77A | Spring Action Clamp Terminal Pull | 6 | Conducted on attachment plugs with spring action clamp terminals only |
| 78 | Fuseholder Temperature | 6 | Plugs with fuseholders only. |
| 80<br>81<br>84 | Assembly<br>Temperature<br>Dielectric Voltage-Withstand | 12 | Plugs employing pin-type terminals. Number of devices indicated assumes plug accommodates 18 AWG Type SPT-1 wire only. Total number of devices will vary depending upon the number of sizes and types of flexible cord intended for use with the plug. See 81.2. |
| 80<br>82 | Assembly<br>Strain Relief | 12 | Plugs employing pin-type terminals. Number of devices indicated assumes plug accommodates 18 AWG Type SPT-1 wire only. Total number of devices will vary depending upon the number of sizes and types of flexible cord intended for use with the plug. See 82.2. |

**Table 59.1 Continued on Next Page**

## Table 59.1 Continued

| Section | Test Sequences | No. of devices[a] | Details |
|---|---|---|---|
| 80 | Assembly | 6 | Plugs employing pin-type terminals. Number of devices indicated assumes plug accommodates 18 AWG Type SPT-1 wire only. Total number of devices will vary depending upon the number of sizes and types of flexible cord intended for use with the plug. |
| 83 | Fault Current | | |

[a] A set of representative devices may be used for more than one group of tests if agreeable to all concerned.

## Table 59.2
## Summary of tests
## Inlets (motor attachment plugs)

| Section | Test sequences | No. of devices[a] | Details |
|---|---|---|---|
| 60 | Comparative Tracking Index | 5 | Materials to be evaluated in accordance with Exception No. 1 to 8.3.1. |
| 61 | Glow Wire | 3 | Materials to be evaluated in accordance with Exception No. 1 to 8.3.2. |
| 62 | High-Current Arc Resistance to Ignition | 3 | Materials to be evaluated in accordance with Exception No. 2 to 8.3.2 |
| 65 | Dielectric Voltage-Withstand | 6 | All inlets. |
| 63 | Mold Stress Relief | 6 | Inlets employing thermoplastic materials. |
| 65 | Dielectric Voltage-Withstand (Repeated) | 6 | Inlets subjected to Mold Stress Relief Test. |
| 64 | Moisture Absorption Resistance | 6 | Conducted on vulcanized fibre, fuseholders and insulating backplates. Use insulating material portion of device only. |
| 66 | Accelerated Aging | 6 | Materials to be evaluated in accordance with the Exception to 8.4.1. |
| 86 | Security of Blades | 6 | Inlets rated 15 A or less and 250 V or less. |
| 67 | Insulation Resistance | 6 | Conducted on devices molded of rubber or similar materials, or any material containing enough free carbon to render the material grey or black. |
| 68 | Conductor Secureness | 6 | Inlets employing wire leads only. |
| 69 | Tightening Torque | 6 | Inlets with wire-binding screws with pitch greater than that specified in Table 12.1. |
| 86 | Security of Blades | 6 | Inlets rated 15A or less and 250 V or less that are not subjected to the Accelerated Aging Test. |
| 87 | Terminal Temperature | 6 | Not conducted on inlets with soldered, brazed, or welded cord connections or with wire-binding or solder terminals. |
| 88 | Fuseholder Temperature | 6 | Inlets with fuseholders only. |
| 89 | Pressure-Wire Terminals – General | 6 | Inlets with pressure wire terminals only. |
| 91 | Strength of Insulating Base | 6 | Inlets with pressure wire terminals only. |

[a] A set of representative devices may be used for more than one groups of tests if agreeable to all concerned.

## Table 59.3
## Summary of tests
## Cord connectors

| Section | Test sequences | No. of devices[a] | Details |
|---|---|---|---|
| 60 | Comparative Tracking Index | 5 | Materials to be evaluated in accordance with Exception No. 1 to 8.3.1. |
| 61 | Glow Wire | 3 | Materials to be evaluated in accordance with Exception No. 1 to 8.3.2. |
| 62 | High-Current Arc Resistance to Ignition | 3 | Materials to be evaluated in accordance with Exception No. 2 to 8.3.2. |
| 65<br>63<br>65 | Dielectric Voltage-Withstand<br>Mold Stress Relief<br>Dielectric Voltage-Withstand (Repeated) | 6 | All cord connectors.<br>Cord connectors employing thermoplastic materials.<br>Cord Connectors subjected to Mold Stress Relief Test. |
| 64 | Moisture Absorption Resistance | 3 | Conducted on vulcanized fibre, fuseholders and insulating backplates. Use insulating material portion of device only. |
| 66 | Accelerated Aging | 6 | Materials to be evaluated in accordance with the Exception to 8.4.1. |
| 67 | Insulation Resistance | 6 | Conducted on devices molded of rubber or similar materials, or any material containing enough free carbon to render the material grey or black. |
| 68 | Conductor Secureness | 6 | Cord connectors employing wire leads only. |
| 69 | Tightening Torque | 6 | Cord connectors with wire-binding screws with pitch greater than that specified in Table 12.1. |
| 93<br>94<br>95<br>96<br>97 | Retention of Plugs<br>Overload<br>Temperature<br>Retention of Plugs (Repeated)<br>Resistance to Arcing | 6[b] | Cord connectors having a 1-15R, 5-15R, 5-20R, 6-15R, or 6-20R configuration.<br>Test based on current rating.<br><br>Cord connectors having a 1-15R, 5-15R, 5-20R, 6-15R, or 6-20R configuration.<br>Not required for devices employing phenolic, urea or melamine in the outlet face. |
| 94 | Overload (horsepower) | 6 | Conducted only on cord connectors with horsepower ratings. |
| 98 | Latching Mechanism Tests | 12 | Cord connectors employing a spring-actuated latching mechanism only. |
| 99 | Fuseholder Temperature | 6 | Cord connectors with fuseholders only. |
| 99A | Spring Action Clamp Terminal Pull | 6 | Conducted on cord connectors with spring action clamp terminals only |
| 100 | Improper Insertion | 12 | Cord connectors having a 1-15R configuration only. |
| 101 | Potential Drop in Grounding Connections | 6 | Cord connectors with grounding connections secured by means other than riveting, bolting, welding or equivalent. |
| 102 | Integrity of Assembly | 6 | Not conducted on connectors employing pin terminals, strain relief knots, or certain strain relief constructions. Refer to test description. |
| 103 | Self-Hinge Flexing | 12 | Cord connectors employing self-hinges in the enclosure. |
| 105 | Assembly | 12 | Cord connectors employing pin-type terminals. Number of devices indicated assumes connector accommodates 18 AWG Type SPT-1 wire only. Total number of devices will vary depending upon the number of sizes and types of flexible cord intended for use with the connector. See 106.2. |

Table 59.3 Continued on Next Page

## Table 59.3 Continued

| Section | Test sequences | No. of devices[a] | Details |
|---|---|---|---|
| 106<br>109 | Temperature<br>Dielectric Voltage-Withstand | | |
| 105<br><br>107 | Assembly<br><br>Strain Relief | 12 | Cord connectors employing pin-type terminals. Number of devices indicated assumes connector accommodates 18 AWG Type SPT-1 wire only. Total number of devices will vary depending upon the number of sizes and types of flexible cord intended for use with the connector. See 107.2. |
| 105<br><br>108 | Assembly<br><br>Fault Current | 6 | Cord connectors employing pin-type terminals. Number of devices indicated assumes connector accommodates 18 AWG Type SPT-1 wire only. Total number of devices will vary depending upon the number of sizes and types of flexible cord intended for use with the connector. |

[a] A set of representative devices may be used for more than one group of tests if agreeable to all concerned.

[b] For a cord connector with a spring-activated latching mechanism, see 92.2.

## Table 59.4
## Summary of tests
## Receptacles

| Section | Test sequences | No. of devices[a] | Details |
|---|---|---|---|
| 60 | Comparative Tracking Index | 5 | Materials to be evaluated in accordance with Exception No. 1 to 8.3.1. |
| 61 | Glow Wire | 3 | Materials to be evaluated in accordance with Exception No. 1 to 8.3.2. |
| 62 | High-Current Arc Resistance to Ignition | 3 | Materials to be evaluated in accordance with Exception No. 2 to 8.3.2. |
| 65<br>63<br>65 | Dielectric Voltage-Withstand<br>Mold Stress Relief<br>Dielectric Voltage-Withstand (Repeated) | 6 | All receptacles.<br>Receptacles employing thermoplastic materials.<br>Receptacles subjected to Mold Stress Relief Test. |
| 64 | Moisture Absorption Resistance | 3 | Conducted on vulcanized fibre, fuseholders and insulating backplates. Use insulating material portion of device only. |
| 66 | Accelerated Aging | 6 | Materials to be evaluated in accordance with the Exception to 8.4.1. |
| 67 | Insulation Resistance | 6 | Conducted on devices molded of rubber or similar materials, or any material containing enough free carbon to render the material grey or black. |
| 68 | Conductor Secureness | 6 | Receptacles employing wire leads only. |
| 69 | Tightening Torque | 6 | Receptacles with wire-binding screws with pitch greater than that specified in Table 12.1. |
| 111<br><br>112<br>113 | Retention of Blades<br><br>Overload<br>Temperature | 6 | Flush and self-contained receptacles having a 5-15R, 5-20R, 6-15R, or 6-20R configuration. Sections 111 – 115 are superseded by the tests required by Sections 116 – 120 for all other receptacles. |

Table 59.4 Continued on Next Page

## Table 59.4 Continued

| Section | Test sequences | No. of devices[a] | Details |
|---|---|---|---|
| 114<br>115 | Retention of Blades (Repeated)<br>Resistance to Arcing | | |
| 116<br><br>117<br>118<br>119<br><br>120 | Retention of Plugs<br><br>Overload<br>Temperature<br>Retention of Plugs (Repeated)<br><br>Resistance to Arcing | 6 | Receptacles having a 1-15R, 5-15R, 5-20R, 6-15R or 6-20R configuration and not of the flush or self-contained type.<br>Test based on current rating.<br><br>Receptacles having a 1-15R, 5-15R, 5-20R, 6-15R or 6-20R configuration and not of the flush or self-contained type.<br>Not required for devices employing phenolic, urea or melamine in the outlet face. |
| 118 | Temperature (Terminal) | 6 | Flush and self-contained receptacles having a 5-15R, 5-20R, 6-15R, or 6-20R configuration. Conducted when a 15 A receptacle is not represented by a 20 A receptacle. |
| 117 | Overload (horsepower) | 6 | Conducted only on receptacles with horsepower ratings and receptacles having the NEMA configurations specified in Table 192.2. |
| 121 | Fuseholder Temperature | 6 | Receptacles with fuseholder only. |
| 122 | Fault Current | 2 | Flush and self-contained receptacles having a 5-15R, 5-20R, 6-15R, or 6-20R configuration. |
| 123<br><br>124 | Terminal Strength<br><br>Assembly Security | 3 | Flush and self-contained receptacles having a 5-15R, 5-20R, 6-15R, or 6-20R configuration. |
| 125 | Grounding Contact | 6 | Receptacles having a 5-15R, 5-20R, 6-15R, 6-20R, 7-15R, 14-15R or 15-15R configuration only. |
| 126 | Pressure-Wire Terminals (General) | 6 | Receptacles with pressure-wire terminals only. |
| 128 | Strength of Insulating Base and Support | 6 | Receptacles with pressure-wire terminals only. |
| 130 | Fault Current | 6 | Self-grounding receptacles only. |
| 132 | Pullout | 6 | Factory-wired push-in terminals only. |
| 133 | Temperature | 6 | Factory-wire push-in terminals only. |
| 134<br><br>135<br>136 | Conductor Insertion and Retention<br><br>Conductor Push-In<br>Terminal Abuse | 6 | Flush and self-contained receptacles having a 5-15R, 5-20R, 6-15R, or 6-20R configuration with push-in terminals with wire release mechanism. |
| 134 | Conductor Insertion and Retention | 6 | Flush and self-contained receptacles having a 5-15R, 5-20R, 6-15R, or 6-20R configuration with push-in terminals without wire release mechanism. |
| 135 | Conductor Push-In | 6 | Flush and self-contained receptacles having a 5-15R, 5-20R, 6-15R, or 6-20R configuration with push-in terminals without wire release mechanism. |
| 136 | Terminal Abuse | 6 | Flush and self-contained receptacles having a 5-15R, 5-20R, 6-15R, or 6-20R configuration with push-in terminals without wire release mechanism. |
| 137 | Temperature | 8 | Flush and self-contained receptacles having a 5-15R, 5-20R, 6-15R, or 6-20R configuration with push-in terminals. |
| 139 | Probe | 6 | Tamper-resistant receptacles only. |

Table 59.4 Continued on Next Page

## Table 59.4 Continued

| Section | Test sequences | No. of devices[a] | Details |
|---|---|---|---|
| 140<br>139<br>142 | Impact<br>Probe (repeated)<br>Dielectric Voltage-Withstand | | |
| 139<br>141<br>139<br>142 | Probe<br>Mechanical Endurance<br>Probe (repeated)<br>Dielectric Voltage-Withstand | 6 | Tamper-resistant receptacles only. |
| 143 | Bonding (Non-Metallic Outlet Box Fault Current) Test | 12 | Flush receptacle provided with adjustable mounting means |
| 144 | Bonding (Metallic Outlet Box Fault Current) Test | 12 | Flush receptacle provided with adjustable mounting means |
| 145 | Mounting Yoke Resistance Test | 6 | Flush receptacle provided with adjustable mounting means |
| 147 | Mechanical Endurance | 12 | Pop-out receptacle and pop-up receptacle assembly. |
| 148 | Mechanical Load | same 6 | Pop-out receptacle only. |
| 149 | Spill | same 6 | Pop-up receptacle assembly only. |
| 151 | Heat Cycling and Vibration | 6 | Pin-type or insulation-displacement terminals only. |
| 153 | Retention of Tab Connection Test | 6 | Flush receptacle provided with separable terminal assembly |
| 154 | Separable Connector Pull Test | 6 | Flush receptacle provided with separable terminal assembly |
| 155 | Mold Stress Relief Test | 6 | Flush receptacle provided with separable terminal assembly |
| 156 | Dielectric Voltage-Withstand Test | Same 6 | Flush receptacle provided with separable terminal assembly |
| 157 | Grounding Contact Temperature Test | Same 6 | Flush receptacle provided with separable terminal assembly |
| 158 | Resistance Test | Same 6 | Flush receptacle provided with separable terminal assembly |
| 159 | Latching Mechanism Test | 6 | Flush receptacle provided with separable terminal assembly |
| 160 | Short Circuit Test | 1 | Flush receptacle provided with separable terminal assembly |
| 161 | Continuity Impedance Test | 1 | Flush receptacle provided with separable terminal assembly |
| 163 | Rotational Endurance | 6 | Flush receptacle provided with a rotatable outlet or outlets. |
| 164 | Temperature | Same 6 | Flush receptacle provided with a rotatable outlet or outlets. |
| 165 | Dielectric Votlage-Withstand | Same 6 | Flush receptacle provided with a rotatable outlet or outlets. |
| 166 | Resistance | Same 6 | Flush receptacle provided with a rotatable outlet or outlets. |
| 167 | Fault Current | Same 6 | Flush receptacle provided with a rotatable outlet or outlets. |

[a] A set of representative devices may be used for more than one test sequence if agreeable to all concerned.

## Table 59.5
## Summary of tests[a]
## Self-contained receptacles

| Section | Test sequences | No. of devices[b] | Details |
|---|---|---|---|
| 169 | Heat Cycling and Vibration | 10 | Test to be conducted on separate sets of devices rated 15 A and 20 A. Not required if crimp, wire-binding screw or pressure-wire terminal intended for use with copper wire only is used. |
| 170 | Cable Pullout | 6 | Test to be conducted on separate sets of devices rated 15 A and 20 A. |
| 171 | Conductor Pullout | 3 | Test to be conducted on separate sets of devices rated 15 A and 20 A. |
| 172 | Mounting Strength | 6 | Test to be conducted on separate sets of devices if mounted in paneling or mounted to frame construction by bracket. |
| 173 | Wall-Mounting Secureness | 6 | |
| 174 | Assembly Security | 9 | |
| 175 | Field Replacement | 1 | |
| 176 | Fault Current Withstand | 3 | |
| 177 | Knockouts | 3 | |
| 178 | Creep | 6 | |
| 179 | Mold Stress | 6 | May be combined with the Mold Stress Relief Test in Section 63. See Table 59.4. |
| 180 | Specimen Flammability | 15 | Only conducted on materials having less than a V-2 flame rating. Insulating material specimens measuring 5.0 in by 0.5 in (127 by 12.7 mm) are used for this test. |

[a] To be conducted in addition to any applicable tests specified in Table 59.4.

[b] A set of representative devices may be used for more than one test sequence if agreeable to all concerned.

## Table 59.6
## Summary of tests
## Current taps

| Section | Test sequence | No. of devices[a] | Details |
|---|---|---|---|
| 60 | Comparative Tracking Index | 5 | Materials to be evaluated in accordance with Exception No. 1 to 8.3.1. |
| 61 | Glow Wire | 3 | Materials to be evaluated in accordance with Exception No. 1 to 8.3.2. |
| 62 | High-Current Arc Resistance to Ignition | 3 | Materials to be evaluated in accordance with Exception No. 2 to 8.3.2. |
| 65<br>63<br>65 | Dielectric Voltage-Withstand<br>Mold Stress Relief<br>Dielectric Voltage-Withstand (Repeated) | 6 | All devices<br>Devices employing thermoplastic materials.<br>Devices subjected to Mold Stress Relief Test. |
| 64 | Moisture Absorption Resistance | 3 | Conducted on vulcanized fibre, fuseholders and insulating backplates. Use insulating material portion of device only. |
| 66<br>71 | Accelerated Aging<br>Security of Blades | 6 | Materials to be evaluated in accordance with the Exception to 8.4.1.<br>Devices rated 15 A or less and 250 V or less. |

**Table 59.6 Continued on Next Page**

## Table 59.6 Continued

| Section | Test sequence | No. of devices[a] | Details |
|---|---|---|---|
| 67 | Insulation Resistance | 6 | Conducted on devices molded of rubber or similar materials, or any material containing enough free carbon to render the material grey or black. |
| 68 | Conductor Secureness | 6 | Devices employing wire leads only. |
| 69 | Tightening Torque | 6 | Devices with wire-binding screws with pitch greater than that specified in Table 12.1. |
| 71 | Security of Blades | 6 | Devices rated 15 A or less and 250 V or less that are not subjected to the Accelerated Aging Test. |
| 72 | Secureness of Cover | 6 | Devices for wiring onto flexible cord that employ separable face covers as described in Enclosure, Section 9. |
| 75 | Integrity of Assembly | 6 | Devices for wiring onto flexible cord only. Not conducted on devices employing pin terminals, strain-relief knots, or certain strain relief constructions. Refer to test description. |
| 76 | Self-Hinge Flexing | 18 | Devices employing self-hinges in the enclosure only. |
| 182 | Contact Security | 6 | Devices having 1-15P configuration blades only. |
| 93 | Retention of Plugs | 6 | Devices having a 1-15R, 5-15R, 5-20R, 6-15R or 6-20R configuration. |
| 94 | Overload | | |
| 95 | Temperature | | |
| 96 | Retention of Plugs (Repeated) | | Devices having a 1-15R, 5-15R, 5-20R, 6-15R or 6-20R configuration. |
| 97 | Resistance to Arcing | | Not required for devices employing phenolic, urea, or melamine in the outlet face. |
| 99 | Fuseholder Temperature | 6 | Devices with fuseholders only. |
| 100 | Improper Insertion | 12 | Devices with a 1-15R outlet face configuration only. |
| 105 | Assembly | 12 | Devices employing pin-type terminals. Number of devices indicated assumes device accommodates 18 AWG Type SPT-1 wire only. Total number of devices will vary depending upon the number of sizes and types of flexible cord intended for use with the device. See 102.2. |
| 106 | Temperature | | |
| 109 | Dielectric Voltage-Withstand | | |
| 105 | Assembly | 12 | Devices employing pin-type terminals. Number of devices indicated assumes device accommodates 18 AWG Type SPT-1 wire only. Total number of devices will vary depending upon the number of sizes and types of flexible cord intended for use with the device. See 103.2. |
| 107 | Strain Relief | | |
| 105 | Assembly | 6 | Devices employing pin-type terminals. Number of devices indicated assumes device accommodates 18 AWG Type SPT-1 wire only. Total number of devices will vary depending upon the number of sizes and types of flexible cord intended for use with the device. |
| 108 | Fault Current | | |

[a] A set of representative devices may be used for more than one group of tests if agreeable to all concerned.

**Table 59.7**
**Summary of tests**
**Flatiron and appliance plugs**

| Section | Test sequences | No. of devices [a] | Details |
|---|---|---|---|
| 60 | Comparative Tracking Index | 5 | Materials to be evaluated in accordance with Exception No. 1 to 8.3.1. |
| 61 | Glow Wire | 3 | Materials to be evaluated in accordance with Exception No. 1 to 8.3.2. |
| 62 | High-Current Arc Resistance to Ignition | 3 | Materials to be evaluated in accordance with Exception No. 2 to 8.3.2. |
| 65<br>63<br>65 | Dielectric Voltage-Withstand<br>Mold Stress Relief<br>Dielectric Voltage-Withstand (Repeated) | 6 | All plugs.<br>Plugs employing thermoplastic materials.<br>Plugs subjected to Mold Stress Relief Test. |
| 64 | Moisture Absorption Resistance | 3 | Conducted on vulcanized fibre, fuseholders and insulating backplates. Use insulating material portion of device only. |
| 67 | Insulation Resistance | 6 | Conducted on devices molded of rubber or similar materials, or any material containing enough free carbon to render the material grey or black. |
| 68 | Conductor Secureness | 6 | Plugs employing wire leads only. |
| 69 | Tightening Torque | 6 | Plugs with wire-binding screws with pitch greater than that specified in Table 12.1. |
| 184<br>185<br>186<br>187 | Millivolt Drop<br>Overload<br>Heating<br>Millivolt Drop (Repeated) | 6 | |
| 188 | Crushing | 6 | |
| 189 | Mechanical Endurance | 6 | Not required for thermostatically-controlled appliance plugs. |
| 190 | Accelerated Aging | 6 | Devices employing rubber cord guards. |
| 191 | Cord Guard | 6 | |

[a] A set of representative devices may be used for more than one group of tests if agreeable to all concerned.

All Devices

## 60 Comparative Tracking Index Test

60.1 A polymeric material used for electrical insulation or enclosure of live parts, evaluated in accordance with Exception No. 1 to 8.3.1 and tested in accordance with the Comparative Tracking Index and Comparative Tracking Performance Level Class of Electrical Insulation Materials test described in the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A, shall have a performance level class value not greater than 3.

## 61 Glow Wire Test

61.1 A polymeric material used for electrical insulation or enclosure of live parts and evaluated in accordance with Exception No. 1 of 8.3.2, shall be tested in accordance with the requirements of 61.2 in order to determine its resistance to ignition from overheated conductors caused by circuit overloads.

61.2 Devices are to be subjected to the Glow-Wire End-Product Test described in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. As a result of this test, there shall not be ignition of the insulating material during 30 seconds of application of the probe at a glow-wire temperature of 650°C for all devices.

## 62 High-Current Arc Resistance to Ignition Test

62.1 A polymeric material used for electrical insulation or enclosure of live parts and evaluated in accordance with Exception No. 2 to 8.3.2, when tested as described in 62.2 – 62.6, shall not ignite within the number of arcs specified in Table 62.1 for the flame class of the insulating material. In addition, there shall not be dielectric breakdown caused by formation of a permanent carbon conductor path.

*Exception No. 1: An insulating material used in the face of a female outlet device that has been subjected to the Resistance to Arcing Test described in Section 97 or 120, as appropriate, is not required to be subjected to this test.*

*Exception No. 2: An insulating material that has previously been accepted for use in the face of a female outlet device as specified in Exception No. 1 may be judged acceptable for use in other applications without being subjected to this test.*

**Table 62.1**
**High-current arc resistance to ignition test arcing criteria**

| Flame class | No. of arcs |
|---|---|
| HB | 60 |
| V-2, VTM-2 | 15 |
| V-1, VTM-1 | 15 |
| V-0, VTM-0 | 15 |

62.2 When preparing devices for test, the condition that will cause the greatest arcing near the material being tested in the device is to be simulated as follows:

a) If the live parts are in direct contact with the polymeric material or located less than 1/32 inch (0.8 mm) from the polymeric material, the moving electrode is to be positioned on the surface of the material. The test arc is to be established between a live part acting as the fixed electrode and any adjacent part where breakdown is likely to occur. For example, if the material being tested is used in the face of an attachment plug, one line blade is to be connected to the test circuit as the fixed electrode.

b) If the live parts are located at least 1/32 inch (0.8 mm) but less than 1/2 inch (12.7 mm) from the material, both the fixed and moving electrodes are to be positioned above the surface of the material at a distance equal to the minimum spacing between the live part and the material.

62.3 The test circuit is to provide test currents and test voltages equal to the current and voltage ratings of the device to be tested, but not exceeding 30 A or 240 V ac in any case. The test arc is to be established between a fixed electrode and a moving electrode consisting of a copper or stainless steel conductive probe. Each device is to be positioned with the electrodes making initial contact. The circuit is to be energized and the cyclic arcing started. The electrodes are to be drawn apart a distance not exceeding either 3/64 inches (1.2 mm) for a device rated 250 V or less and 1/8 inch (3.2 mm) for a device rated more than 250 V. The arc is to be used to attempt to ignite materials forming parts of the enclosure or to ignite materials located between the parts of different potential. The moving electrode is to be used to break through insulation, create arc tracking or create a carbon build-up across the surface of the insulating material at a rate of 30 to 40 arc separations per minute.

62.4 Immediately following the completion of the arcing portion of the test, the device is to be subjected to a 50 to 60 Hz essentially sinusoidal potential applied as described in 62.5 between live parts of opposite polarity and between live parts and dead metal parts. The test potential is to equal twice the rated voltage of the device plus 1000 V.

62.5 The device is to be tested by means of a 500 VA or larger capacity transformer whose output voltage is essentially sinusoidal and can be varied. The applied potential is to be increased from zero until the required test level is reached, and is to be held at that level for one minute. The increase in the applied potential is to be at a uniform rate and as rapid as is consistent with its value being correctly indicated by a voltmeter.

62.6 If the output of the test-equipment transformer is less than 500 volt-amperes, the equipment is to include a voltmeter in the output circuit to indicate the test potential directly.

## 63 Mold Stress Relief Test

63.1 As a result of temperature conditioning specified in 63.2, there shall not be any warpage, shrinkage or other distortion that results in any of the following:

a) Making uninsulated live parts, other than exposed wiring terminals, or internal wiring accessible to contact, by the probe illustrated in Figure 9.1.

b) Defeating the integrity of the enclosure so that acceptable mechanical protection is not afforded to the internal parts of the device.

c) Interference with the operation, function or installation of the device. The outlet slot openings of a female device shall be capable of receiving a fully inserted attachment plug of the intended configuration.

d) A condition that results in the device not complying with the strain relief requirements, if applicable.

e) A reduction of spacings between uninsulated live parts of opposite polarity, uninsulated live parts and accessible dead or grounded metal below the minimum acceptable values.

f) Any other evidence of damage that could increase the risk of fire or electric shock.

*Exception: Devices employing only thermosetting materials are not required to be subjected to this test, including thermosetting elastomeric materials such as neoprene (chloroprene butadiene) rubber (CBR), ethylene/propylene/diene (EPDM), natural rubber (NR), nitrile rubber (NBR), styrene (butadiene) rubber (SBR), and silicone rubber (SIR).*

63.2 The devices are to be placed in a circulating air oven maintained at a temperature of 70°C (158°F) for 7 hours. The devices are to be removed from the oven and allowed to cool to room temperature before determining compliance.

63.3 Immediately following the completion of this test, the devices are to be subjected to a repeated Dielectric Voltage-Withstand Test as described in Section 65. The devices are not required to be subjected to the humidity conditioning described in 65.1.2.

## 64 Moisture Absorption Resistance Test

64.1 Moisture-resistant insulating materials shall not absorb more than 6% of water by mass.

64.2 The material is to be:

a) Dried at 105 ±5°C for 1 hour;

b) Weighed ($W_1$);

c) Immersed in distilled water at 23 ±1°C for 24 hours;

d) Removed from the distilled water and the excess surface moisture wiped off; and

e) Reweighed ($W_2$).

The moisture absorbed by the material is to be calculated as:

$$\frac{W_2 - W_1}{W_1} \times 100\,\%$$

*Exception: A material tested in accordance with Test Method for Water Absorption of Plastics (ASTM D 570) described in the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A, is not required to be tested.*

## 65 Dielectric Voltage-Withstand Test

### 65.1 Devices for fixed or permanent installation

65.1.1 Devices intended for fixed or permanent installation including appliance, fixture or equipment outlets, inlets, and receptacles, shall withstand without breakdown a 50 – 60 Hz essentially sinusoidal potential applied as described in 65.1.3 for one minute, immediately following the humidity conditioning described in 65.1.2, between the following:

a) Live parts of opposite polarity, and

b) Live parts and grounding or dead metal parts including both the equipment grounding path and the mounting means of an isolated-ground receptacle.

*Exception: Devices employing polymeric materials consisting wholly of ceramic, thermoset, thermoplastic or elastomeric materials are not required to be subjected to the humidity conditioning.*

65.1.2 Mating attachment plugs with solid blades are to be inserted into the contact openings of three of the six devices. The devices are then to be placed into an environmental chamber and subjected to the following conditions:

a) 4 hours at a temperature of 75 ±1°C (167 ±1.8°F) at a relative humidity of 92 ±3 percent.

b) 16 hours at a temperature of 75 ±1°C (167 ±1.8°F) at a relative humidity of 40 ±3 percent.

c) 4 hours at a temperature of 30 ±1°C (86 ±1.8°F) at a relative humidity of 60 ±3 percent.

65.1.3 Upon completion of the humidity conditioning, the device is to be tested by means of a 500 VA or larger capacity transformer whose output voltage is essentially sinusoidal and can be varied. The applied potential is to be increased from zero until the required test level is reached, and is to be held at that level for one minute. The increase in the applied potential is to be at a uniform rate and as rapid as is consistent with its value being correctly indicated by a voltmeter. The test potential is to be 2000 V for devices rated 300 V or less and 3000 V for devices rated greater than 300 V.

65.1.4 The mating attachment plugs used in 65.1.2 are to be capable of withstanding the application of a 2500 V potential for devices rated 300 V or less and a 3500 V potential for devices rated greater than 300 V.

65.1.5 If the output of the test-equipment transformer is less than 500 volt-amperes, the equipment is to include a voltmeter in the output circuit to indicate the test potential directly.

65.1.6 If the receptacle is provided with break-off tabs for feed-through wiring, the tabs are to be removed immediately following the completion of the test described in 65.1.3. A test potential of 2000 V is then to be applied again across the two adjacent line terminals.

### 65.2 Cord-connected devices

65.2.1 Devices intended for installation on flexible cords including attachment plugs, cord connectors, and current taps, shall be capable of withstanding the application of an ac potential of 1000 V plus 2 times the rated voltage applied for a period of one minute between live parts of opposite polarity and between live parts and grounding or dead metal parts.

## 66 Accelerated Aging Tests

### 66.1 General

66.1.1 A device employing one of the insulating materials tabulated in the Exception to 8.4.1 in an insulation or enclosure application shall be subjected to one of the following tests as applicable.

### 66.2 Rubber, EPDM, and TEE compounds

66.2.1 A device employing a rubber, EPDM, or TEE compound shall not show any apparent deterioration and no greater change in hardness than ten units as a result of the test described in 66.2.2 – 66.2.4.

66.2.2 A complete device is to be used for this test. The hardness of the material is to be determined as the average of five readings with an appropriate gauge, such as the Rex hardness gauge or the Shore durometer. The device is to be placed in a full-draft air-circulating oven for 70 hours at a temperature of 100°C (212°F). The device is to be allowed to rest at room temperature for four or more hours after removal from the oven. The hardness is to be determined again as the average of five readings. The difference between the average original hardness reading and the average reading taken after exposure is the change in hardness.

*Exception: As an alternative to testing on a complete device, representative plaques or bars of the insulating material which measure a minimum of 1 inch (25.4 mm) in diameter by 1/4 inch (6.4 mm) thick are to be used.*

66.2.3 Following the accelerated aging conditioning described in 66.2.2, a device having male blades supported by the material under test shall be capable of withstanding the applicable Security of Blades Test described in Section 71 or 86.

66.2.4 The accelerated-aging tests described in 66.2.1 – 66.2.3 are to be made on each color of material and on each basic rubber, EPDM, or TEE material employed for the device.

### 66.3 PVC compounds and copolymers

66.3.1 A device employing polyvinyl chloride or one of its copolymers shall not show any cracks, severe discoloration, or other visible signs of deterioration of the molding material as a result of this test.

66.3.2 The device is to be placed in a full-draft air-circulating oven for 96 hours at a temperature of 100°C (212°F). The device is to be allowed to rest at room temperature for at least one hour after removal from the oven. Warping or distortion of the device housing that occurs as a result of the oven conditioning shall not be considered to be a sign of deterioration.

*Exception: As an alternative to testing on a complete device, representative plaques or bars of the insulating material which measure a minimum of 1 inch (25.4 mm) in diameter by 1/4 inch (6.4 mm) thick are to be used.*

## 67 Insulation Resistance Test

67.1 When determined as described in this section, the insulation resistance shall not be less than 100 megohms between:

a) Live parts of opposite polarity,

b) Live parts and dead-metal parts that are exposed to contact by persons or that may be grounded in service, and

c) Live parts and any surface of insulating material that is exposed to contact by persons or that may be in contact with ground in service.

67.2 The insulation resistance measurement is to be made on rubber and similar materials of any color. Other materials are to be tested if they contain free carbon in such quantity that it renders the material grey or black.

67.3 To determine compliance with the requirement in 67.1, the insulation resistance is to be measured by a magneto megohmmeter that has an open-circuit output of 500 V or by equivalent equipment.

67.4 The use of a megohmmeter between metal parts requires no special clarification or instruction. However, in measuring insulation resistance to the surface of an insulating material, it is necessary to apply an electrode to the insulating material as described in 67.5.

67.5 A quantity of No. 7 lead or nickel-plated lead drop shot (approximate diameter 0.10 inch or 2.5 mm) is to be placed in a container that is open at the top. After cord holes or other openings through which the shot could enter have been carefully plugged with a high-resistance insulating material, the device is to be immersed in the shot so that the shot serves as an electrode in contact with the surface to which the test is to be applied.

67.6 All rubber parts are to be kept for at least 48 hours at room temperature before being subjected to the test mentioned in 67.3.

## 68 Conductor Secureness Test

68.1 If a conductor or lead is connected to an element (male blade or female contact) of a device before the element has been assembled into the device, the connection shall not break under a pull applied for 1 minute between the element and the conductor before the element has been assembled into the device. A force of 20 lbf (89 N) is to be applied if the conductor is 18 AWG (0.82 $mm^2$) or larger in size. If a smaller conductor is used, the force is to be 8 lbf (36 N).

68.2 While the test mentioned in 68.1 is being performed, the angle between the element and the conductor or lead is to be that used in the completely assembled device. The force is to be applied gradually.

## 69 Tightening Torque Test

69.1 A No. 8 or larger wire-binding screw having more than 32 threads per inch (per 25.4 mm) shall be capable of withstanding the torque application described in 69.2 without stripping either the screw threads or the terminal plate threads or damaging the slot in the head of the screw.

69.2 Six devices are to be tested. Solid 14 AWG (2.1 $mm^2$) copper wire is to be placed under the screw head and wrapped 2/3 – 3/4 turn around the screw. The screw is then to be tightened with a clutch-type torque screwdriver which has been calibrated and preset to release at 16 lbf-in (1.8 N·m).

ATTACHMENT PLUGS

All Devices

## 70 General

70.1 The performance of an attachment plug is to be investigated by means of the applicable tests described in Sections 60 – 69, and 71 – 84. For Hospital Grade Devices, see Supplement SC.

## 71 Security of Blades Test

### 71.1 General

71.1.1 The blades and pins of an attachment plug rated 15 A or less, and 250 V or less, shall be capable of withstanding a pull of 20 lbf (89 N) for 2 minutes without loosening. In a device of nonrigid construction (when, for example, a soft, molded material is used) a residual displacement of either blade of more than 3/32 inch (2.4 mm) measured 2 minutes after the removal of the weight is not acceptable. See 66.2.3.

*Exception: This requirement does not apply to a special-purpose attachment plug that is intended for use only with a corresponding cord connector and that is not interchangeable with any of the attachment plugs illustrated in Figure C1.1 of the Standard for Wiring Device Configurations, UL 1681 or in Wiring Devices – Dimensional Specifications, ANSI/NEMA WD6.*

71.1.2 The device is to be wired in the intended manner and then supported on a horizontal steel plate with the blades, pins, or both projecting downward through a single hole with the smallest dimension through which the blades, pins, or both will be permitted to pass through. A device whose flexible cord is assembled to the blades at the factory is to be tested with a cord approximately 6 inches (150 mm) in length.

71.1.3 A weight that exerts a force of 20 lb (89 N) is to be supported by each blade or pin in succession. The pull is to be gradually applied.

71.1.4 If parallel blades are involved and the connection of wiring to the blades in the field requires disassembly of the blades from the body so that the secureness of each blade is dependent to some degree on the assembly of the other blade, the two blades are also to be tested together. A rigid pin is to be placed in holes that may be drilled in the blades if not provided, and a weight that exerts a force of 20 lb (89 N) is to be placed on the rigid pin, centered between the blades.

### 71.2 Self-hinged plugs

71.2.1 If the attachment plug employs a self-hinge that is relied upon to hold the plug face in place, the tests described in 71.1.1 – 71.1.4 are to be repeated with the hinges cut. The device under test is to be supported such that the separation of the plug face from the enclosure is not restricted. If unacceptable results are obtained, a separate set of six devices is to be subjected to the Self-Hinge Flexing Test described in Section 76.

## 72 Secureness-Of-Cover Test

72.1 The disc or separable cover of an attachment plug shall remain capable of being mechanically secured after 5 cycles of removal and replacement and after conditioning as described in 72.2.

72.2 Prior to testing, the disc or separable cover is to be subjected to 85 ±5 percent relative humidity at 30.0 ±2.0°C (86.0 ±3.6°F) for 24 hours.

## 73 Crushing Test

73.1 An attachment plug having a 1-15P, 2-15P, 5-15P, or 6-15P configuration shall be capable of withstanding for 1 minute a crushing force of 75 lbf (334 N) applied in any direction perpendicular to its major axis.

73.2 Any testing equipment that can apply a steady force of 75 lbf (334 N) to the plug may be employed. The plug is to be tested between two 1/2-inch (13-mm) or thicker parallel flat maple blocks. The crushing force is to be applied gradually.

## 74 Attachment Plug Grip Tests

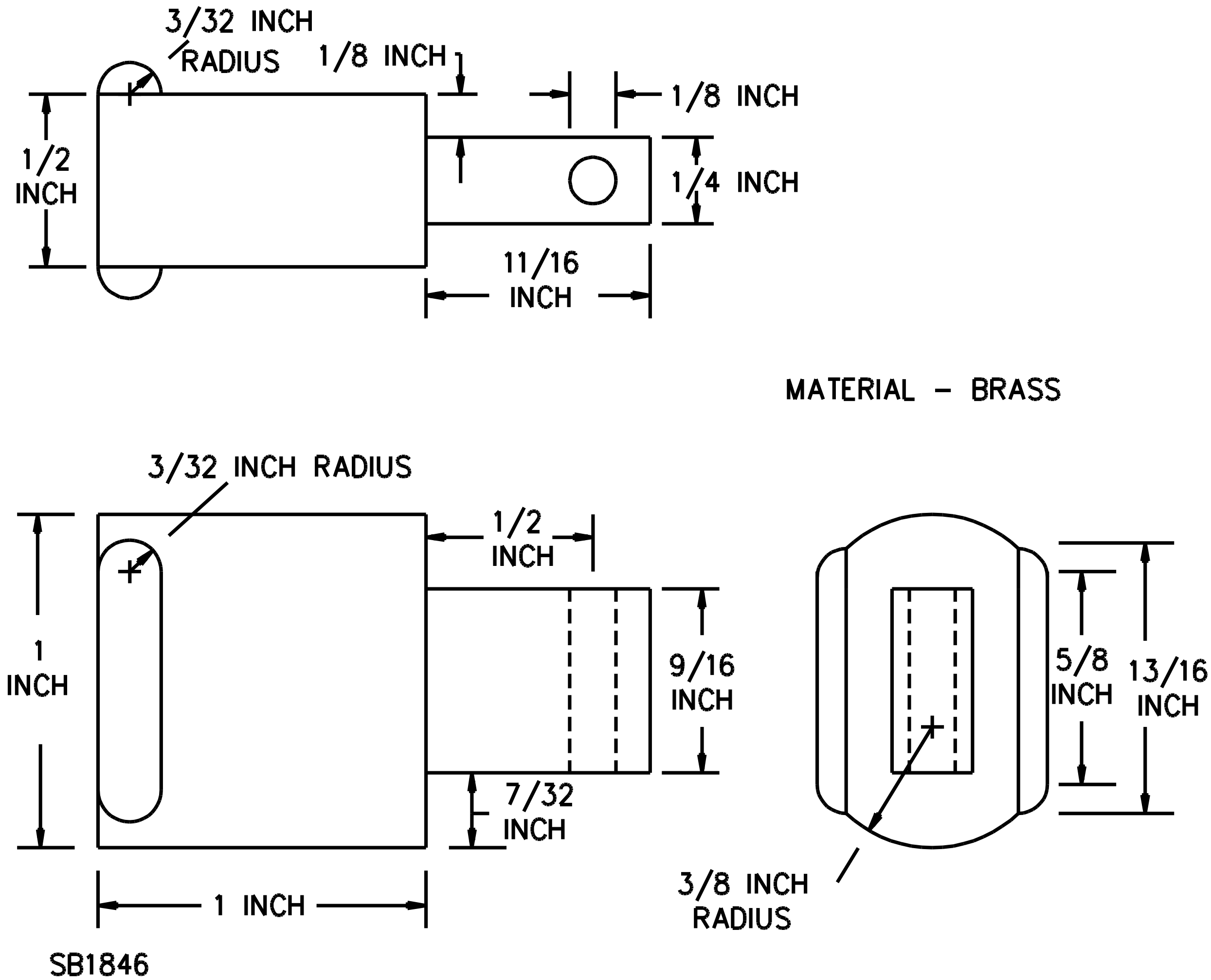
74.1 An attachment plug having a 1-15P configuration is to be tested as described in this section to determine compliance with 17.2.1.

74.2 Prior to testing, the reference plug shown in Figure 74.1 is to be cleaned with a metal cleaner. The reference plug, the test plugs, and the hands of each individual conducting the test are to be washed with soap and water, rinsed, and then dried.

74.3 The test apparatus is to consist of a spring scale equipped with a means to securely attach both the reference plug and test devices in a manner that reduces the likelihood of rotational movement during pulls. A simulated face plate, having an opening for the plug blades, is to be secured to the movable member. The mounting arrangement for the plug being tested is to be such that the face of the plug is flush with the face plate. A typical apparatus is shown in Figure 74.2.

**Figure 74.1**

**Reference plug**

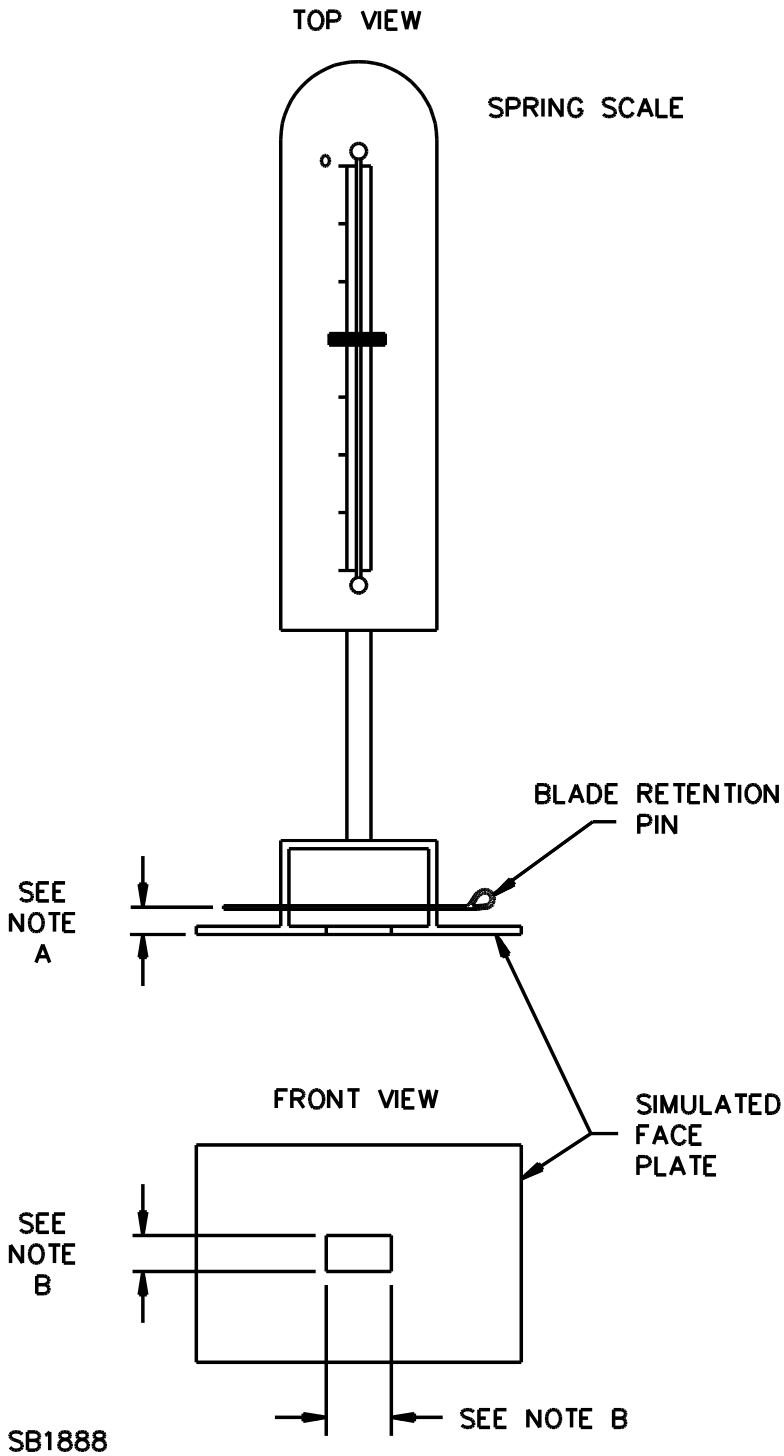



| inch | 3/32 | 1/8 | 7/32 | 1/4 | 3/8 | 1/2 |
|---|---|---|---|---|---|---|
| mm | 2.4 | 3.2 | 5.6 | 6.4 | 9.7 | 12.7 |

| inch | 9/16 | 5/8 | 11/16 | 13/16 | 1.0 |
|---|---|---|---|---|---|
| mm | 14.3 | 15.9 | 17.5 | 20.6 | 25.4 |

**Figure 74.2**

**Typical test apparatus**




NOTES

A – Retaining pin through blades spaced to keep plug close to plate

B – Large enough for blades to pass through

74.4 A test plug, without cord installed, is to be securely attached to the test apparatus. The individual performing the test is to grip the test plug with either hand in a manner intended to apply the maximum pull force. A steady straight pull is to be applied until the plug pulls free from the individual's hand. The individual applying the force is not to view the force indicator during the pull. The maximum pull force applied during the pull is to be recorded. Immediately following the pull test, the reference plug is to be attached to the test apparatus and a comparison pull made using the same hand. The maximum pull force is to be recorded. The ratio of the force for the test plug to the reference plug is to be calculated and recorded.

74.5 The comparison pull procedure described in 74.4 is to be repeated on the same plug an additional two times by the same individual. The ratio for each pair of pulls (test/reference) is to be calculated and recorded.

74.6 Each individual is to test three plugs as described in 74.4 and 74.5 with the ratio for each pair of pulls being calculated and recorded for all three plugs.

74.7 Two additional individuals are to test three plugs each (for a total of 9 comparison pulls per individual), as described in 74.4 – 74.6. The ratio for each pair of pulls (test/reference) is to be calculated and recorded.

74.8 The results are considered acceptable if all of the following conditions are met:

a) The ratio for each pair of pulls (test/reference) is 0.55 or larger for at least two pulls (of the three pulls performed) on each plug,

b) At least two (of the three) plugs tested by each individual comply with (a), and

c) At least two individual's test results comply with (b).

74.9 If only one individual obtains results that comply with 74.8(b), at the manufacturer's request, two individuals not previously involved in the testing may test three plugs each as described in 74.4 – 74.6. The results are considered acceptable if both individual's test results comply with 74.8 (a) and (b).

## 75 Integrity of Assembly Test

### 75.1 General

75.1.1 An attachment plug shall not experience breakage or separation of the device body, detachment of any cord conductor, or any other damage that could increase the risk of fire or electric shock, when tested as described in this section.

*Exception No. 1: A device intended for use with a strain-relief knot as described in 13.3 is not required to be subjected to this test.*

*Exception No. 2: A strain-relief that consists of a cord clamp located outside the wiring compartment and that is tightened by one or more screws is not required to be subjected to this test.*

*Exception No. 3: Attachment plugs employing pin-type terminals instead shall be subjected to the Strain Relief Test, Section 82.*

*Exception No. 4: Hospital Grade attachment plugs shall instead be subjected to the Strain Relief Tests, Section SC5.*

75.1.2 A field-wired device is to be wired in accordance with the manufacturer's instructions using 12 inch (305 mm) lengths of the sizes and types of flexible cord chosen to represent the range of cords intended for use with the device. See Reference No. 4 of Table 193.1.

75.1.3 The device is to be anchored securely by the blades and the cord is to be pulled steadily as follows:

a) 30 lbf (133 N) for a cord with 18 AWG (0.82 $mm^2$) or larger conductors, and

b) 20 lbf (89 N) for a cord with conductors smaller than 18 AWG (0.82 $mm^2$),

for 1 minute in the direction perpendicular to the plane of the cord entrance.

### 75.2 Self-hinged plugs

75.2.1 If the attachment plug employs a self-hinge that is relied upon to hold the flexible cord in place, the tests described in 75.1.1 – 75.1.3 are to be repeated with the hinges cut. If unacceptable results are obtained, a separate set of six devices is to be subjected to the Self-Hinge Flexing Test described in Section 76.

## 76 Self-Hinge Flexing Test

76.1 A self-hinge that is relied upon to maintain the integrity of the enclosure or strain relief after an attachment plug is assembled shall not break, crack, or experience other damage as a result of this test.

76.2 Three groups of six devices each shall be tested as follows:

a) Group 1 – As received;

b) Group 2 – Oven conditioned for 168 hours at 100°C (212°F); and

c) Group 3 – Cold conditioned for 2 hours at −10°C (14°F) and allowed to return to room temperature.

76.3 The hinge of each device shall be completely opened and closed for 100 cycles of operation.

## 77 Terminal Temperature Test

77.1 When tested as described in this section, the temperature rise of an attachment plug for use with a flexible cord shall not be more than 30°C (54°F).

*Exception: An attachment plug employing wire-binding screws, pressure wire terminals or soldering lugs, or with factory-wired cord connections that are soldered, brazed, or welded, is not required to be subjected to this test.*

77.2 The plug is to carry the current corresponding to the capacity of the maximum size of cord that the device is intended to accommodate. The maximum size of cord that the device is intended to accommodate anticipates the use of cord with ampacity that does not exceed the maximum current rating of the device. If the device can accommodate a cord with an ampacity that exceeds its maximum ampere rating, the test is to be made at maximum rated current of the device with conductors no larger than necessary to carry that current.

77.3 Temperatures are to be measured by means of thermocouples attached to the wiring terminals or cord connections.

*Exception: If the wiring terminals or cord connections are not accessible for mounting thermocouples, the thermocouples are to be attached to the blades as close as possible to the face of the device.*

77.4 Temperature readings are to be obtained by means of thermocouples consisting of 28 – 32 AWG (0.08 – 0.032 $mm^2$) iron and constantan wires. It is a common practice to employ thermocouples consisting of 30 AWG (0.05 $mm^2$) iron and constantan wires with a potentiometer type of indicating instrument. This equipment will be used if a referee measurement of temperature is necessary.

## 77A Spring Action Clamp Terminal Pull Test

77A.1 An attachment plug employing spring action clamp terminals shall be subjected to the test conditions as specified in 77A.2 – 77A.6.

77A.2 Upon completion of this test, there shall not be any damage to the terminal or its securement mechanism. The spring action clamp shall remain capable of functioning as intended. There shall not be any damage, arcing or dielectric breakdown during application of the test potential. The conductor shall not pull free from the terminal during application of the test force.

77A.3 Each terminal of each device (three terminals minimum) shall be tested. Each terminal shall be wired with the smallest AWG conductor size of the intended flexible cord and wired with the largest conductor size of the intended flexible cord, as specified by the manufacturer. The attachment plug enclosure housing and strain relief clamp shall not be used.

77A.4 The conductor insulation shall be prepared by removing the insulation from the conductor according to manufacturer's instructions (strip length) and then inserted into the spring action clamp terminal as intended. The lever of the spring action clamp shall then be operated to the fully latched and locked position and back to the unlatched and unlocked position. This sequence of operation shall be repeated for a total of 100 cycles.

77A.5 Following the 100 cycles, the conductor shall be reattached to the spring action clamp terminal and the lever placed in the latched and locked position as intended. A static pull force as specified in Table 77A.1 shall be applied to the conductor for 1 minute in a direction perpendicular to the plane of the device under test, tending to remove the conductor.

**Table 77A.1**
**Test values for spring action clamp terminal pull test**

| Size of conductor AWG | Pullout force lbf (pounds) |
|---|---|
| 16 | 9 |
| 14 | 11.5 |
| 12 | 13.5 |
| 10 | 18.0 |
| 8 | 20.5 |
| 6 | 21 |
| 4 | 30 |

77A.6 Each device is then to be subjected to a 50 – 60 Hz essentially sinusoidal potential equal to twice the rated voltage plus 1000 V applied between live parts of opposite polarity and between live parts and grounding or dead metal parts. The test voltage is to be increased at a uniform rate and as rapidly as is consistent with its value being correctly indicated by a voltmeter and maintained at the test potential for 1 minute.

## 78 Fuseholder Temperature Test

78.1 When tested as described in this section, the temperature rise of an attachment plug incorporating a fuseholder shall not exceed the following:

a) 30°C (54°F) on the fuse clips when tested with a dummy fuse;

b) 85°C (153°F) on the fuse clips when tested with a live fuse;

c) 30°C (54°F) at the wiring terminals or cord connections at any time (see 78.7); and

d) The relative thermal index of the surrounding insulating material, minus an assumed ambient of 25°C (77°F), at any time (see 78.7).

78.2 The test is to be conducted on a set of six previously untested devices. The test may be conducted with either a live fuse or a dummy fuse (see 78.6 and 78.7).

*Exception: The test may be conducted in conjunction with the Terminal Temperature Test, Section 77, if agreeable to all concerned.*

78.3 The devices are to be wired in a series circuit with the blades of the attachment plugs connected by the shortest possible length of solid copper wire soldered across the blades. Each connection to the device being tested is to be made by means of a 12-inch (300-mm) or greater length of the appropriate type of flexible cord that has an ampacity at least equal to that of the device. Wire of the intended ampacity is to be used regardless of the size of the cord which is intended to be used with the device.

78.4 Temperatures are to be measured by means of thermocouples attached to the fuse clips, the insulating material of the device body in proximity to the fuseholder, and the wiring terminals or cord connections.

*Exception: If the wiring terminals or cord connections are not accessible for mounting thermocouples, the thermocouples are to be attached to the blades as close as possible to the face of the device.*

78.5 The test is to continue until stabilized temperatures are attained. A temperature is considered to be stabilized when three consecutive readings, taken at 5 minute intervals, indicate no further rise above the ambient temperature.

78.6 If the test is to be conducted with a live fuse, the devices are to be tested with the largest ampere-rated fuse intended for use with the device installed and subjected to a test current equal to the maximum fuse ampere rating.

78.7 If the test is to be conducted with a dummy fuse, the devices are to be subjected to a test current equal to the maximum ampere rating of the intended fuse. The dummy fuse size for devices incorporating Class CC, G, H, J, K, or R is to be as specified in the Standard for Fuseholders – Part 1: General Requirements, UL 4248-1, the Standard for Fuseholders – Part 4: Class CC, UL 4248-4, the Standard for Fuseholders – Part 5: Class G, UL 4248-5, the Standard for Fuseholders – Part 6: Class H, UL 4248-6, the Standard for Fuseholders – Part 8: Class J, UL 4248-8, the Standard for Fuseholders – Part 9: Class K, UL 4248-9, the Standard for Fuseholders – Part 11: Type C (Edison Base) and Type S Plug Fuse, UL 4248-11, the Standard for Fuseholders – Part 12: Class R, UL 4248-12, and the Standard for Fuseholders – Part 15: Class T, UL 4248-15. The dummy fuse size for devices employing miscellaneous, miniature and micro fuses is to be as indicated in Table 78.1. To represent the heating of a live fuse, 20°C (36°F) is to be added to the recorded temperature rise on the wiring terminals, cord connections, and surrounding insulating materials.

**Table 78.1**
**Nominal dimensions of dummy fuses for miscellaneous, miniature and micro fuses**

| Size of fuse | Dimensions | | |
|---|---|---|---|
| | Outside diameter | Wall thickness | Length |
| 5 x 20 mm (0.2 x 0.8 inches) | 5 mm (0.2 inches) | 1.2 mm (0.047 inches) | 20 mm (0.8 inches) |
| 1/4 x 1-1/4 inches (6.4 x 31.8 mm) | 0.25 inches (6.4 mm) | 0.049 inches (1.2 mm) | 1-1/4 inches (31.8 mm) |

78.8 The thermocouples are to consist of 28 – 32 AWG (0.08 – 0.032 mm$^2$) iron and constantan wires. It is a common practice to employ thermocouples consisting of 30 AWG (0.05 mm$^2$) iron and constantan wires with a potentiometer type of indicating instrument. This equipment will be used if a referee measurement of temperature is necessary.

Pin-Type Terminals

## 79 General

79.1 In addition to the general performance requirements for attachment plugs, an attachment plug with pin-type terminals shall comply with the requirements in Sections 80 – 84.

## 80 Assembly Test

80.1 An attachment plug with pin-type terminals shall be able to be readily assembled to the flexible cords with which it is intended to be used.

80.2 The device shall be assembled and tested with each of the sizes and types of flexible cords that it will physically accommodate following the instructions provided by the manufacturer. Proper assembly shall be determined by visual examination and compliance with the tests described in Sections 71 – 84.

*Exception: The device is not required to be assembled and tested with those cord types and sizes excluded by the marking specified in item (c) of Reference No. 5 of Table 193.1.*

## 81 Temperature Test

81.1 The temperature rise shall not be more than 30°C (54°F) when an attachment plug with pin-type terminals is carrying the current corresponding to the ampacity of the size cord that the device is intended to accommodate.

81.2 The test is to be conducted on devices assembled to flexible cords selected as follows:

a) For an attachment plug intended to be used with 18 AWG (0.82 mm$^2$) Types SP-1 and SPT-1 flexible cord, two sets of six devices each are to be assembled. One set is to be assembled using 18 AWG (0.82 mm$^2$) polyvinyl chloride insulated Type SPT-1 cord having a maximum width of 0.205 inch (5.21 mm) and a maximum overall thickness of 0.110 inch (2.79 mm). The second set is to be assembled using 18 AWG (0.82 mm$^2$) polyvinyl chloride insulated Type SPT-1 cord having a minimum overall width of 0.210 inch (5.33 mm).

b) For an attachment plug intended for use with other types of flexible cord, consideration is to be given to the need for testing different types of cords and the effects of variations on insulation material and thickness for each type of flexible cord.

c) For an attachment plug intended for use with more than one size of flexible cord, the temperature test is to be repeated for each size wire.

81.3 Each set is to be tested for temperature rise following assembly. Thermocouples are to be attached to the male blades of the attachment plug at points as close as possible to the male face. The assemblies are to be tested for 15 days without interruption. The device temperature is to be measured at the end of each working day.

81.4 Following the completion of this test, three assemblies using each of the flexible cord sizes and types specified in 81.2 are to be selected and subjected to the Dielectric Voltage-Withstand Test described in Section 84.

## 82 Strain Relief Test

82.1 When assembled to the intended flexible cord, an attachment plug with pin-type terminals shall withstand the straight pull described in this section without detachment of any cord conductor or any other evidence of damage that increases the risk of fire or electric shock.

82.2 The test is to be conducted on devices assembled to flexible cords selected as follows:

a) For an attachment plug intended to be used with 18 AWG (0.82 $mm^2$) Types SP-1 and SPT-1 flexible cord, two sets of six devices each are to be assembled using the smaller of the two cords indicated in 81.2.

b) When cords other than 18 AWG (0.82 $mm^2$) Types SP-1 and SPT-1 are to be used, device assemblies representing each size and type cord are to be tested. Consideration is to be given to the effects of anticipated variations in cord insulation material and thickness in selecting cords for the tests. Two sets with a minimum of three assemblies are to be tested using each representative size and type cord.

82.3 One set of devices for each cord size and type is to be subjected to the test described in 82.4 following assembly in the as-received condition. The second set is to be tested after being conditioned in a full-draft air-circulating oven for 30 days at 67.0°C (152.6°F).

82.4 While the attachment plug is securely supported by the blades, a pull is to be applied to the flexible cord for 1 minute of either:

a) 30 lbf (133 N) when the conductors are 18 AWG (0.82 $mm^2$) or larger, or

b) 20 lbf (89 N) when the conductors are smaller than 18 AWG (0.82 $mm^2$).

The direction of the force is to be perpendicular to the plane of the cord entrance.

## 83 Fault Current Test

83.1 When assembled to the intended flexible cord, an attachment plug with pin-type terminals shall withstand the applied fault current without ignition of the cotton or cord insulation. The circuit breaker shall operate when the test circuit is closed.

83.2 The test is to be conducted on devices assembled to flexible cords selected as follows:

a) For an attachment plug intended to be used with 18 AWG (0.82 $mm^2$) Types SP-1 and SPT-1 flexible cord, three sets of two devices each are to be tested using the larger of the two flexible cords described in 77.2.

b) For an attachment plug intended to be used with other cord sizes and types, device assemblies representing each size and type of cord are to be tested. Consideration is to be given to the effects of variations in cord insulation material and thickness in selecting cords for the tests. Three sets of two devices each are to be tested using each representative size and type of cord.

83.3 The attachment plugs are to be assembled to a 2-ft (0.6 m) length of each size and type of flexible cords twisted and soldered at the end.The assemblies are to be tested as follows:

a) The first set is to be subjected to the test described in 83.4 following assembly in the as-received condition.

b) The second set is to be subjected to the test described in 83.4 after being subjected to a 15 lbf (67 N) strain relief test for 1 minute.

c) The third set is to be subjected to the test described in 83.4 after being conditioned in an oven at 67.0°C (152.6°F) for 30 days.

83.4 A standard screw terminal receptacle of the 5-15R configuration (2-pole, 3-wire, 15A, 125V) is to be wired in a circuit capable of delivering 1000 A rms at 125 V when the system is short circuited at the testing terminals. The receptacle is to be wired to the testing terminals by 4 ft (1.2 m) of 12 AWG (3.3 $mm^2$) wire. A thermal-type 20-A circuit breaker is to be connected between the receptacle and the testing terminals. The circuit breaker is to be calibrated and found to meet the calibration requirements for circuit breakers. Cotton is to be placed around the attachment plug being tested. The male blades of the attachment plug are to be inserted into the contacts of the receptacle and the test circuit is to be closed by means of an external switching device.

## 84 Dielectric Voltage-Withstand Test

84.1 The assembly of a cord and attachment plug with pin-type terminals shall be capable of withstanding without breakdown, for a period of 1 minute, the application of a 60 Hz essentially sinusoidal potential of 1250 V between the two conductors of the flexible cord. Three assemblies are to be selected from the temperature test specified in Temperature Test, Section 81.

84.2 The test potential is to be supplied from a 500 V-A or larger capacity testing transformer whose output is essentially sinusoidal and can be varied. The applied potential is to be increased from zero until the required test voltage is reached, and is to be held at that voltage for a period of 1 minute. The increase in the applied potential is to be at uniform rate and as rapid as is consistent with its value being correctly indicated by the voltmeter.

INLETS

All Devices

## 85 General

85.1 The performance of an inlet is to be investigated by means of the applicable tests described in Sections 60 – 69, and 86 – 91.

## 86 Security of Blades Test

86.1 The blades or grounding pin of an inlet employing a 1-15P, 2-15P, 2-20P, 5-15P, 5-20P, 6-15P, or 6-20P configuration shall be capable of withstanding a pull of 20 lbf (88 N) for 2 minutes without loosening.

86.2 The inlet is to be supported in a horizontal plane with the blades or pin projecting downward. If a hole is not provided in the blade, one may be drilled through the blade in order to support the test weight. A weight that exerts a force of 20 lbs (89 N) is to be supported by each blade or pin in succession. The pull is to be gradually applied.

## 87 Terminal Temperature Test

87.1 The temperature rise of an inlet intended for mounting in or on an outlet box and employing wire-binding screw, clamp terminals, or spring action clamp terminals for field connection to branch-circuit conductors, when measured at the points described in 87.2, shall not be more than 30°C (54°F) when the device is carrying its maximum rated current.

87.2 Temperatures are to be measured by means of thermocouples attached to the wiring terminals of the inlet.

*Exception: When the wiring terminals are not accessible for mounting thermocouples, the thermocouples are to be attached to the blades as close as possible to the face of the inlet.*

87.3 The temperature test is to continue until stabilized temperatures are attained. A temperature is considered to be stabilized when three consecutive readings, taken at 5-minute intervals, indicate no further rise above the ambient temperature.

87.4 The generation of heat from sources other than the wiring terminals is to be minimized as much as possible. Each connection to the device being tested is to be made by means of a 12-inch (300-mm) or greater length of Type RH, Type TW, or other equivalent building wire. The wire size is to be determined using the appropriate value for the device's current rating based on the use of copper conductors with a temperature rating of 60°C (140°F) from Table 310-16 of the National Electrical Code, ANSI/NFPA 70.

87.5 The blades of the inlet are to be short-circuited by means of the shortest feasible lengths of solid copper wire soldered to the plug blades.

87.6 The terminals are to be tightened to the marked torque limit or, if no tightening torque is specified, to 9 in-lbf (1.0 N·m) for devices rated 15 A or less or 14 in-lbf (1.6 N·m) for devices rated greater than 15 A.

87.7 If an inlet incorporates both wire-binding screw and clamp-type pressure-wire terminals, three inlets are to be tested using the wire-binding screw terminals and three inlets are to be tested using the clamp terminals.

87.8 The thermocouples are to consist of 28 – 32 AWG (0.08 – 0.32 $mm^2$) iron and constantan wires. It is a common practice to employ thermocouples consisting of 30 AWG (0.05 $mm^2$) iron and constantan wires with a potentiometer type of indicating instrument. This equipment will be used if a referee measurement of temperature is necessary.

## 88 Fuseholder Temperature Test

88.1 When tested as described in this section, the temperature rise of an inlet incorporating a fuseholder shall not exceed the following:

a) 30°C (54°F) on the fuse clips when tested with a dummy fuse;

b) 85°C (153°F) on the fuse clips when tested with a live fuse;

c) 30°C (54°F) at the wiring terminals or cord connections at any time (see 88.7); and

d) The relative thermal index of the surrounding insulating material, minus an assumed ambient of 25°C (77°F), at any time (see 88.7).

88.2 The test is to be conducted on a set of six previously untested devices. The test may be conducted with either a live fuse or a dummy fuse (see 88.6 and 88.7).

*Exception: The test is not prohibited from being conducted in conjunction with the Terminal Temperature Test, Section 87.*

88.3 The devices are to be wired in a series circuit with the blades of the inlets connected by the shortest possible length of solid copper wire soldered across the blades. Type RH, Type TW, or equivalent building wires 12 inches (300 mm) long or greater are to be connected to the wiring terminals. Wire of the intended ampacity is to be used regardless of the size of the cord which is intended to be used with the device.

88.4 Temperatures are to be measured by means of thermocouples attached to the fuse clips, the insulating material of the device body in proximity to the fuseholder, and the wiring terminals or cord connections.

*Exception: When the wiring terminals or cord connections are not accessible for mounting thermocouples, the thermocouples are to be attached to the blades as close as possible to the face of the device.*

88.5 The test is to continue until stabilized temperatures are attained. A temperature is considered to be stabilized when three consecutive readings, taken at 5-minute intervals, indicate no further rise above the ambient temperature.

88.6 If the test is to be conducted with a live fuse, the devices are to be tested with the largest ampere-rated fuse intended for use with the device installed and subjected to a test current equal to the maximum fuse ampere rating.

88.7 If the test is to be conducted with a dummy fuse, the devices are to be subjected to a test current equal to the maximum ampere rating of the intended fuse. The dummy fuse size for devices incorporating Class CC, G, H, J, K, or R is to be as specified in the Standard for Fuseholders – Part 1: General Requirements, UL 4248-1, the Standard for Fuseholders – Part 4: Class CC, UL 4248-4, the Standard for Fuseholders – Part 5: Class G, UL 4248-5, the Standard for Fuseholders – Part 6: Class H, UL 4248-6, the Standard for Fuseholders – Part 8: Class J, UL 4248-8, the Standard for Fuseholders – Part 9: Class K, UL 4248-9, the Standard for Fuseholders – Part 11: Type C (Edison Base) and Type S Plug Fuse, UL 4248-11, the Standard for Fuseholders – Part 12: Class R, UL 4248-12, and the Standard for Fuseholders – Part 15: Class T, UL 4248-15. The dummy fuse size for devices employing miscellaneous, miniature and micro fuses is to be as indicated in Table 88.1. To represent the heating of a live fuse, 20°C (36°F) is to be added to the recorded temperature rise on the wiring terminals, cord connections, or surrounding insulating materials.

**Table 88.1**
**Nominal dimensions of dummy fuses for miscellaneous, miniature and micro fuses**

| Size of fuse | Dimensions | | |
|---|---|---|---|
| | Outside diameter | Wall thickness | Length |
| 5 x 20 mm (0.2 x 0.8 inches) | 5 mm (0.2 inches) | 1.2 mm (0.047 inches) | 20 mm (0.8 inches) |
| 1/4 x 1-1/4 inches (6.4 x 31.8 mm) | 0.25 inches (6.4 mm) | 0.049 inches (1.2 mm) | 1-1/4 inches (31.8 mm) |

88.8 The thermocouples are to consist of 28 – 32 AWG (0.08 – 0.32 $mm^2$) iron and constantan wires. It is a common practice to employ thermocouples consisting of 30 AWG (0.05 $mm^2$) iron and constantan wires with a potentiometer type of indicating instrument. This equipment will be used if a referee measurement of temperature is necessary.

Pressure-Wire Terminals

## 89 General

89.1 In addition to the requirements in Sections 85 – 88, the following types of inlets, intended for mounting in or on an outlet box, shall comply with the Strength of Insulating Base Test, Section 91, and with the applicable performance requirements in the Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors, UL 486E:

a) An inlet rated less than 30 A and employing setscrew-type pressure-wire terminals for field connection to copper branch circuit conductors only.

b) An inlet rated 35 A or greater and employing setscrew- or clamp-type pressure-wire terminals for field connection to copper branch circuit conductors only.

The copper test conductors to be used in these tests are to be selected in accordance with Table 89.1.

**Table 89.1**
**Copper test conductor sizes**

| Device rating, A | Conductor size, AWG |
|---|---|
| 15 | 14 solid<br>14 stranded<br>12 solid<br>12 stranded |
| 20 | 12 solid<br>12 stranded |
| 30 | 10 solid<br>10 stranded |

**Table 89.1 Continued on Next Page**

**Table 89.1 Continued**

| Device rating, A | Conductor size, AWG |
|---|---|
| 50 | 6 stranded |
| 60 | 4 stranded |
| 100 | 1 stranded |
| 200 | 30 stranded |

89.2 An inlet rated less than 30 A, intended for mounting in or on an outlet box, and employing clamp-type pressure-wire terminals for use on copper alloy branch circuit conductors only, shall comply with the general requirements for inlets contained in Sections 85 – 88, only.

## 90 Combination Wire Binding/Pressure Wire-Type Terminals

90.1 In addition to the requirements as specified in Sections 85 – 88, an inlet rated less than 20 A and also employing a combination wire binding/pressure wire-type terminal for field connection to copper branch circuit conductors, intended for mounting in or on an outlet box, shall comply with the Strength of Insulating Base Test, Section 91, and with the applicable performance requirements in the Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors, UL 486E:

90.2 The copper test conductors to be used in these tests are to be selected in accordance with Table 90.1.

**Table 90.1**
**Copper test conductor sizes**

| Device rating, A | Conductor size, AWG |
|---|---|
| 15 | 14 solid 14 stranded 12 solid 12 stranded |
| 20 | 12 solid 12 stranded 10 solid10 stranded |

## 91 Strength of Insulating Base Test

91.1 An inlet intended for mounting in or on an outlet box and employing pressure-wire terminals for field connection to branch circuit conductors, shall not be damaged when 110 percent of the specified terminal tightening torque is applied to the wire securing means of the pressure-wire terminal which secures the maximum intended size conductor.

91.2 Damage is considered to have occurred if any cracking, bending, breakage, or displacement of the insulating base, current-carrying parts, assembly parts, or device enclosure reduces electrical spacings to less than those required, exposes live parts, or otherwise impairs the intended secure installation and use of the device.

91.3 The terminal tightening torque to be used for this test is to be that assigned by the manufacturer in accordance with 12.4.3 and marked in accordance with Reference No. 4 of Table 193.2.

## 91A Spring Action Clamp Terminal Pull Test

91A.1 An inlet employing spring action clamp terminals shall be subjected to the test conditions as specified in 91A.2 – 91A.6.

91A.2 Upon completion of this test, there shall not be any damage to the terminal or its securement mechanism. The spring action clamp shall remain capable of functioning as intended. There shall not be any damage, arcing or dielectric breakdown during application of the test potential. The conductor shall not pull free from the terminal during application of the test force.

91A.3 Each terminal of each device (three terminals minimum) shall be tested. Each terminal shall be wired with the smallest AWG conductor size and wired with the largest conductor size, as specified by the manufacturer. If the spring action clamp is also intended for both solid and stranded AWG conductors, both solid and stranded shall be tested.

91A.4 The conductor insulation shall be prepared by removing the insulation from the conductor according to manufacturer's strip gauge and then inserted into the spring action clamp terminal as intended. The lever of the spring action clamp shall then be operated to the fully latched and locked position and back to the unlatched and unlocked position. This sequence of operation shall be repeated for a total of 100 cycles.

91A.5 Following the 100 cycles, the conductor shall be reattached to the spring action clamp terminal and the lever place in the latched and locked position as intended. A static pull force as specified in Table 91A.1 shall be applied to the conductor for 1 minute in a direction perpendicular to the plane of the inlet body, tending to remove the conductor.

**Table 91A.1**
**Test values for spring action clamp terminal pull test**

| Size of conductor AWG | Pullout force lbf (pounds) |
|---|---|
| 16 | 9 |
| 14 | 11.5 |
| 12 | 13.5 |
| 10 | 18.0 |
| 8 | 20.5 |
| 6 | 21 |
| 4 | 30 |

91A.6 Each device is then to be subjected to a 50 – 60 Hz essentially sinusoidal potential equal to twice the rated voltage plus 1000 V applied between live parts of opposite polarity and between live parts and grounding or dead metal parts. The test voltage is to be increased at a uniform rate and as rapidly as is consistent with its value being correctly indicated by a voltmeter, and maintained at the test potential for 1 minute.

CORD CONNECTORS

All Devices

## 92 General

92.1 The performance of a cord connector is to be investigated by means of the tests described in Sections 60 – 69 and 93 – 109. For Hospital Grade Devices, see Supplement SC.

92.2 A cord connector with a latching mechanism shall be subjected to the tests described in Sections 93 – 97 with the mechanism defeated.

92.3 Devices of the ANSI/ESTA E1.24 Standard, Type 5 configurations (5T20, 5T30, 5T60 and 5T100) shall be subjected to all the applicable tests at a voltage rating of 250V. All other ANSI/ESTA E1.24 Standard configurations shall be subjected to all applicable tests at their identified and marked voltage rating.

## 93 Retention of Plugs Tests

93.1 The contacts of a 1-15R, 5-15R, 5-20R, 6-15R or 6-20R configuration cord connector shall retain an attachment plug so that a force greater than 3 lbf (13 N) is required to withdraw the plug when tested as described in this section.

93.2 *Deleted*

93.3 Each of six devices is to be subjected to ten conditioning cycles of insertion and withdrawal of a standard solid-blade attachment plug that has American National Standard detent holes in accordance with Wiring Devices – Dimensional Specifications, ANSI/NEMA WD6, in rigidly mounted blades, following which the plug is to be fully reinserted into the device. The mating plugs are to have the configuration indicated in Table 93.1. A pull of 3 lbf (13 N) in a direction perpendicular to the plane of the face of the cord connector and tending to withdraw the plug from the device is then to be applied to the plug for 1 minute. The displacement of the plug shall not be greater than 0.079 inch (2 mm).

*Exception: Connectors may instead be subjected to the Retention of Blades Test, Section 111.2 and 111.3 (conditioning and 3 lb retention).*

**Table 93.1**
**Mating plug configurations for plug retention**

| Device under test | Mating plug | No. of devices tested |
|---|---|---|
| 1-15R | 1-15P | 6 |
| 5-15R | 1-15P | 6 |
| 5-20R | 1-15P | 3 |
| | 5-20P[a] | 3 |
| 6-15R | 2-15P | 6 |
| 6-20R | 2-15P | 3 |
| | 6-20P[a] | 3 |

[a] Shall have the ground blade removed.

## 94 Overload Tests

### 94.1 General

94.1.1 A cord connector shall be capable of performing acceptably when subjected to the current overload test as described in this section. A cord connector additionally rated in horsepower shall also be capable of performing acceptably when subjected to the horsepower overload test as described in this section. In either case, there shall not be any electrical or mechanical failure of the device, opening of a line or grounding fuse, welding of the contacts, nor burning or pitting of the contacts that would affect the intended function of the device.

*Exception No. 1: A cord connector that is intended for disconnecting use only and not for current interruption, is not required to be subjected to this test. See also 192.6.*

*Exception No. 2: Either the current overload test or horsepower overload test may be omitted if it is obvious that one test is fully represented by the other.*

94.1.2 *Deleted*

94.1.3 The device is to be mounted and wired to represent service conditions. Any metal armor is to be connected to the grounding conductor of the test circuit.

*Exception: Any metal armor on a nongrounding device is to be electrically positive with respect to the nearest arcing point of the device.*

94.1.4 The fuse in the grounding conductor is to be:

a) A 15 A fuse if the device being tested is rated 30 A or less; or

b) A 30 A fuse if the device being tested is rated more than 30 A.

The fuse in the test circuit is to have the next higher standard fuse rating than the value of the test current.

94.1.5 The potential of the test circuit is to be from 95 to 105 percent of the rating of the device in volts. Devices rated 250 V are to be tested on circuits with a potential to ground of 125 V. Cord connectors having other voltage ratings are to be tested on circuits involving full rated potential to ground, except for multi-phase rated devices which are to be tested on circuits consistent with their voltage ratings (for example, a 120/208 V, 3-phase device, is to be tested on a circuit involving 120 V to ground). Testing using a 60 Hz supply voltage may represent testing using a higher frequency supply voltage not exceeding 400 Hz.

94.1.6 Each of six devices is to be tested by machine or manually by inserting and withdrawing an attachment plug having rigidly secured solid blades that are connected through a flexible cord to a load. For devices with the 1-15R, 5-15R, 5-20R, 6-15R or 6-20R configurations, the mating plugs shall have the configurations specified in Table 94.1. When an equipment-grounding connection is provided in the device being tested, a grounding-type attachment plug is to be used and the grounding blade of the plug connected to the grounding contact of the device being tested. The grounding contact is then to be grounded through a fuse as specified in 94.1.4.

**Table 94.1**
**Mating plug configurations for overload testing**

| Device under test | Mating plug | No. of devices tested |
|---|---|---|
| 1-15R | 1-15P | 6 |
| 5-15R | 5-15P | 6 |
| 5-20R | 5-15P | 3 |
| | 5-20P | 3 |
| 6-15R | 6-15P | 6 |
| 6-20R | 6-15P | 3 |
| | 6-20P | 3 |

94.1.7 For a device rated 20 A or less, the test machine is to withdraw and insert an unrestricted attachment plug with an average velocity of 30 ±3 inches/s (760 ±75 mm/s) in each direction during a 2-1/2 inch (64 mm) stroke measured from the fully inserted position. The velocity is to be determined without the outlet device installed on the machine to eliminate restrictions on the plug motion.

94.1.8 For a device rated more than 20 A the test machine unrestricted plug velocity and stroke length are to be adjusted as necessary to obtain the maximum mating time required in 94.1.9.

94.1.9 The device is then to make and break the required test load for 50 cycles of operation at a rate no faster than 10 cycles per minute. The blade of the attachment plug is to mate with the female contact of the device for no more than 1 second for straight-blade devices, and 3 seconds for locking devices during each cycle. For locking devices, each cycle of operation is to include rotation of the test plug to the full lock position after insertion, and back to the unlocked position before withdrawal.

94.1.10 Blades or contacts are not to be adjusted, lubricated, or otherwise conditioned before or during either test. The attachment plug used for either test may be changed after 50 cycles.

94.1.11 In the event that unacceptable results are obtained in the machine testing described in 94.1.7 or 94.1.8, referee tests may be conducted manually under conditions similar to those described in 94.1.7 or 94.1.8.

### 94.2 Current overload test

94.2.1 The test current shall be 150 percent of the rated current of the device. For devices with standard configurations rated 125 V, 250 V, or 125/250 V illustrated in Wiring Devices – Dimensional Specifications, ANSI/NEMA WD6, the test is to be conducted on direct current. All other devices with standard configurations denoted as "AC" or "3-phase" are to be tested on alternating current. For devices with nonstandard configurations, the test is to be conducted using direct current with a resistive load, except that alternating current is to be used if the device is rated for alternating current only. Whenever alternating current is used for the test, the power factor of the load is to be from 0.75 to 0.80.

94.2.2 Testing of a device that has a dual voltage rating and a dual current rating is to be performed at the maximum rating in volts and with 150 percent of the rated current that corresponds to the maximum voltage rating.

*Exception: A test on alternating current is not required when equivalent results have been obtained from a direct potential that is equal to or greater than the alternating-potential rating.*

### 94.3 Horsepower overload test

94.3.1 If a separate horsepower overload test is conducted, the tests for the horsepower ratings are to be conducted on separate sets of previously untested devices. For devices with a phase to phase (L-L) and phase to neutral (L-N) horsepower rating, the test for each rating is to be conducted on a separate set of previously untested devices.

94.3.2 For devices with standard configurations illustrated in Wiring Device – Dimensional Specifications, ANSI/NEMA WD6, the test current corresponding to the AC horsepower rating shall be as specified in Table 94.2. The load for an alternating current horsepower rating is to have a power factor of 0.40 – 0.50. For devices with a voltage rating of 250 volts, the overload test for the phase to phase horsepower rating is to be conducted at both 208 V ac and 250 V ac. A single test may be conducted at 250 V ac and at the test current for 208 V ac, if agreeable to all parties.

*Exception: Devices having a L9-20R, L9-30R, L13-30R, L17-30R, L20-20R, L20-30R, L23-20R, L23-30R, SS1-50R, SS2-50R, TT-R, ML-1R, ML-2R, or ML-3R configuration in Wiring Devices – Dimensional Specifications, ANSI/NEMA WD6 or one of the configurations illustrated in Figures C1.1 – C1.5 of the Standard for Wiring Device Configurations, UL 1681 do not have assigned horsepower ratings and are not required to be subjected to the horsepower overload test.*

**Table 94.2**
**Test current (locked rotor amperes) for horsepower rated NEMA configuration cord connectors**

| NEMA configuration | AC HP rating[a] | LRA (amperes) | AC test voltage |
|---|---|---|---|
| 1-15R | 0.5 | 58.8 | 125 |
| 2-15R | 1.5[b] | 60 | 250 |
| | | 66 | 208 |
| 2-20R | 2[b] | 72 | 250 |
| | | 79.2 | 208 |
| 2-30R | 2[b] | 72 | 250 |
| | | 79.2 | 208 |
| 5-15R | 0.5 | 58.8 | 125 |
| 5-20R | 1 | 96 | 125 |
| 5-30R | 2 | 144 | 125 |
| 5-50R | 2 | 144 | 125 |
| 6-15R | 1.5[b] | 60 | 250 |
| | | 66 | 208 |
| 6-20R | 2[b] | 72 | 250 |
| | | 79.2 | 208 |
| 6-30R | 2[b] | 72 | 250 |
| | | 79.2 | 208 |
| 6-50R | 3[b] | 102 | 250 |
| | | 112.2 | 208 |
| 7-15R | 2 | 59.8 | 277 |
| 7-20R | 2 | 59.8 | 277 |
| 7-30R | 3 | 84.7 | 277 |
| 7-50R | 5 | 139.4 | 277 |
| 10-20R | 2 L-L[b] | 72 | 250 |
| | | 79.2 | 208 |
| | 1 L-N | 96 | 125 |
| 10-30R | 2 L-L[b] | 72 | 250 |
| | | 79.2 | 208 |
| | 2 L-N | 144 | 125 |
| 10-50R | 3 L-L[b] | 102 | 250 |
| | | 112.2 | 208 |
| | 2 L-N | 144 | 125 |
| 11-15R | 2 | 50 | 250 |
| 11-20R | 3 | 64 | 250 |
| 11-30R | 3 | 64 | 250 |
| 11-50R | 7.5 | 132 | 250 |

**Table 94.2 Continued on Next Page**

## Table 94.2 Continued

| NEMA configuration | AC HP rating[a] | LRA (amperes) | AC test voltage |
|---|---|---|---|
| 14-15R | 1.5 L-L[b] | 60 | 250 |
| | | 66 | 208 |
| | 0.5 L-N | 58.8 | 125 |
| 14-20R | 2 L-L[b] | 72 | 250 |
| | | 79.2 | 208 |
| | 1 L-N | 96 | 125 |
| 14-30R | 2 L-L[b] | 72 | 250 |
| | | 79.2 | 208 |
| | 2 L-N | 144 | 125 |
| 14-50R | 3 L-L[b] | 102 | 250 |
| | | 112.2 | 208 |
| | 2 L-N | 144 | 125 |
| 14-60R | 3 L-L[b] | 102 | 250 |
| | | 112.2 | 208 |
| | 2 L-N | 144 | 125 |
| 15-15R | 2 | 50 | 250 |
| 15-20R | 3 | 64 | 250 |
| 15-30R | 3 | 64 | 250 |
| 15-50R | 7.5 | 132 | 250 |
| 15-60R | 10 | 168 | 250 |
| 18-15R | 2 | 55 | 208 |
| 18-20R | 2 | 55 | 208 |
| 18-30R | 3 | 71 | 208 |
| 18-50R | 7.5 | 145.2 | 208 |
| 18-60R | 7.5 | 145.2 | 208 |
| L1-15R | 0.5 | 58.8 | 125 |
| L2-20R | 2[b] | 72 | 250 |
| | | 79.2 | 208 |
| L5-15R | 0.5 | 58.8 | 125 |
| L5-20R | 1 | 96 | 125 |
| L5-30R | 2 | 144 | 125 |
| L6-15R | 1.5[b] | 72 | 250 |
| | | 79.2 | 208 |
| L6-20R | 2[b] | 72 | 250 |
| | | 79.2 | 208 |
| L6-30R | 2[b] | 72 | 250 |
| | | 79.2 | 208 |

Table 94.2 Continued on Next Page

## Table 94.2 Continued

| NEMA configuration | AC HP rating[a] | LRA (amperes) | AC test voltage |
|---|---|---|---|
| L7-15R | 2 | 59.8 | 277 |
| L7-20R | 2 | 59.8 | 277 |
| L7-30R | 3 | 84.7 | 277 |
| L8-20R | 3 | 51 | 480 |
| L8-30R | 5 | 84 | 480 |
| L10-20R | 2 L-L[b] | 72 | 250 |
| | | 79.2 | 208 |
| | 1 L-N | 96 | 125 |
| L10-30R | 2 L-L[b] | 72 | 250 |
| | | 79.2 | 208 |
| | 2 L-N | 144 | 125 |
| L11-15R | 2 | 50 | 250 |
| L11-20R | 3 | 64 | 250 |
| L11-30R | 3 | 64 | 250 |
| L12-20R | 5 | 45.6 | 480 |
| L12-30R | 10 | 84 | 480 |
| L14-20R | 2 L-L[b] | 72 | 250 |
| | | 79.2 | 208 |
| | 1 L-N | 96 | 125 |
| L14-30R | 2 L-L[b] | 72 | 250 |
| | | 79.2 | 208 |
| | 2 L-N | 144 | 125 |
| L15-20R | 3 | 64 | 250 |
| L15-30R | 3 | 64 | 250 |
| L16-20R | 5 | 45.6 | 480 |
| L16-30R | 10 | 84 | 480 |
| L18-20R | 2 | 55 | 208 |
| L18-30R | 3 | 71 | 208 |
| L19-20R | 5 | 45.6 | 480 |
| L19-30R | 10 | 84 | 480 |
| L21-20R | 2 | 55 | 208 |
| L21-30R | 3 | 71 | 208 |
| L22-20R | 5 | 45.6 | 480 |
| L22-30R | 10 | 84 | 480 |

[a] The phase to phase horsepower ratings are noted by "L-L". The phase to neutral ratings are identified by "L-N".

[b] Also suitable for 208 V motor applications at the indicated horsepower rating.

94.3.3 For all devices with nonstandard configurations, the test current corresponding to the horsepower rating is to be as specified in the Standard for General-Use Snap Switches, UL 20, for a device having an alternating-current rating of 2 horsepower or less and as specified in the Standard for Enclosed and Dead-

Front Switches, UL 98, for a device having an alternating-current rating of more than 2 horsepower. The load for an alternating current horsepower rating is to have a power factor of 0.40 – 0.50.

## 95 Temperature Test

95.1 The temperature rise of a cord connector measured at the points described in 95.3 shall not be more than 30°C (54°F) when the device is carrying its maximum rated current.

95.2 *Deleted*

95.3 Each of six devices is to be tested. Temperatures are to be measured by means of thermocouples attached to the wiring terminals or cord connections.

*Exception: When the wiring terminals or cord connections are not accessible for mounting thermocouples or when the device does not have any wiring terminals, the thermocouples are to be attached to the blades of the mated attachment plug as close as possible to the face of the device*

95.4 The temperature test is to be made following the overload test on the devices and is to continue until stabilized temperatures are attained. A temperature is considered to be stabilized when three consecutive readings, taken at 5-minute intervals, indicate no further rise above the ambient temperature.

95.5 The generation of heat from sources other than the female contacts is to be minimized as much as possible. Each connection to the device being tested is to be made by means of a 12-inch (300 mm) or greater length of the appropriate type of flexible cord that has an ampacity at least equal to that of the device. The wire size and type are to be determined using the appropriate value for the device's current rating from Table 400.5(A) or 400.5(B) of the National Electrical Code, ANSI/NFPA 70.

95.6 The contacts of the device being tested are to be connected together by means of a mated attachment plug. For devices with the 1-15R, 5-15R, 5-20R, 6-15R and 6-20R configurations, the mating plugs shall have the configurations specified in Table 95.1. The plug is to have rigidly attached solid blades, and the terminals of the plug are to be short-circuited by means of the shortest feasible lengths of the appropriate flexible cord as described in 95.5.

**Table 95.1**
**Mating plug configurations for temperature testing**

| Device under test | Mating plug | No. of devices tested |
|---|---|---|
| 1-15R | 1-15P | 6 |
| 5-15R | 5-15P | 6 |
| 5-20R | 5-15P | 3 |
| | 5-20P | 3 |
| 6-15R | 6-15P | 6 |
| 6-20R | 6-15P | 3 |
| | 6-20P | 3 |

95.7 The terminals are to be tightened to the marked torque limit or, when a tightening torque is not provided, the torque used is to be 9 in-lbf (1.0 N·m) for devices rated 15 A or less and 14 in-lbf (1.6 N·m) for other ratings.

95.8 Temperature readings are to be obtained by means of thermocouples consisting of 28 – 32 AWG (0.08 – 0.03 $mm^2$) iron and constantan wires. It is a common practice to employ thermocouples consisting of 30 AWG (0.05 $mm^2$) iron and constantan wires with a potentiometer type of indicating instrument. This equipment is to be used when a referee measurement of temperature is necessary.

## 96 Retention of Plugs Test (Repeated)

### 96.1 General

96.1.1 After completion of the Overload Tests, Section 94, and the Temperature Test, Section 95, the contacts of a 1-15R, 5-15R, 5-20R, 6-15R or 6-20R configuration cord connector shall retain an attachment plug so that when tested as described in this section:

a) A force greater than 3 lbf (13 N) is required to withdraw the plug, and

b) A force of 15 lbf (67 N) is capable of withdrawing the plug.

96.1.2 *Deleted*

### 96.2 Plug retention

96.2.1 Each of six devices is to be tested. A standard solid-blade attachment plug that has American National Standard detent holes, in accordance with Wiring Devices – Dimensional Specifications , ANSI/NEMA WD6, in rigidly mounted blades is to be fully inserted into the device. The test plugs are to have the configuration specified in Table 96.1. A pull of 3 lbf (13 N) in a direction perpendicular to the plane of the face of the cord connector and tending to withdraw the plug from the device is then to be applied to the plug for 1 minute. The displacement of the plug shall not be greater than 0.079 inch (2 mm).

*Exception: Connectors may instead be subjected to the Retention of Blades Test, Section 111.3 (3 lb retention).*

**Table 96.1**
**Mating plug configurations for plug retention**

| Device under test | Mating plug | No. of devices tested |
|---|---|---|
| 1-15R | 1-15P | 6 |
| 5-15R | 1-15P | 6 |
| 5-20R | 1-15P | 3 |
| | 5-20P[a] | 3 |
| 6-15R | 2-15P | 6 |
| 6-20R | 2-15P | 3 |
| | 6-20P[a] | 3 |

[a] Shall have the ground blade removed.

### 96.3 Plug withdrawal

96.3.1 Each of six devices is to be tested. Following the application of the 3 lbf (13 N), the pull is to be increased to 15 lbf (67 N), using test plugs having the configuration specified in Table 96.2, and the plug shall be withdrawn by the force.

*Exception: Connectors may instead be subjected to the Retention of Blades Test, Section 111.4 (15 lb withdrawal).*

**Table 96.2**
**Mating plug configurations for plug withdrawal**

| Device under test | Mating plug[a] | No. of devices tested |
|---|---|---|
| 1-15R | 1-15P | 6 |
| 5-15R | 5-15P | 6 |
| 5-20R | 5-15P | 3 |
| | 5-20P | 3 |
| 6-15R | 6-15P | 6 |
| 6-20R | 6-15P | 3 |
| | 6-20P | 3 |

[a] Shall have American National Standard detent holes in accordance with Wiring Devices – Dimensional Specifications, ANSI/NEMA WD6.

## 97 Resistance to Arcing Test

97.1 If a material is used in the construction of the face of a cord connector in a way that the material is likely to be exposed to arcing while in service, the devices that were subjected to 50 cycles of operation in the overload test described in Overload Tests, Section 94, shall perform acceptably when subjected to an additional 200 cycles of operation under the overload-test conditions following the temperature test and the repetition (if required – see 93.3) of the retention-of-plugs and gripping tests. There shall not be any indication of electrical tracking, formation of a permanent carbon conductive path or ignition of the material. The attachment plug used for this test may be changed after every 50 operations.

97.2 Alternatively one set of devices may be subjected to the 50 cycles of operation in the overload test described in Overload Tests, Section 94, followed by the temperature test on the devices and then, to determine resistance to arcing, a second, previously untested set of devices may be subjected to 250 cycles of operation under the overload-test conditions.

## 98 Latching Mechanism Tests

### 98.1 General

98.1.1 A 1-15R, 5-15R, 5-20R, 6-15R, or 6-20R cord connector employing a latching mechanism for locking a mated attachment plug in place after its blades have been inserted into the female contacts shall be subjected to the tests in this section.

### 98.2 Cycling test

98.2.1 *Deleted*

98.2.2 *Deleted*

**Table 98.1**
**Mating plug configurations for cycling testing**
Table deleted

98.2.3 *Deleted*

98.2.4 *Deleted*

### 98.3 Pull test

98.3.1 After completion of this test, there shall not be any damage to the cord connectors or the blades of the attachment plugs or other evidence of increased risk of injury or electric shock. The latching means shall remain functional. There shall not be any loosening of the plug blades or displacement between the blades at the attachment plug face, nor compression of the folded blades below the minimum allowable thickness for the configuration. The attachment plug shall be capable of being inserted into a standard mating receptacle. There shall not be any damage, arcing, or dielectric breakdown during application of the test potential. The retention of blades test, Section 96 is to be repeated.

98.3.2 Previously untested devices are to be used. With the device firmly secured in place, a mating attachment plug is to be inserted into the device and the latching mechanism activated to lock the plug in place. The mating plugs are to have the configurations shown in Table 98.2. A pull of 20 lbf (89 N) in a direction perpendicular to the plane of the face of the cord connector and tending to withdraw the plug from the device is then to be applied to the plug and the plug shall be withdrawn by the force. The force is then to be removed from the plug and the latching mechanism activated to release the plug, and the plug removed from the outlet. This is to be repeated for a total of 250 cycles. Three devices are to be tested using attachment plugs with rigidly mounted solid blades with standard detent holes. Three devices are to be tested using attachment plugs with folded blades and standard detent holes.

**Table 98.2**
**Mating plug configurations for pull testing**

| Device under test | Mating plug | No. of devices tested |
|---|---|---|
| 1-15R | 1-15P | 6 |
| 5-15R | 1-15P | 6 |
| 5-20R | 1-15P | 3 |
| | 5-20P | 3 |
| 6-15R | 6-15P | 6 |
| 6-20R | 6-15P | 3 |
| | 6-20P | 3 |

98.3.3 Each device is then to be subjected to a 50-60 Hz essentially sinusoidal potential equal to twice the rated voltage plus 1000 V applied between live parts of opposite polarity and between live parts and grounding or dead metal parts. The test voltage is to be increased at a uniform rate and as rapidly as is consistent with its value being correctly indicated by a voltmeter, and maintained at the test potential for 1 minute. A mating attachment plug capable of withstanding a 2500 V potential is then to be inserted into the outlet and the application of the test potential is to be repeated.

## 99 Fuseholder Temperature Test

99.1 When tested as described in this section, the temperature rise of a cord connector incorporating a fuseholder shall not exceed the following:

a) 30°C (54°F) on the fuse clips when tested with a dummy fuse;

b) 85°C (153°F) on the fuse clips when tested with a live fuse;

c) 30°C (54°F) at the wiring terminals or cord connections at any time (see 99.7); and

d) The relative thermal index of the surrounding insulating material, minus an assumed ambient of 25°C (77°F), at any time (see 99.7).

99.2 The test is to be conducted on a set of six previously untested devices. The test may be conducted with either a live fuse or a dummy fuse (see 99.6 and 99.7).

*Exception: The test is not prohibited from being conducted in conjunction with the Temperature Test, Section 95, when agreeable to all concerned.*

99.3 The cord connectors are to be wired in a series circuit as described in the Temperature Test, Section 95.

99.4 Temperatures are to be measured by means of thermocouples attached to the fuse clips, the insulating material of the device body in proximity to the fuseholder, and the wiring terminals or cord connections.

*Exception: If the wiring terminals or cord connections are not accessible for mounting thermocouples, the thermocouples are to be attached to the blades as close as possible to the face of the device.*

99.5 The test is to continue until stabilized temperatures are attained. A temperature is considered to be stabilized when three consecutive readings, taken at 5-minute intervals, indicate no further rise above the ambient temperature.

99.6 If the test is to be conducted with a live fuse, the devices are to be tested with the largest ampere-rated fuse intended for use with the device installed and subjected to a test current equal to the maximum fuse ampere rating.

99.7 If the test is to be conducted with a dummy fuse, the devices are to be subjected to a test current equal to the maximum ampere rating of the intended fuse. The dummy fuse size for devices incorporating Class CC, G, H, J, K, or R is to be as specified in the Standard for Fuseholders – Part 1: General Requirements, UL 4248-1, the Standard for Fuseholders – Part 4: Class CC, UL 4248-4, the Standard for Fuseholders – Part 5: Class G, UL 4248-5, the Standard for Fuseholders – Part 6: Class H, UL 4248-6, the Standard for Fuseholders – Part 8: Class J, UL 4248-8, the Standard for Fuseholders – Part 9: Class K, UL 4248-9, the Standard for Fuseholders – Part 11: Type C (Edison Base) and Type S Plug Fuse, UL 4248-11, the Standard for Fuseholders – Part 12: Class R, UL 4248-12, and the Standard for Fuseholders – Part 15: Class T, UL 4248-15. The dummy fuse size for devices employing miscellaneous, miniature and micro fuses is to be as indicated in Table 99.1. To represent the heating of a live fuse, 20°C (36°F) is to be added to the recorded temperature rise on the wiring terminals, cord connections, or surrounding insulating materials.

**Table 99.1**
**Nominal dimensions of dummy fuses for miscellaneous, miniature and micro fuses**

| Size of fuse | Dimensions | | |
|---|---|---|---|
| | Outside diameter | Wall thickness | Length |
| 5 x 20 mm<br>(0.2 x 0.8 inches) | 5 mm<br>(0.2 inches) | 1.2 mm<br>(0.047 inches) | 20 mm<br>(0.8 inches) |
| 1/4 x 1-1/4 inches<br>(6.4 x 31.8 mm) | 0.25 inches<br>(6.4 mm) | 0.049 inches<br>(1.2 mm) | 1-1/4 inches<br>(31.8 mm) |

99.8 The thermocouples are to consist of 28 – 32 AWG (0.08 – 0.032 $mm^2$) iron and constantan wires. It is a common practice to employ thermocouples consisting of 30 AWG (0.05 $mm^2$) iron and constantan wires with a potentiometer type of indicating instrument. This equipment will be used if a referee measurement of temperature is necessary.

## 99A Spring Action Clamp Terminal Pull Test

99A.1 A cord connector employing spring action clamp terminals shall be subjected to the test conditions as specified in 99A.2 – 99A.6.

99A.2 Upon completion of this test, there shall not be any damage to the terminal or its securement mechanism. The spring action clamp shall remain capable of functioning as intended. There shall not be any damage, arcing or dielectric breakdown during application of the test potential. The conductor shall not pull free from the terminal during application of the test force.

99A.3 Each terminal of each device (three terminals minimum) shall be tested. Each terminal shall be wired with the smallest AWG conductor size of the intended flexible cord and wired with the largest conductor size of the intended flexible cord, as specified by the manufacturer. The cord connector enclosure housing and strain relief clamp shall not be used.

99A.4 The conductor insulation shall be prepared by removing the insulation from the conductor according to manufacturer's instructions (strip length) and then inserted into the spring action clamp terminal as intended. The lever of the spring action clamp shall then be operated to the fully latched and locked position and back to the unlatched and unlocked position. This sequence of operation shall be repeated for a total of 100 cycles.

99A.5 Following the 100 cycles, the conductor shall be reattached to the spring action clamp terminal and the lever placed in the latched and locked position as intended. A static pull force as specified in Table 99A.1 shall be applied to the conductor for 1 minute in a direction perpendicular to the plane of the device under test, tending to remove the conductor.

**Table 99A.1**
**Test values for spring action clamp terminal pull test**

| Size of conductor<br>AWG | Pullout force<br>lbf (pounds) |
|---|---|
| 16 | 9 |
| 14 | 11.5 |
| 12 | 13.5 |
| 10 | 18.0 |
| 8 | 20.5 |
| 6 | 21 |
| 4 | 30 |

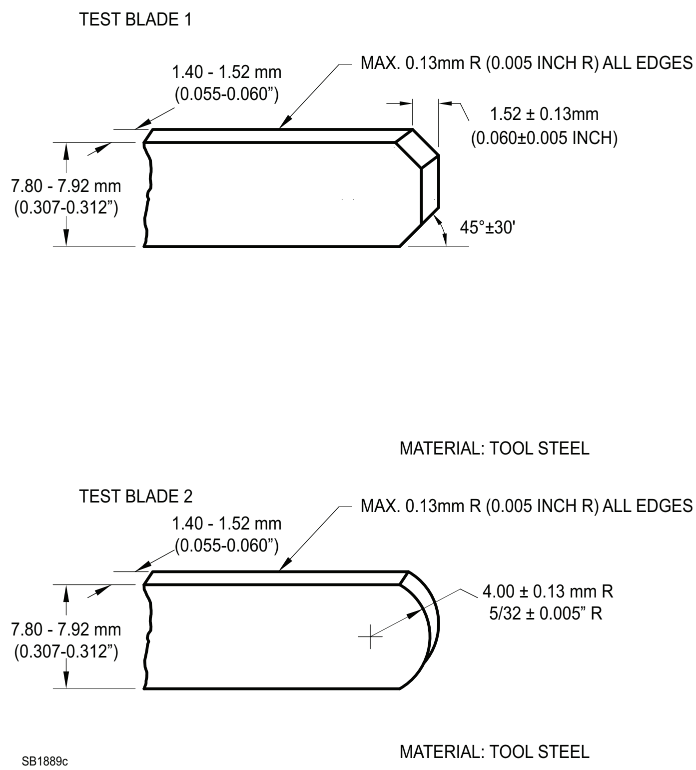
99A.6 Each device is then to be subjected to a 50 – 60 Hz essentially sinusoidal potential equal to twice the rated voltage plus 1000 V applied between live parts of opposite polarity and between live parts and grounding or dead metal parts. The test voltage is to be increased at a uniform rate and as rapidly as is consistent with its value being correctly indicated by a voltmeter and maintained at the test potential for 1 minute.

## 100 Improper Insertion Test

100.1 To determine compliance with 15.2.3 and 15.2.4, a cord connector having a 1-15R configuration shall obstruct the attempted insertion of the test blades illustrated in Figure 100.1, when tested as described in 100.2 and 100.3.

**Figure 100.1**

**Improper Insertion Test Blades**




100.2 Each of 12 cord connectors is to be tested while being supported on a flat steel plate. Rigid spacing materials may be used to support a cord connector that because of its shape does not lie flat on the steel plate, provided that by doing so, pressure is not exerted against the cord connector that will influence test results. The test blades shall be supported and centered above the non-polarized contact slot of the cord connector being tested. Each contact slot of a non-polarized cord connector is to be tested separately.

100.3 Each test blade is to be inserted into the non-polarized contact slot with a force that is to be gradually increased from zero to a 35 lbf (156 N). The force is to be maintained for one minute. Six cord connectors are to be tested using test blade 1, and six using test blade 2. In each case, the test blades shall be obstructed to the extent that they do not make electrical contact with the device contact relating to the non-polarized slot.

## 101 Potential Drop in Grounding Connections Test

101.1 A pressure connection that is secured by a means other than riveting, bolting, or welding in the grounding path of a cord connector grounding device (see 2.14) shall not show a drop in potential of more than 30 mV from the grounding contact or blade to the grounding terminal while a direct current equal to the maximum rated current of the device is flowing in the grounding path.

## 102 Integrity of Assembly Test

### 102.1 General

102.1.1 A cord connector shall not experience breakage or separation of the device body, detachment of any cord conductor, or any other damage that could increase the risk of fire or electric shock, when tested as described in this section.

*Exception No. 1: A device intended for use with a strain-relief knot as described in 13.3 is not required to be subjected to this test.*

*Exception No. 2: A strain-relief that consists of a cord clamp located outside the wiring compartment and that is tightened by one or more screws is not required to be subjected to this test.*

*Exception No. 3: A cord connector employing pin-type terminals instead shall be subjected to the Strain Relief Test, Section 107.*

*Exception No. 4: A Hospital Grade cord connector shall instead be subjected to the Strain Relief Tests, Section SC19.*

102.1.2 A field-wired device is to be wired in accordance with the manufacturer's instructions using 12 inch (305 mm) lengths of the sizes and types of flexible cord chosen to represent the range of cords intended for use with the device. See Reference No. 5 to Table 193.3.

102.1.3 The device is to be anchored securely and the cord is to be pulled steadily as follows:

a) 30 lbf (133 N) for a cord with 18 AWG (0.82 $mm^2$) or larger conductors, and

b) 20 lbf (89 N) for a cord with conductors smaller than 18 AWG (0.82 $mm^2$),

for 1 minute in the direction perpendicular to the plane of the cord entrance.

### 102.2 Self-hinged cord connectors

102.2.1 If the cord connector employs a self-hinge that is relied upon to hold the flexible cord in place, the tests described in 102.1.1 – 102.1.3 are to be repeated with the hinges cut. If unacceptable results are obtained, a separate set of six devices is to be subjected to the Self-Hinge Flexing Test described in Section 103.

## 103 Self-Hinge Flexing Test

103.1 A self-hinge that is relied upon to maintain the integrity of the enclosure or strain relief after a cord connector is assembled shall not break, crack or experience other damage as a result of this test.

103.2 Three groups of six devices each shall be tested as follows:

a) Group 1 – As received;

b) Group 2 – Oven conditioned for 168 hours at 100°C (212°F); and

c) Group 3 – Cold conditioned for 2 hours at -10°C (14°F) and allowed to return to room temperature.

103.3 The hinge of each device shall be completely opened and closed for 100 cycles of operation.

Pin-Type Terminals

## 104 General

104.1 In addition to the general performance requirements for cord connectors, a cord connector with pin-type terminals shall comply with the requirements in Sections 105 – 109.

## 105 Assembly Test

105.1 A cord connector with pin-type terminals shall be able to be readily assembled to the flexible cords with which it is intended to be used.

105.2 The device shall be assembled and tested with each of the sizes and types of flexible cords that it will physically accommodate following the instructions provided by the manufacturer. Proper assembly shall be determined by visual examination and compliance with the tests described in Sections 93 – 109.

*Exception: The device is not required to be assembled and tested with those cord types and sizes excluded by the marking specified in item (c) of Reference No. 6 of Table 193.3.*

## 106 Temperature Test

106.1 The temperature rise shall not be more than 30°C (54°F) when a cord connector with pin-type terminals is carrying the current corresponding to the ampacity of the size cord that the device is intended to accommodate.

106.2 The test is to be conducted on devices assembled to flexible cords selected as follows:

a) For a cord connector intended to be used with 18 AWG (0.82 $mm^2$) Types SP-1 and SPT-1 flexible cord, two sets of six devices each are to be assembled. One set is to be assembled using 18 AWG (0.82 $mm^2$) polyvinyl chloride insulated Type SPT-1 cord having a maximum width of 0.205 inch (5.21 mm) and a maximum overall thickness of 0.110 inch (2.79 mm). The second set is to be assembled using 18 AWG (0.82 $mm^2$) polyvinyl chloride insulated Type SPT-1 cord having a minimum overall width of 0.210 inch (5.33 mm).

b) For a cord connector intended for use with other types of flexible cord, consideration is to be given to the need for testing different types of cords and the effects of variations on insulation material and thickness for each type of flexible cord.

c) For a cord connector intended for use with more than one size of flexible cord, the temperature test is to be repeated for each size wire.

106.3 Each set is to be tested for temperature rise following assembly. Thermocouples are to be attached to the male blades of an attachment plug inserted in the outlet of the cord connector, as close as possible to the male face of the attachment plug. The assemblies are to be tested for 15 days without interruption. The device temperature is to be measured at the end of each working day.

106.4 Following the completion of this test, three assemblies using each of the flexible cord sizes and types specified in 106.2 are to be selected and subjected to the Dielectric Voltage-Withstand Test described in Section 109.

## 107 Strain Relief Test

107.1 When assembled to the intended flexible cord, a cord connector with pin-type terminals shall withstand the straight pull described in this section without detachment of any cord conductor or any other evidence of damage that increases the risk of fire or electric shock.

107.2 The test is to be conducted on devices assembled to flexible cords selected as follows:

a) For a cord connector intended to be used with 18 AWG (0.82 $mm^2$) Types SP-1 and SPT-1 flexible cord, two sets of six devices each are to be assembled using the smaller of the two cords indicated in 106.2.

b) When cords other than 18 AWG (0.82 $mm^2$) Types SP-1 and SPT-1 are to be used, device assemblies representing each size and type cord are to be tested. Consideration is to be given to the effects of anticipated variations in cord insulation material and thickness in selecting cords for the tests. Two sets with a minimum of three assemblies are to be tested using each representative size and type cord.

107.3 One set of devices for each cord size and type is to be subjected to the test described in 107.4 following assembly in the as-received condition. The second set is to be tested after being conditioned in a full-draft air-circulating oven for 30 days at 67.0°C (152.6°F).

107.4 While the cord connector is securely supported by the body, a pull is to be applied to the flexible cord for 1 minute of either:

a) 30 lbf (133 N) when the conductors are 18 AWG (0.82 $mm^2$) or larger, or

b) 20 lbf (89 N) when the conductors are smaller than 18 AWG (0.82 $mm^2$).

The direction of the force is to be perpendicular to the plane of the cord entrance.

## 108 Fault Current Test

108.1 When assembled to the intended flexible cord, a cord connector with pin-type terminals shall withstand the applied fault current without ignition of the cotton or cord insulation. The circuit breaker shall operate when the test circuit is closed.

108.2 The test is to be conducted on devices assembled to flexible cords selected as follows:

a) For a cord connector intended to be used with 18 AWG (0.82 $mm^2$) Types SP-1 and SPT-1 flexible cord, three sets of two devices each are to be tested using the larger of the two flexible cords described in 106.2.

b) For a cord connector intended to be used with other cord sizes and types, device assemblies representing each size and type of cord are to be tested. Consideration is to be given to the effects of variations in cord insulation material and thickness in selecting cords for the tests. Three sets of two devices each are to be tested using each representative size and type of cord.

108.3 The cord connectors are to be assembled to a 2-ft (0.6 m) length of each size and type of flexible cords wired at one end to an attachment plug having screw terminals. A second attachment plug having screw terminals shorted by a 12 AWG (3.3 $mm^2$) wire is to be plugged into the cord connector. The assemblies are to be tested as follows:

a) The first set is to be subjected to the test described in 108.4 following assembly in the as-received condition.

b) The second set is to be subjected to the test described in 108.4 after being subjected to a 15 lbf (67 N) strain relief test for 1 minute.

c) The third set is to be subjected to the test described in 108.4 after being conditioned in an oven at 67.0°C (152.6°F) for 30 days.

108.4 A standard screw terminal receptacle of the 5-15R configuration (2-pole, 3-wire, 15A, 125V) is to be wired in a circuit capable of delivering 1000 A rms at 125 V when the system is short circuited at the testing terminals. The receptacle is to be wired to the testing terminals by 4 ft (1.2 m) of 12 AWG (3.3 $mm^2$) wire. A thermal-type 20 A circuit breaker is to be connected between the receptacle and the testing terminals. The circuit breaker is to be calibrated and found to meet the calibration requirements for circuit breakers. Cotton is to be placed around the cord connector being tested. The male blades of the attachment plug at the opposite end of the assembly are to be inserted into the contacts of the receptacle and the test circuit is to be closed by means of an external switching device.

### 109 Dielectric Voltage-Withstand Test

109.1 The assembly of a cord and cord connector with pin-type terminals shall be capable of withstanding without breakdown, for a period of 1 minute, the application of a 60 Hz essentially sinusoidal potential of 1250 V between the two conductors of the flexible cord. Three assemblies are to be selected from the temperature test specified in Temperature Test, Section 106.

109.2 The test potential is to be supplied from a 500 V-A or larger capacity testing transformer whose output is essentially sinusoidal and can be varied. The applied potential is to be increased from zero until the required test voltage is reached, and is to be held at that voltage for a period of 1 minute. The increase in the applied potential is to be at uniform rate and as rapid as is consistent with its value being correctly indicated by the voltmeter.

RECEPTACLES

All Devices

### 110 General

110.1 The performance of a receptacle is to be investigated by means of the applicable tests described in Sections 60 – 69 and 111 – 161 as specified in Table 59.4. For Hospital Grade receptacles, see also General, Section SC20 of Hospital Grade Devices, Supplement SC. For self-contained receptacles, see also General, Section 168.

110.2 Flush or self-contained receptacles having a 5-15R, 5-20R, 6-15R, or 6-20R configuration shall be subjected to the series of tests described in Sections 111 – 115 and other receptacle types to Sections 116 – 120 along with other additional sections as indicated in Table 59.4. The Retention of Plugs Test, Section 116, and the Retention of Plugs Test (Repeated), Section 119, is only required for receptacles having a 1-15R, 5-15R, 5-20R, 6-15R or 6-20R configuration and not of the flush or self-contained type.

*Exception: A receptacle having a 1-15R, 5-15R, 5-20R, 6-15R, or 6-20R configuration and not of the flush or self-contained type may instead be subjected to the Retention of Blades Test, Section 111, and the Retention of Blades Test (Repeated), Section 114, as applicable. See Sections 116 and 119 for requirements.*

110.3 Devices of the ANSI/ESTA E1.24 Standard, Type 5 configurations (5T20, 5T30, 5T60 and 5T100) shall be subjected to all the applicable tests at a voltage rating of 250V. All other ANSI/ESTA E1.24 Standard configurations shall be subjected to all applicable tests at their identified and marked voltage rating.

## 111 Retention of Blades Test

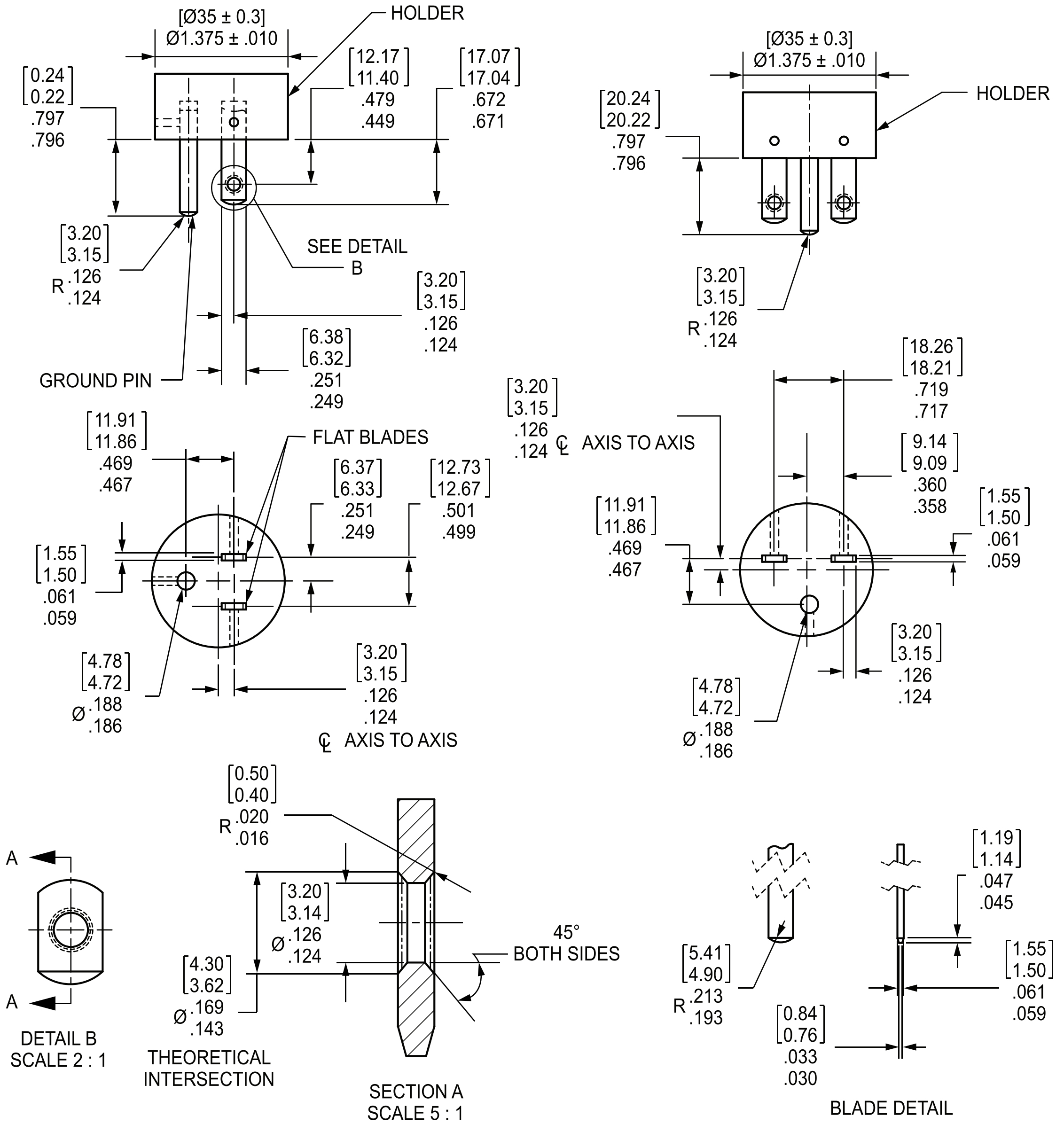
111.1 A flush or self-contained receptacle having a 5-15R, 5-20R, 6-15R, or 6-20R configuration shall be subjected to the retention of blades test described in this Section.

*Exception: A receptacle having a 1-15R, 5-15R, 5-20R, 6-15R, or 6-20R configuration and not of the flush or self-contained type may instead be subjected to the Retention of Plugs Test, Section 116.*

111.2 Receptacles having the break-off tab, when provided, removed from one nonidentified terminal are to be subjected to ten conditioning cycles of manual insertion and withdrawal of a standard gauge, see Figure 111.1. Each of six devices is to be tested. The gauge is to be configured as outlined in Table 111.1. The force applied to insert the gauge for any of the conditioning cycles is not to exceed 40 lbf (178 N). The gauge is to have the dimensions indicated in Figure 111.1 but is not to have holes in the outer ends of the blades.

**Figure 111.1**

**Test gauge**

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NOTES

1) Pin and blades shall be made of tool steel, Rockwell Hardness C58 to C60.

2) Sharp edges of the blades shall be removed to radius of 0.016 to 0.020” [0.40 mm to 0.50 mm]. Ends of all flat blades bevelled as shown in the end of blade detail.

3) Blade surfaces shall have a maximum of 32 microinch [813 nm] surface finish in a direction 90° to major axis. Finish is to be determined visually using a comparative method and 10X optical magnification.

4) “R” designates radius.

5) Grounding pin and flat blades shall be removable and fit in hole/slot with maximum clearance of 0.002” [0.05 mm].

6) All dimensions are in inches. Dimensions in bracket are in mm.

7) Flat blade position in relation to main axis shall be used to suit configurations 1-15R, 5-20R, 5-20RA, 6-20A, 6-20RA.

8) General tolerance not otherwise specified is ±0.012” [±0.3 mm].

**Table 111.1**
**Test gauge configurations for conditioning**

| Device under test | Test gauge | No. of devices tested |
|---|---|---|
| 5-15R | 5-15P | 6 |
| 5-20R | 5-15P | 3 |
| | 5-20P | 3 |
| 6-15R | 6-15P | 6 |
| 6-20R | 6-15P | 3 |
| | 6-20P | 3 |

111.3 The standard gauge is to be configured as shown in Table 111.2 using the line blades without holes and with the grounding blade removed. The gauge is then to be inserted in the receptacle and a static 3 lbf (13.3 N) (including the weight of the gauge), which tends to remove the gauge from the receptacle, is to be applied for a period of 1 minute in a direction normal to the plane of the face of the receptacle. There shall not be more than 0.079 inch (2 mm) displacement of the gauge.

**Table 111.2**
**Test gauge configurations for retention testing**

| Device under test | Test gauge | No. of devices tested |
|---|---|---|
| 5-15R | 1-15P or 5-15P[a] | 6 |
| 5-20R | 1-15P or 5-15P[a] | 3 |
| | 5-20P[a] | 3 |
| 6-15R | 2-15P or 6-15P[a] | 6 |
| 6-20R | 2-15P or 6-15P[a] | 3 |
| | 2-20P or 6-20P[a] | 3 |

[a] Test gauge having grounding blade removed.

111.4 The standard gauge is to be configured as shown in Table 111.3 using the line blades with holes in the end and with the grounding blade in place. The test is to be conducted using the apparatus as described in Figure 111.1A. The gauge is attached to the apparatus as shown. The apparatus consists of a principal mass, and a supplementary mass. The supplementary mass is 1.5 lbs (6.7 N). The principal mass, together with the supplementary mass, the Gage and any hardware equals 15 lbs (67 N) total. The gage is inserted fully into the device. The principal mass and associated hardware is hung on the gage without jolting. The gage shall not remain in the receptacle. If the gage does not withdraw the supplementary mass is raised and allowed to fall from a height of 2 in (51 mm) onto the principal mass one time. The gage shall not remain in the receptacle. A test apparatus that does not incorporate a supplementary mass and equals the 15 lbs (67 N) total is permitted if agreeable to all parties.

**Figure 111.1A**

**15 lb test fixture**

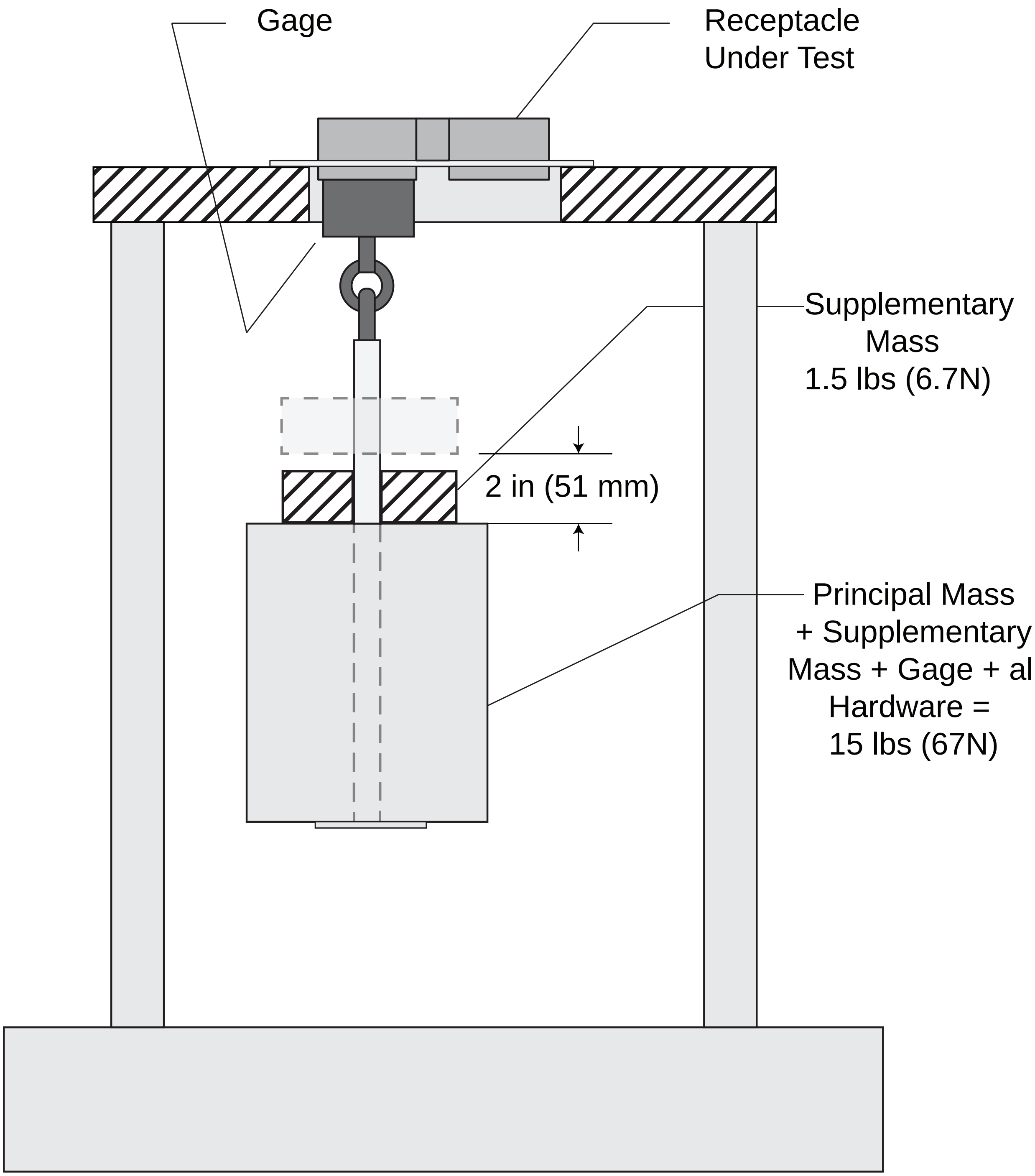


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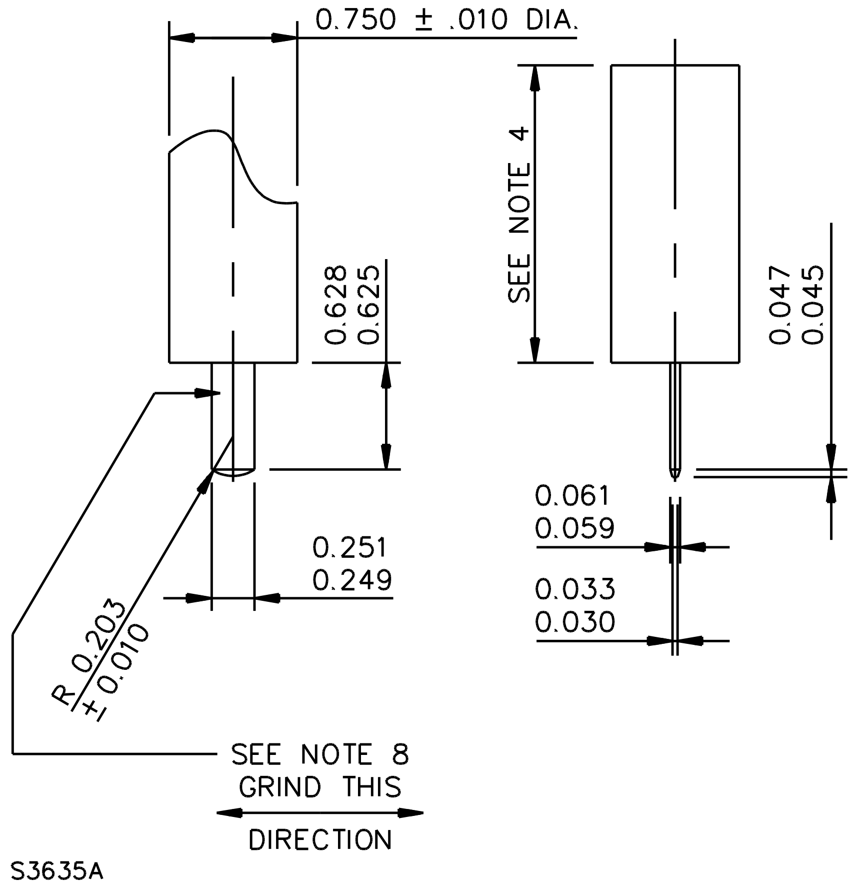
**Table 111.3**
**Test gauge configurations for withdrawal testing**

| Device under test | Test gauge | No. of devices tested |
|---|---|---|
| 5-15R | 5-15P | 6 |
| 5-20R | 5-15P | 3 |
| | 5-20P | 3 |
| 6-15R | 6-15P | 6 |
| 6-20R | 6-15P | 3 |
| | 6-20P | 3 |

111.5 Each of the line contacts of the receptacles is to be tested using the test blade illustrated in Figure 111.2. Each line contact shall be capable of withstanding for 1 minute a static 0.5 lbf (2.2 N) applied to the test blade in a direction normal to the plane of the face of the specimen and in a direction that tends to remove the test blade, when the test blade is fully inserted in the contact opening. There shall not be more than 0.079 inch (2 mm) displacement of the test blade.

**Figure 111.2**

**Test blade**




| Inch | (mm) | Inch | (mm) |
|---|---|---|---|
| 0.010 | 0.25 | 0.061 | 1.55 |
| 0.030 | 0.76 | 0.203 | 5.16 |
| 0.033 | 0.84 | 0.249 | 6.33 |
| 0.045 | 1.14 | 0.251 | 6.37 |
| 0.047 | 1.19 | 0.625 | 15.88 |
| 0.059 | 1.50 | 0.628 | 15.95 |
| | | 0.750 | 19.05 |

NOTES

1) Dimensions are in inches.

2) Metric equivalents are given for general information only and are based upon 1.00 inch = 25.4 mm.

3) Axis of blade and axis on holder must have a combined concentricity and axial alignment tolerance of 0.006 inch (0.15 mm) maximum T.I.R.

4) Length to suit total tool weight of 0.50 pounds.

5) The blade is to be fastened to the handle in a rigid manner.

6) Sharp edges shall be removed to a maximum radius of 0.015 inch (0.38 mm).

7) The blade shall be of steel having a Rockwell Hardness of C58 to C60. The handle shall be cold rolled steel.

8) The blade surfaces shall not exceed a 32 microinch finish grind in a direction perpendicular to the major axis. Finish is to be determined visually using a comparative method and 10 X optical magnification.

## 112 Overload Test

112.1 A flush or self-contained receptacle having a 5-15R, 5-20R, 6-15R, or 6-20R configuration shall be subjected to the overload test described in this Section. There shall not be any electrical or mechanical failure of the device nor pitting or burning of the contacts that would affect the intended function.

*Exception: All other receptacles shall instead be subjected to the Overload Test, Section 117.*

112.2 The test is to be conducted using direct current with a resistive load. If a receptacle employs electronic components or if the receptacle is a tamper-resistant type with internal switching contacts, the test is to be conducted while bypassing those components.

112.3 Each of six receptacles is to be tested, by machine or manually, as outlined in 112.4 and 112.5, by inserting and withdrawing an attachment plug of the configuration specified in Table 112.1 having rigidly secured solid blades that are connected through a flexible cord to a suitable load. A grounding type attachment plug is to be used and the grounding blade of the attachment plug is to be connected to the grounding contact of the receptacle under test. The grounding contact of the receptacle under test is to be connected through a fuse to the ground. The receptacle is to be caused to make and break 150 percent of rated current for 100 cycles of operation at a rate not faster than 10 cycles per minute. The blade of the attachment plug is to mate with the contact of the receptacle for not more than 1 second during each cycle. The attachment plug used for this test is able to be changed after 50 cycles. In the case of a duplex receptacle, only one set of contacts of each receptacle is to be overloaded; half of the receptacles are to be tested at one contact position and half at the other contact position.

**Table 112.1**
**Mating plug configurations for overload testing**

| Device under test | Mating plug | No. of devices tested |
|---|---|---|
| 5-15R | 5-15P | 6 |
| 5-20R | 5-15P | 3 |
| | 5-20P | 3 |
| 6-15R | 6-15P | 6 |
| 6-20R | 6-15P | 3 |
| | 6-20P | 3 |

112.4 If conducted by machine, it is to withdraw and insert an unrestricted attachment plug with an average velocity of 30 ±3 inches/s (760 ±75 mm/s) in each direction during a 2-1/2 inch (64 mm) stroke measured from the fully inserted position. The velocity is to be determined without the receptacle installed on the machine in order to eliminate restrictions on the attachment plug motion.

112.5 In the event of failures during machine testing, referee tests may be conducted manually under conditions similar to those described in 112.4.

112.6 The open circuit voltage of the test circuit shall not exceed 105 percent of the rated voltage and the closed circuit voltage shall not be less than 95 percent of the rated voltage. At the option of the manufacturer the open circuit voltage may exceed 105 percent of the rated voltage.

112.7 Neither the blades nor the contacts are to be adjusted, lubricated, or conditioned, other than as required by Retention of Blades Test, Section 111, before or during the test.

112.8 The receptacle is to be mounted and wired to represent service conditions. If the receptacle is intended for use with a face plate or the like, it is to be mounted with a suitable metal plate as in service.

The metal parts that are intended to be grounded shall be connected through a fuse to ground.The frame (yoke) and enclosure, if any, are to be positive with respect to the nearest arcing point of the receptacle.

112.9 The fuse in the grounding circuit is to be a 15 A-fuse. The fuses in the test circuit are to have the next higher standard fuse rating than the value of the test current. If either the line fuse or the grounding fuse opens during the test, the results are not acceptable.

## 113 Temperature Test

113.1 The contact temperature rise of a flush or self-contained receptacle having a 5-15R, 5-20R, 6-15R, or 6-20R configuration shall not be more than 30°C (54°F) when the receptacle is carrying its maximum rated current.

*Exception: All other receptacles shall instead be subjected to the Temperature Test, Section 118.*

113.2 Each receptacle provided with means for through-wiring on a branch circuit is also to be subjected to a terminal temperature test at a current of 20 A. The temperature rise on the terminals shall not be more than 30°C (54°F), except as noted in 113.9.

*Exception No. 1: Self-contained receptacles are not required to be subjected to a terminal temperature test.*

*Exception No. 2: Devices employing "Push-In" terminals are to be subjected to the tests in Temperature Test, Push-In Terminals, Section 137.*

*Exception No. 3: If a device employs both "Push-In" terminals and either pressure-wire, clamp, set screw or wire-binding screw terminals, the "Push-In" terminals are to be subjected to the tests in Temperature Test, Push-In Terminals, Section 137. The remaining terminals are to be subjected to the terminal temperature test in this section. Such receptacles shall be marked to identify the intended use of each terminal in accordance with Reference No. 25 of Table 193.4.*

113.3 For receptacles of configurations 5-20R and 6-20R the contact temperature and terminal temperature tests are to be combined. The receptacle is to be wired with 12 AWG (3.3 $mm^2$) solid or stranded copper building wire.

113.4 For receptacles of configuration 5-15R or 6-15R intended for through-wiring and not represented by otherwise similar receptacles of configuration 5-20R or 6-20R, the contact temperature and terminal temperature tests are to be conducted separately. These 15-A configuration receptacles are to be wired with 14 AWG (2.1 $mm^2$) solid or stranded copper building wire for the contact temperature test which is to be conducted at a current of 15 A. The same receptacles are to be rewired with 12 AWG (3.3 $mm^2$) solid or stranded copper building wire for the terminal temperature test.

113.5 For receptacles of configurations 5-15R and 6-15R not intended for through-wiring, the contact temperature and terminal temperature tests are to be combined. The receptacle is to be wired with 14 AWG (2.1 $mm^2$) solid or stranded copper building wire.

113.6 The temperature measurement mentioned in 113.1 is to be taken at points as close to the face of the receptacle as possible on the male blades of an attachment plug inserted in the outlet. The temperature measurement mentioned in 113.2 is to be made on the wiring terminals of the receptacle if they are accessible for the mounting of thermocouples.

113.7 When testing receptacles with wire leads that are intended for through-wiring on a branch circuit or with terminals that are inaccessible for mounting thermocouples, the terminal temperature is to be measured on the conductor as close as possible to the entry (exit) of the conductor to (from) the receptacle.

113.8 When testing receptacles with wire binding screws, screw actuated clamp type or spring action clamp terminations, the terminal temperature is to be measured on the terminations in a manner such that the thermocouple does not interfere with the termination.

113.9 When conducting the terminal temperature test on a receptacle provided with break-off tabs the test current is to pass through one break-off tab (the tab between the identified terminals of a 125 V receptacle) and a thermocouple affixed to the tab shall not indicate a temperature rise at the tab of more than 40°C (72°F).

113.10 The temperature test(s) are to be conducted following the overload test on six receptacles and are to continue until stabilized temperatures are attained. A temperature is considered to be stabilized when three consecutive readings, taken at 5-minute intervals, indicate no further rise above the ambient temperature. The contact temperatures are to be measured at the contacts previously subjected to the overload test.

113.11 The overloaded contacts of individual receptacles are to be connected together by means of a shorted attachment plug of the configuration shown in Table 113.1. A standard solid blade attachment plug is to be used. The terminals of the plug are to be short-circuited by means of the shortest feasible length of wire that has an ampacity at least equal to that of the receptacle. The shorting wire is able to be soldered to the plug terminals in order to minimize the generation of heat from sources other than the contacts.

**Table 113.1**
**Mating plug configurations for temperature testing**

| Device under test | Mating plug | No. of devices tested |
|---|---|---|
| 5-15R | 5-15P | 6 |
| 5-20R | 5-15P | 3 |
| | 5-20P | 3 |
| 6-15R | 6-15P | 6 |
| 6-20R | 6-15P | 3 |
| | 6-20P | 3 |

113.12 The receptacles under test are to be connected in series in the test circuit with building wire as specified in 113.4 or 113.5 using lengths of no less than 20 inches (500 mm). The receptacles are to be connected in a manner such that the current path enters the receptacle at the terminal furthest from an overloaded contact (if more than one terminal per contact is provided), passes through the break-off tab (if a break-off tab is provided), passes through one overloaded contact, the shorted plug and the other overloaded contact, and then exits the receptacle through the terminal closest to the other overloaded contact.

113.13 Wire binding terminal screws and screw actuated clamp type terminals on the receptacle under test are to be tightened using a torque of 9 in-lbf (1.0 N·m) for receptacles wired with 14 AWG (2.1 $mm^2$) conductor and 14 in-lbf (1.6 N·m) for receptacles wired with 12 AWG (3.3 $mm^2$) conductor.

## 114 Retention of Blades Test (Repeated)

114.1 Following the temperature test(s) the overloaded contacts of a flush or self-contained receptacle having a 5-15R, 5-20R, 6-15R, or 6-20R configuration are to be subjected to a repeated Retention of Blades Test in accordance with Section 111.

*Exception: A receptacle having a 1-15R, 5-15R, 5-20R, 6-15R, or 6-20R configuration and not of the flush or self-contained type may instead be subjected to a repeated Retention of Plugs Test in accordance with Section 116.*

## 115 Resistance to Arcing Test

115.1 If an insulating material is used in the construction of the face of a flush or self-contained receptacle having a 5-15R, 5-20R, 6-15R, or 6-20R configuration in a way that the material is likely to be exposed to arcing while in service, the outlets that were subjected to 100 cycles of operation in the Overload Test described in Section 112 shall perform acceptably when subjected to an additional 150 cycles of operation under the overload test conditions following the temperature test and the repeated retention of blades test.

*Exception: A receptacle having a 1-15R, 5-15R, 5-20R, 6-15R, or 6-20R configuration and not of the flush or self-contained type shall instead be subjected to the Resistance to Arcing Test, Section 120.*

115.2 Alternatively, one set of receptacles may be subjected to the 100 cycles of operation in the Overload Test described in Section 112, followed by the temperature test and repeated retention of blades test on the receptacles and then, to determine resistance to arcing, a second, previously untested set of receptacles may be subjected to 250 cycles of operation under the overload-test conditions.

115.3 The attachment plug used for this test may be changed after every 50 operations. There shall not be any sustained flaming of the material in excess of five seconds duration. There shall not be any electrical tracking or the formation of a permanent carbon conductive path which results in a dielectric breakdown, as determined by the application of a 60 Hz essentially sinusoidal potential of 1500 V applied for one minute between live parts of opposite polarity and between live parts and dead metal parts.

## 116 Retention of Plugs Test

116.1 The contacts of a 1-15R, 5-15R, 5-20R, 6-15R or 6-20R configuration receptacle, other than the flush or self-contained type, shall retain an attachment plug so that a force greater than 3 lbf (13 N) is required to withdraw the plug when tested as described in this section.

*Exception: A receptacle that has provision for locking the plug in place after the blades have been inserted in the female contacts (such as a rotating collar) is not required to be subjected to this test.*

116.2 Each of six devices is to be subjected to ten conditioning cycles of insertion and withdrawal of a standard solid-blade attachment plug that has American National Standard detent holes in accordance with Wiring Devices – Dimensional Specifications, ANSI/NEMA WD6, in rigidly mounted blades, following which the plug is to be fully reinserted into the device. The mating plugs are to have the configuration indicated in Table 116.1. A pull of 3 lbf (13 N) in a direction perpendicular to the plane of the face of the receptacle and tending to withdraw the plug from the device is then to be applied to the plug for 1 minute. The displacement of the plug shall not be greater than 0.079 inch (2 mm).

*Exception: Receptacles of this type may instead be subjected to the Retention of Blades Test, Section 111.2 and 111.3 (conditioning and 3 lb retention).*

**Table 116.1**
**Mating plug configurations for plug retention**

| Device under test | Mating plug | No. of devices tested |
|---|---|---|
| 1-15R | 1-15P | 6 |
| 5-15R | 1-15P | 6 |
| 5-20R | 1-15P | 3 |
| | 5-20P[a] | 3 |
| 6-15R | 2-15P | 6 |
| 6-20R | 2-15P | 3 |
| | 6-20P[a] | 3 |

[a] Shall have the ground blade removed.

## 117 Overload Test

### 117.1 General

117.1.1 A receptacle shall be capable of performing acceptably when subjected to the current overload test as described in this section. A receptacle additionally rated in horsepower shall also be capable of performing acceptably when subjected to the horsepower overload test as described in this section. In either case, there shall not be any electrical or mechanical failure of the device, opening of a line or grounding fuse, welding of the contacts, nor burning or pitting of the contacts that would affect the intended function of the device.

*Exception No. 1: A receptacle that is intended for disconnecting use only and not for current interruption, is not required to be subjected to this test. See also 192.6.*

*Exception No. 2: Either the current overload test or horsepower overload test may be omitted if it is obvious that one test is fully represented by the other.*

117.1.2 The device is to be mounted and wired to represent service conditions. If the device is intended for use with a face plate or the like, it is to be mounted with a metal plate as in service. If the device is rated at 250 V or less, the metal plate is to be connected through a fuse to ground, to the grounded conductor of the test circuit, or to a circuit conductor that differs from at least 125 V in potential from one or more of the remaining conductors in the circuit. If the device is rated more than 250 V, the plate is to be connected similarly to a circuit conductor that differs by at least the rated potential from one or more of the remaining conductors in the circuit. The frame (yoke) and enclosure, if any, are to be electrically positive with respect to the nearest arcing point of the device.

117.1.3 The fuse in the grounding conductor is to be:

a) A 15 A fuse if the device being tested is rated 30 A or less; or

b) A 30 A fuse if the device being tested is rated more than 30 A.

The fuse in the test circuit is to have the next higher standard fuse rating than the value of the test current.

117.1.4 The potential of the test circuit is to be from 95 to 105 percent of the rating of the device in volts. Devices rated 250 V are to be tested on circuits with a potential to ground of 125 V. Receptacles having other voltage ratings are to be tested on circuits involving full rated potential to ground, except for multi-phase rated devices which are to be tested on circuits consistent with their voltage ratings (for example, a 120/208 V, 3-phase device, is to be tested on a circuit involving 120 V to ground). Testing using a 60 Hz supply voltage may represent testing using a higher frequency supply voltage not exceeding 400 Hz.

117.1.5 Each of six devices is to be tested by machine or manually by inserting and withdrawing an attachment plug having rigidly secured solid blades that are connected through a flexible cord to a load. For devices with a 1-15R, 5-15R, 5-20R, 6-15R or 6-20R configuration, the mating plugs shall have the configurations specified in Table 117.1. When an equipment-grounding connection is provided in the device being tested, a grounding-type attachment plug is to be used and the grounding blade of the plug connected to the grounding contact of the device being tested. The grounding contact is then to be grounded through a fuse as specified in 117.1.3.

**Table 117.1**
**Mating plug configurations for overload testing**

| Device under test | Mating plug | No. of devices tested |
|---|---|---|
| 1-15R | 1-15P | 6 |
| 5-15R | 5-15P | 6 |
| 5-20R | 5-15P | 3 |
| | 5-20P | 3 |
| 6-15R | 6-15P | 6 |
| 6-20R | 6-15P | 3 |
| | 6-20P | 3 |

117.1.6 For a device rated 20 A or less, the test machine is to withdraw and insert an unrestricted attachment plug with an average velocity of 30 ±3 inches/s (760 ±75 mm/s) in each direction during a 2-1/2 inch (64 mm) stroke measured from the fully inserted position. The velocity is to be determined without the outlet device installed on the machine to eliminate restrictions on the plug motion.

117.1.7 For a device rated more than 20 A the test machine unrestricted plug velocity and stroke length are to be adjusted as necessary to obtain the maximum mating time required in 117.1.8.

117.1.8 The device is then to make and break the required test load for 50 cycles of operation at a rate no faster than 10 cycles per minute. The blade of the attachment plug is to mate with the female contact of the device for no more than 1 second for straight-blade devices, and 3 seconds for locking devices during each cycle. For locking devices, each cycle of operation is to include rotation of the test plug to the full lock position after insertion, and back to the unlocked position before withdrawal.

117.1.9 Blades or contacts are not to be adjusted, lubricated, or otherwise conditioned before or during either test. The attachment plug used for either test may be changed after 50 cycles.

117.1.10 In the event that unacceptable results are obtained in the machine testing described in 117.1.6 or 117.1.7, referee tests may be conducted manually under conditions similar to those described in 117.1.6 or 117.1.7.

### 117.2 Current overload test

117.2.1 The test current shall be 150 percent of the rated current of the device. For devices with standard configurations rated 125 V, 250 V, or 125/250 V illustrated in Wiring Devices – Dimensional Specifications, ANSI/NEMA WD6, the test is to be conducted on direct current. All other devices with standard configurations denoted as "AC" or "3-phase" are to be tested on alternating current. For devices with nonstandard configurations, the test is to be conducted using direct current with a resistive load, except that alternating current is to be used if the device is rated for alternating current only. Whenever alternating current is used for the test, the power factor of the load is to be from 0.75 to 0.80.

117.2.2 Testing of a device that has a dual voltage rating and a dual current rating is to be performed at the maximum rating in volts and with 150 percent of the rated current that corresponds to the maximum voltage rating.

*Exception: A test on alternating current may be waived if equivalent results have been obtained from a direct potential that is equal to or greater than the alternating-potential rating.*

### 117.3 Horsepower overload test

117.3.1 If a separate horsepower overload test is conducted, the tests for the horsepower ratings are to be conducted on separate sets of previously untested devices. For devices with a phase to phase (L-L) and phase to neutral (L-N) horsepower rating, the test for each rating is to be conducted on a separate set of previously untested devices.

117.3.2 For devices with standard configurations illustrated in Wiring Devices – Dimensional Specifications, ANSI/NEMA WD6, the test current corresponding to the AC horsepower rating shall be as specified in Table 117.2. The load for an alternating current horsepower rating is to have a power factor of 0.40 – 0.50. For devices with a voltage rating of 250 volts, the overload test for the phase to phase horsepower rating is to be conducted at both 208 V ac and 250 V ac. A single test may be conducted at 250 V ac and at the test current for 208 V ac, if agreeable to all parties.

*Exception No. 1: Devices with a L9-20R, L9-30R, L13-30R, L17-30R, L20-20R, L20-30R, L23-20R, L23-30R, SS1-50R, SS2-50R, TT-R, ML-1R, ML-2R, or ML-3R configuration in Wiring Devices – Dimensional Specifications, ANSI/NEMA WD6 or one of the configurations illustrated in Figures C1.1 – C1.5 of the Standard for Wiring Device Configurations, UL 1681 do not have assigned horsepower ratings and are not required to be subjected to the horsepower overload test.*

*Exception No. 2: Appliance, equipment or fixture outlets do not have assigned horsepower ratings and are not to be subjected to the horsepower overload test.*

*Exception No. 3: Receptacles having a 1-15, 5-15, 5-20, 6-15, or 6-20 configurations in Wiring Devices – Dimensional Specifications, ANSI/NEMA WD6 shall not to be subjected to the horsepower overload test.*

**Table 117.2**
**Test current (locked rotor amperes) for horsepower rated NEMA configuration receptacles**

| NEMA configuration | AC HP rating[a] | LRA (amperes) | AC test voltage |
|---|---|---|---|
| 1-15R | 0.5 | 58.8 | 125 |
| 2-15R | 1.5[b] | 60<br>66 | 250<br>208 |
| 2-20R | 2[b] | 72<br>79.2 | 250<br>208 |
| 2-30R | 2[b] | 72<br>79.2 | 250<br>208 |
| 5-15R | 0.5 | 58.8 | 125 |

**Table 117.2 Continued on Next Page**

## Table 117.2 Continued

| NEMA configuration | AC HP rating[a] | LRA (amperes) | AC test voltage |
|---|---|---|---|
| 5-20R | 1 | 96 | 125 |
| 5-30R | 2 | 144 | 125 |
| 5-50R | 2 | 144 | 125 |
| 6-15R | 1.5[b] | 60 | 250 |
| | | 66 | 208 |
| 6-20R | 2[b] | 72 | 250 |
| | | 79.2 | 208 |
| 6-30R | 2[b] | 72 | 250 |
| | | 79.2 | 208 |
| 6-50R | 3[b] | 102 | 250 |
| | | 112.2 | 208 |
| 7-15R | 2 | 59.8 | 277 |
| 7-20R | 2 | 59.8 | 277 |
| 7-30R | 3 | 84.7 | 277 |
| 7-50R | 5 | 139.4 | 277 |
| 10-20R | 2 L-L[b] | 72 | 250 |
| | | 79.2 | 208 |
| | 1 L-N | 96 | 125 |
| 10-30R | 2 L-L[b] | 72 | 250 |
| | | 79.2 | 208 |
| | 2 L-N | 144 | 125 |
| 10-50R | 3 L-L[b] | 102 | 250 |
| | | 112.2 | 208 |
| | 2 L-N | 144 | 125 |
| 11-15R | 2 | 50 | 250 |
| 11-20R | 3 | 64 | 250 |
| 11-30R | 3 | 64 | 250 |
| 11-50R | 7.5 | 132 | 250 |
| 14-15R | 1.5 L-L[b] | 60 | 250 |
| | | 66 | 208 |
| | 0.5 L-N | 58.8 | 12 |
| 14-20R | 2 L-L[b] | 72 | 250 |
| | | 79.2 | 208 |
| | 1 L-N | 96 | 125 |
| 14-30R | 2 L-L[b] | 72 | 250 |

Table 117.2 Continued on Next Page

## Table 117.2 Continued

| NEMA configuration | AC HP rating[a] | LRA (amperes) | AC test voltage |
|---|---|---|---|
| | | 79.2 | 208 |
| | 2 L-N | 144 | 125 |
| | | | |
| 14-50R | 3 L-L[b] | 102 | 250 |
| | | 112.2 | 208 |
| | 2 L-N | 144 | 125 |
| | | | |
| 14-60R | 3 L-L[b] | 102 | 250 |
| | | 112.2 | 208 |
| | 2 L-N | 144 | 125 |
| | | | |
| 15-15R | 2 | 50 | 250 |
| 15-20R | 3 | 64 | 250 |
| 15-30R | 3 | 64 | 250 |
| 15-50R | 7.5 | 132 | 250 |
| 15-60R | 10 | 168 | 250 |
| | | | |
| 18-15R | 2 | 55 | 208 |
| 18-20R | 2 | 55 | 208 |
| 18-30R | 3 | 71 | 208 |
| 18-50R | 7.5 | 145.2 | 208 |
| 18-60R | 7.5 | 145.2 | 208 |
| | | | |
| L1-15R | 0.5 | 58.8 | 125 |
| L2-20R | 2[b] | 72 | 250 |
| | | 79.2 | 208 |
| | | | |
| L5-15R | 0.5 | 58.8 | 125 |
| L5-20R | 1 | 96 | 125 |
| L5-30R | 2 | 144 | 125 |
| | | | |
| L6-15R | 1.5[b] | 72 | 250 |
| | | 79.2 | 208 |
| L6-20R | 2[b] | 72 | 250 |
| | | 79.2 | 208 |
| L6-30R | 2[b] | 72 | 250 |
| | | 79.2 | 208 |
| | | | |
| L7-15R | 2 | 59.8 | 277 |
| L7-20R | 2 | 59.8 | 277 |
| L7-30R | 3 | 84.7 | 277 |
| | | | |
| L8-20R | 3 | 51 | 480 |
| L8-30R | 5 | 84 | 480 |

Table 117.2 Continued on Next Page

## Table 117.2 Continued

| NEMA configuration | AC HP rating[a] | LRA (amperes) | AC test voltage |
|---|---|---|---|
| L10-20R | 2 L-L[b] | 72 | 250 |
| | | 79.2 | 208 |
| | 1 L-N | 96 | 125 |
| L10-30R | 2 L-L[b] | 72 | 250 |
| | | 79.2 | 208 |
| | 2 L-N | 144 | 125 |
| L11-15R | 2 | 50 | 250 |
| L11-20R | 3 | 64 | 250 |
| L11-30R | 3 | 64 | 250 |
| L12-20R | 5 | 45.6 | 480 |
| L12-30R | 10 | 84 | 480 |
| L14-20R | 2 L-L[b] | 72 | 250 |
| | | 79.2 | 208 |
| | 1 L-N | 96 | 125 |
| L14-30R | 2 L-L[b] | 72 | 250 |
| | | 79.2 | 208 |
| | 2 L-N | 144 | 125 |
| L15-20R | 3 | 64 | 250 |
| L15-30R | 3 | 64 | 250 |
| L16-20R | 5 | 45.6 | 480 |
| L16-30R | 10 | 84 | 480 |
| L18-20R | 2 | 55 | 208 |
| L18-30R | 3 | 71 | 208 |
| L19-20R | 5 | 45.6 | 480 |
| L19-30R | 10 | 84 | 480 |
| L21-20R | 2 | 55 | 208 |
| L21-30R | 3 | 71 | 208 |
| L22-20R | 5 | 45.6 | 480 |
| L22-30R | 10 | 84 | 480 |
| L25-30R | 2 | 72 | 240 |
| | | 79.2 | 208 |
| L26-30R | 7.5 | 84 | 415 |

[a] The phase to phase horsepower ratings are noted by "L-L". The phase to neutral ratings are identified by "L-N".

[b] Also suitable for 208 V motor applications at the indicated horsepower rating.

117.3.3 For all devices with nonstandard configurations, the test current corresponding to the horsepower rating is to be as specified in the Standard for General-Use Snap Switches, UL 20, for a device having an alternating-current rating of 2 horsepower or less and as specified in the Standard for Enclosed and Dead-Front Switches, UL 98, for a device having an alternating-current rating of more than 2 horsepower. The load for an alternating current horsepower rating is to have a power factor of 0.40 – 0.50.

## 118 Temperature Test

### 118.1 Contact and terminal temperature

118.1.1 The temperature rise of a receptacle measured as at the points described in 118.1.2, shall not be more than 30°C (54°F) when the device is carrying its maximum rated current.

118.1.2 Each of six devices is to be tested. Temperatures are to be measured by means of thermocouples attached to the wiring terminals of the device when they are accessible for the mounting of thermocouples.

*Exception: When the wiring terminals are not accessible for mounting thermocouples or when the device is not provided with wiring terminals, the thermocouples are to be attached to the blades of the mated attachment plug as close as possible to the face of the device.*

118.1.3 The temperature test is to be made following the overload test on the devices and is to continue until stabilized temperatures are attained. A temperature is considered to be stabilized when three consecutive readings, taken at no less than 5-minute intervals, indicate no further rise above the ambient temperature.

118.1.4 The generation of heat from sources other than the female contacts is to be minimized as much as possible. Each connection to the device being tested is to be made by means of a 12-inch (300-mm) or greater length of Type RH, Type TW, or other equivalent building wire. The wire size and type are to be determined using the appropriate value for the device's current rating from Table 310-16 of the National Electrical Code, ANSI/NFPA 70, as follows:

a) Ampacities for copper conductors temperature rated at 60°C (140°F) for a receptacle rated 100 A or less for use on copper conductors only.

b) Ampacities for copper conductors temperature rated at 75°C (167°F) for a receptacle rated greater than 100 A for use on copper conductors only.

c) Ampacities for copper conductors temperature rated at 75°C (167°F) for a receptacle rated greater than 30A, and 100 A or less, for use on copper conductors only and marked in accordance with Table 193.4.

d) Ampacities for copper conductors temperature rated at 60°C (140°F) for an AL-CU receptacle.

e) Ampacities for copper conductors temperature rated at 60°C (140°F) for a CO/ALR receptacle.

*Exception: An AL-CU receptacle identified for use on 75°C (167°F) wire is to be wired with the conductors specified in Table 118.1.*

**Table 118.1**
**Test conductor sizes for AL-CU receptacles identified for use on 75°C (167°F) wire**

| Device rating, A | Test conductor type and size, AWG ($mm^2$) |
|---|---|
| 30 | aluminum, 10 (5.3) |
| 50 | copper, 8 (8.4) |
| 60 | copper, 6 (13.3) |

118.1.5 The contacts of the device being tested are to be connected together by means of a mated attachment plug. For devices with a 1-15R, 5-15R, 5-20R, 6-15R or 6-20R configuration, the mating plugs shall have the configurations specified in Table 118.2. The plug is to have rigidly attached solid blades and the terminals of the plug are to be short-circuited by means of the shortest feasible length of flexible cord that has an ampacity at least equal to that of the device. The wire size and type are to be determined using the appropriate value for the device's current rating from Table 400.5(A) or 400.5(B) of the National Electrical Code, ANSI/NFPA 70.

**Table 118.2**
**Mating plug configurations for temperature testing**

| Device under test | Mating plug | No. of devices tested |
|---|---|---|
| 1-15R | 1-15P | 6 |
| 5-15R | 5-15P | 6 |
| 5-20R | 5-15P | 3 |
| | 5-20P | 3 |
| 6-15R | 6-15P | 6 |
| 6-20R | 6-15P | 3 |
| | 6-20P | 3 |

118.1.6 The terminals are to be tightened to the marked torque limit or, when a tightening torque is not provided, the torque used is to be 9 in-lbf (1.0 N·m) for devices rated 15 A or less and 14 in-lbf (1.6 N·m) for other ratings.

118.1.7 Temperature readings are to be obtained by means of thermocouples consisting of 28 – 32 AWG (0.8 – 0.032 $mm^2$) iron and constantan wires with a potentiometer type of indicating instrument. This equipment is to be used when a referee measurement of temperature is necessary.

### 118.2 Feed-through terminal temperature

118.2.1 The temperature rise of the terminals of a receptacle that has a current rating of 15 or 20 A at 125 or 250 V and that is provided with wiring terminals for through connection, shall not be more that 30°C (54°F) when a current of 20 A is passed through both terminals.

*Exception: A receptacle that employs the conventional form of terminal plate with two wire-binding screws or pressure-wire connectors is not required to be subjected to this test.*

118.2.2 The test is to be made in accordance with 118.1.2 – 118.1.6 but without a load on the receptacle contacts. Approximately 12-inch (300-mm) lengths of 12 AWG (3.3 $mm^2$) wire are to be used for connections.

118.2.3 Temperature readings are to be obtained by means of thermocouples consisting of 28 – 32 AWG (0.8 – 0.032 mm$^2$) iron and constantan wires with a potentiometer type of indicating instrument. This equipment is to be used when a referee measurement of temperature is necessary.

## 119 Retention of Plugs Test (Repeated)

### 119.1 General

119.1.1 After completion of the Overload Test, Section 117, and the Temperature Test, Section 118, the contacts of a 1-15R, 5-15R, 5-20R, 6-15R or 6-20R configuration receptacle, other than the flush or self-contained type, shall retain an attachment plug so that when tested as described in this section:

a) A force greater than 3 lbf (13 N) is required to withdraw the plug, and

b) A force of 15 lbf (67 N) is capable of withdrawing the plug.

*Exception: A receptacle that has provision for locking the plug in place after the blades have been inserted in the female contacts (such as a rotating collar) is not required to be subjected to this test.*

### 119.2 Plug retention

119.2.1 Each of six devices is to be tested. A standard solid-blade attachment plug that has American National Standard detent holes, in accordance with Wiring Devices – Dimensional Specifications, ANSI/NEMA WD6, in rigidly mounted blades is to be fully inserted into the device. The test plugs are to have the configuration specified in Table 119.1. A pull of 3 lbf (13 N) in a direction perpendicular to the plane of the face of the receptacle and tending to withdraw the plug from the device is then to be applied to the plug for 1 minute. The displacement of the plug shall not be greater than 0.079 inch (2 mm).

*Exception: Receptacles of this type may instead be subjected to the Retention of Blades Test, Section 111.3 (3 lb retention).*

**Table 119.1**
**Mating plug configurations for plug retention**

| Device under test | Mating plug | No. of devices tested |
|---|---|---|
| 1-15R | 1-15P | 6 |
| 5-15R | 1-15P | 6 |
| 5-20R | 1-15P | 3 |
| | 5-20P[a] | 3 |
| 6-15R | 2-15P | 6 |
| 6-20R | 2-15P | 3 |
| | 6-20P[a] | 3 |

[a] Shall have the ground blade removed.

### 119.3 Plug withdrawal

119.3.1 Each of six devices is to be tested. Following the application of the 3 lbf (13 N), the pull is to be increased to 15 lbf (67 N), using test plugs having the configuration specified in Table 119.2, and the plug shall be withdrawn by the force.

*Exception: Receptacles of this type may instead be subjected to the Retention of Blades Test, Section 111.4 (15 lb withdrawal).*

**Table 119.2**
**Mating plug configurations for plug withdrawal**

| Device under test | Mating plug[a] | No. of devices tested |
|---|---|---|
| 1-15R | 1-15P | 6 |
| 5-15R | 5-15P | 6 |
| 5-20R | 5-15P | 3 |
| | 5-20P | 3 |
| 6-15R | 6-15P | 6 |
| 6-20R | 6-15P | 3 |
| | 6-20P | 3 |

[a] Shall have American National Standard detent holes in accordance with Wiring Devices – Dimensional Specifications, ANSI/NEMA WD6.

## 120 Resistance to Arcing Test

120.1 If a material is used in the construction of the face of a receptacle in a way that the material is likely to be exposed to arcing while in service, the devices that were subjected to 50 cycles of operation in the overload test described in Overload Test, Section 117, shall perform acceptably when subjected to an additional 200 cycles of operation under the overload-test conditions following the temperature test and the repetition (if required – see 116.2) of the retention-of-plugs and gripping tests. There shall not be any indication of electrical tracking, formation of a permanent carbon conductive path or ignition of the material. The attachment plugs used for this test may be changed after every 50 operations.

120.2 Alternatively one set of devices may be subjected to the 50 cycles of operation in the overload test described in Overload Test, Section 117, followed by the temperature test on the devices and then, to determine resistance to arcing, a second, previously untested set of devices may be subjected to 250 cycles of operation under the overload-test conditions.

## 121 Fuseholder Temperature Test

121.1 When tested as described in this section, the temperature rise of a receptacle incorporating a fuseholder shall not exceed the following:

a) 30°C (54°F) on the fuse clips when tested with a dummy fuse;

b) 85°C (153°F) on the fuse clips when tested with a live fuse;

c) 30°C (54°F) at the wiring terminals or cord connections at any time (see 121.7); and

d) The relative thermal index of the surrounding insulating material, minus an assumed ambient of 25°C (77°F), at any time (see 121.7).

121.2 The test is to be conducted on a set of six previously untested devices. The test may be conducted with either a live fuse or a dummy fuse (see 121.6 and 121.7).

*Exception: The test may be conducted in conjunction with the Temperature Test, Section 113, if agreeable to all concerned.*

121.3 The receptacles are to be wired in a series circuit as described in the Temperature Test, Section 113.

121.4 Temperatures are to be measured by means of thermocouples attached to the fuse clips, the insulating material of the device body in proximity to the fuseholder, and the wiring terminals or cord connections.

*Exception: If the wiring terminals or cord connections are not accessible for mounting thermocouples, the thermocouples are to be attached to the blades as close as possible to the face of the device.*

121.5 The test is to continue until stabilized temperatures are attained. A temperature is considered to be stabilized when three consecutive readings, taken at 5-minute intervals, indicate no further rise above the ambient temperature.

121.6 If the test is to be conducted with a live fuse, the devices are to be tested with the largest ampere-rated fuse intended for use with the device installed and subjected to a test current equal to the maximum fuse ampere rating.

121.7 If the test is to be conducted with a dummy fuse, the devices are to be subjected to a test current equal to the maximum ampere rating of the intended fuse. The dummy fuse size for devices incorporating Class CC, G, H, J, K, or R is to be as specified in the Standard for Fuseholders – Part 1: General Requirements, UL 4248-1, the Standard for Fuseholders – Part 4: Class CC, UL 4248-4, the Standard for Fuseholders – Part 5: Class G, UL 4248-5, the Standard for Fuseholders – Part 6: Class H, UL 4248-6, the Standard for Fuseholders – Part 8: Class J, UL 4248-8, the Standard for Fuseholders – Part 9: Class K, UL 4248-9, the Standard for Fuseholders – Part 11: Type C (Edison Base) and Type S Plug Fuse, UL 4248-11, the Standard for Fuseholders – Part 12: Class R, UL 4248-12, and the Standard for Fuseholders – Part 15: Class T, UL 4248-15. The dummy fuse size for devices employing miscellaneous, miniature and micro fuses is to be as indicated in Table 121.1. To represent the heating of a live fuse, 20°C (36°F) is to be added to the recorded temperature rise on the wiring terminals, cord connections, and surrounding insulating materials.

**Table 121.1**
**Nominal dimensions of dummy fuses for miscellaneous, miniature and micro fuses**

| Size of fuse | Dimensions | | |
|---|---|---|---|
| | Outside diameter | Wall thickness | Length |
| 5 x 20 mm<br>(0.2 x 0.8 inches) | 5 mm<br>(0.2 inches) | 1.2 mm<br>(0.047 inches) | 20 mm<br>(0.8 inches) |
| 1/4 x 1-1/4 inches<br>(6.4 x 31.8 mm) | 0.25 inches<br>(6.4 mm) | 0.049 inches<br>(1.2 mm) | 1-1/4 inches<br>(31.8 mm) |

121.8 The thermocouples are to consist of 28 – 32 AWG (0.08 – 0.032 $mm^2$) iron and constantan wires. It is a common practice to employ thermocouples consisting of 30 AWG (0.05 $mm^2$) iron and constantan wires with a potentiometer type of indicating instrument. This equipment will be used if a referee measurement of temperature is necessary.

## 122 Fault Current Test

122.1 When a flush or self-contained receptacle having a 5-15R, 5-20R, 6-15R, or 6-20R configuration is tested as described in this section, the circuit breaker shall operate when the test circuit is closed. The grounding path shall retain its integrity as demonstrated by a continuity check after removing and reinserting the attachment plug.

122.2 Each receptacle is to be tested at rated voltage on a circuit capable of delivering 1000 A rms at 125 V to ground through shorted bus bars. The line and ground terminals of each receptacle are to be wired to the supply terminals using a total of 4 ft (1.22 m) of 12 AWG (3.3 $mm^2$) wire with the receptacle installed in a flush device box with a metal faceplate. A 20 A circuit breaker for branch circuit protection is to be connected between the receptacle line terminal and one supply terminal. The circuit is to be completed by the insertion into the energized receptacle of a standard solid blade grounding-type attachment plug with a 2-ft (0.61-m) length of flexible cord having 14 AWG (2.1 $mm^2$) conductors with the bared ends of the ungrounded and grounding conductors twisted together, soldered, and insulated. Each receptacle is to be tested once. Duplex receptacles are to be tested using one set of contacts for half of the test and the other set of contacts for the remainder of the test.

*Exception: When testing a receptacle intended to be used only on a 15-A branch circuit and so marked, it is to be wired to the test terminals using a total of 4 ft (1.22 $m^2$) of 14 AWG (2.1 $mm^2$) solid copper wire and a 15-A circuit breaker is to be employed.*

## 123 Terminal Strength Test

123.1 A flush or self-contained receptacle having a 5-15R, 5-20R, 6-15R, or 6-20R configuration, when tested as described in this section, shall not exhibit:

a) Damage to the receptacle including but not limited to breakage of the housing, misalignment of contacts, or stripping of the terminal plates or screws;

b) Visible displacement of the wires relative to the terminals following the pull test described in 123.7;

c) Interference with the insertion of a mating attachment plug or its seating against the receptacle face;

d) Forces in excess of 40 lbf (178 N) required to seat a standard gauge against the receptacle face during the conditioning described in 123.3 or during the plug retention and withdrawal evaluations described in 123.8 and 123.9;

e) Displacement of the standard gauge of more than 0.079 inches (2 mm) during the plug retention evaluation described in 123.8; or

f) Inability to release the standard gauge during the plug release evaluation described in 123.9.

123.2 Previously untested receptacles are to be used for this test as follows:

a) Three receptacles if the device employs wire-binding screws alone or in combination with push-in terminals;

b) Three receptacles if the device employs pressure-wire terminals only; or

c) Six receptacles if the device employs wire-binding screws in combination with pressure-wire terminals.

123.3 The contacts of the receptacle are to be subjected to ten conditioning cycles of manual insertion and withdrawal of the standard gauge shown in Figure 111.1. In the case of a duplex receptacle, both sets of contacts are to be conditioned. The gauge is to be assembled with the grounding pin and with the line blades without the holes in the outer ends of the blades. A receptacle rated 20 A with the "T" slot contact is to be subjected to the conditioning cycles with the gauge assembled in the 15 A configuration. If the receptacle is provided with breakoff tabs, one tab is to be removed from one line terminal on each device prior to the conditioning. The receptacle shall comply with 123.1 (a), (c), and (d) upon completion of this conditioning.

123.4 After the receptacle contacts have been conditioned, one line terminal and one neutral terminal on each outlet of a receptacle rated 125 V, or one line terminal on each pole on each outlet of a 250 V receptacle, are to be wired as outlined in Table 123.1 for single receptacles or in Table 123.2 for duplex receptacles.

**Table 123.1**
**Terminal testing configurations single receptacles**

| Terminal type | No. of devices | Terminals to be wired on each device (see 123.4) |
|---|---|---|
| Wire-binding screw (alone or in combination with push-in terminals) | 3 | Two wire-binding screw terminals |
| Pressure-wire terminal only, 1 wire entry per terminal | 3 | Two pressure-wire terminals |
| Pressure-wire terminal only, 2 wire entries per terminal | 1 | Two pressure-wire terminals wired using Configuration No. 1[a] |
| | 1 | Two pressure-wire terminals wired using Configuration No. 2[a] |
| | 1 | Two pressure-wire terminals wired using Configuration No. 3[a] |
| Combination wire-binding screw and pressure-wire terminal, 1 wire entry per terminal | 3 | Two wire-binding screw terminals |
| | 3 | Two pressure-wire terminals |
| Combination wire-binding screw and pressure-wire terminal, 2 wire entries per terminal | 3 | Two wire-binding screw terminals |
| | 1 | Two pressure-wire terminals wired using Configuration No. 1[a] |
| | 1 | Two pressure-wire terminals wired using Configuration No. 2[a] |
| | 1 | Two pressure-wire terminals wired using Configuration No. 3[a] |

[a] The wiring configurations for pressure-wire terminals with two wire entries per terminal are shown in Figure 123.1.

**Table 123.2**
**Terminal testing configurations duplex receptacles**

| Terminal type | No. of devices | Outlet tested | Terminals to be wired on each device (see 123.4) |
|---|---|---|---|
| Wire-binding screw (alone or in combination with push-in terminals) | 3 | Both | Two wire-binding screw terminals |
| Pressure-wire terminal only, 1 wire entry per terminal | 3 | Both | Two pressure-wire terminals |

**Table 123.2 Continued on Next Page**

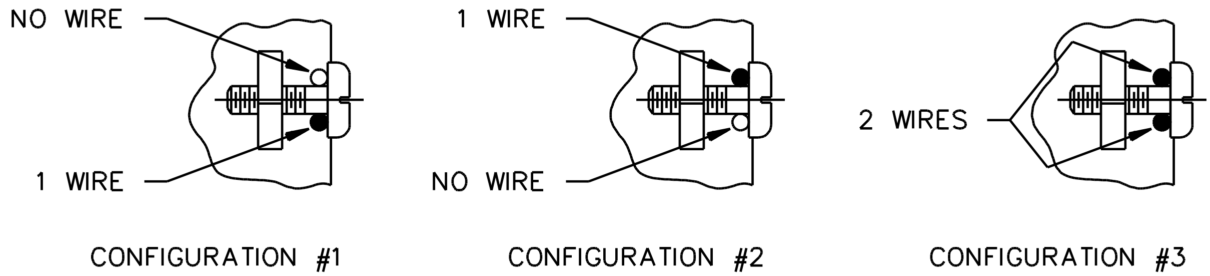
## Table 123.2 Continued

| Terminal type | No. of devices | Outlet tested | Terminals to be wired on each device (see 123.4) |
|---|---|---|---|
| Pressure-wire terminal only, 2 wire entries per terminals | 1 | Both | Two pressure-wire terminals wired using Configuration No. 1[a] |
| | 1 | Both | Two pressure-wire terminals wired using Configuration No. 2[a] |
| | 1 | Both | Two pressure-wire terminals wired using Configuration No. 3[a] |
| Combination wire-binding screw and pressure-wire terminal, | 3 | Upper | Two wire-binding screw terminals |
| 1 wire entry per terminal | | Lower | Two pressure-wire terminals |
| | 3 | Upper | Two pressure-wire terminals |
| | | Lower | Two wire-binding screw terminals |
| Combination wire-binding screw and pressure-wire terminal, | 1 | Upper | Two wire-binding screw terminals |
| 2 wire entries per terminal | | Lower | Two pressure-wire terminals wired using Configuration No. 1[a] |
| | 1 | Upper | Two wire-binding screw terminals |
| | | Lower | Two pressure-wire terminals wired using Configuration No. 2[a] |
| | 1 | Upper | Two wire-binding screw terminals |
| | | Lower | Two pressure-wire terminals wired using Configuration No. 3[a] |
| | 1 | Upper | Two pressure-wire terminals wired using Configuration No. 1[a] |
| | | Lower | Two wire-binding screw terminals |
| | 1 | Upper | Two pressure-wire terminals wired using Configuration No. 2[a] |
| | | Lower | Two wire-binding screw terminals |
| | 1 | Upper | Two pressure-wire terminals wired using Configuration No. 3[a] |
| | | Lower | Two wire-binding screw terminals |

[a] The wiring configurations for pressure-wire terminals with two wire entries per terminal are show in Figure 123.1.

**Figure 123.1**

**Wiring configurations for back-wired terminals**

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123.5 Each terminal is to be wired with 12 AWG (3.3 $mm^2$) solid copper conductor by applying the tightening torque as specified in Table 123.3 to the terminal screw. The wire is to be stripped to the length specified in the manufacturer's installation instructions. Wire-binding screw terminals are to be wired by placing the stripped conductor under the screw head and wrapping it 2/3 – 3/4 turn around the screw. Pressure-wire terminals are to be wired by placing the stripped conductor into the terminal. The conductor is to be seated to follow any wire guides or other openings provided to align the conductor with the back of the receptacle housing. The terminal screw is to be tightened with a clutch-type torque screwdriver which has been calibrated and preset to release at the specified value. The receptacle shall comply with 123.1(a) upon completion of this procedure.

**Table 123.3**
**Terminal screw tightening torque**

| Screw size | Tightening torque pound-inches (N·m) |
|---|---|
| No. 6 or less | 12 (1.4) |
| No. 8 or greater | 14 (1.6) |

123.6 Each termination is then to be disassembled and the assembly and torquing repeated once using newly stripped wire. The receptacle shall comply with 123.1(a) upon completion of this procedure.

123.7 Following the last torquing, each terminal is to be subjected to a straight 20-lbf (89-N) pull applied to each wire for 1 minute perpendicular to the plane of the back cover of the receptacle. The receptacle shall comply with 123.1 (a) and (b) upon completion of this procedure.

123.8 The standard gauge shown in Figure 111.1 assembled without the grounding pin and with the line blades without holes in the outer ends of the blades is then to be inserted into each outlet of the receptacle while measuring the insertion force. A receptacle rated 20 A with the "T" slot contact is to be tested with the gauge assembled in the 15 A configuration. A static 3 lbf (13.3 N) is then to be applied for a period of one minute in a direction perpendicular to the plane of the face of the receptacle that tends to remove the gauge from the outlet. The receptacle shall comply with 123.1 (a), (c), (d), and (e) upon completion of this procedure.

123.9 The standard gauge is then to be reconfigured with the grounding pin and with line blades with holes in the outer ends of the blades and inserted into each outlet of the receptacle. A receptacle rated 20 A with the "T" slot contact is to be tested with the gauge assembled in the 15 A configuration. A static 15 lbf (67 N) is to be applied to the gauge in a direction perpendicular to the plane of the face of the receptacle that tends to remove the gauge from the outlet. The receptacle shall comply with 123.1 (a), (c), (d), and (f) upon completion of this procedure.

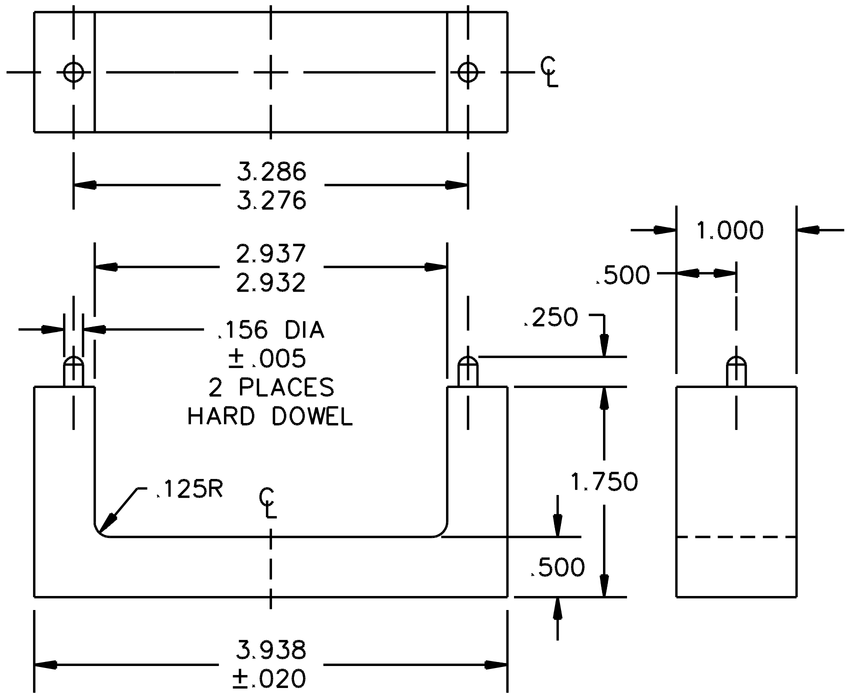
## 124 Assembly Security Test

124.1 A flush receptacle having a 5-15R, 5-20R, 6-15R, or 6-20R configuration is to be mounted in the fixture described in Figure 124.1, and 50 lbf (220 N) is to be applied, as shown in Figure 124.2, for a period of 10 s by means of a push-out tool inserted into the slots of the receptacle. The push-out tool required for configuration 5-15R is to be as shown in Figure 124.3. The tool used for configurations 5-20R, 6-15R, and 6-20R is to have the same design but is to be modified to fit the slots. For a single receptacle, the push-out tool (see Figure 124.3) is to be modified to have a single set of blades.

*Exception: A self-contained receptacle having a 5-15R, 5-20R, 6-15R, or 6-20R configuration shall instead be subjected to the Assembly Security Test, Section 174.*

**Figure 124.1**

**Receptacle test fixture**




SB1276A

| Inches | mm |
|---|---|
| 0.005 | 0.13 |
| 0.020 | 0.51 |
| 0.125 | 3.18 |
| 0.156 | 3.96 |
| 0.250 | 6.35 |
| 0.500 | 12.70 |
| 1.000 | 25.40 |
| 1.750 | 44.45 |
| 2.932 | 74.47 |
| 2.937 | 74.60 |
| 3.276 | 83.21 |
| 3.286 | 83.46 |
| 3.938 | 100.03 |

NOTES

1) Dimensions are in inches.

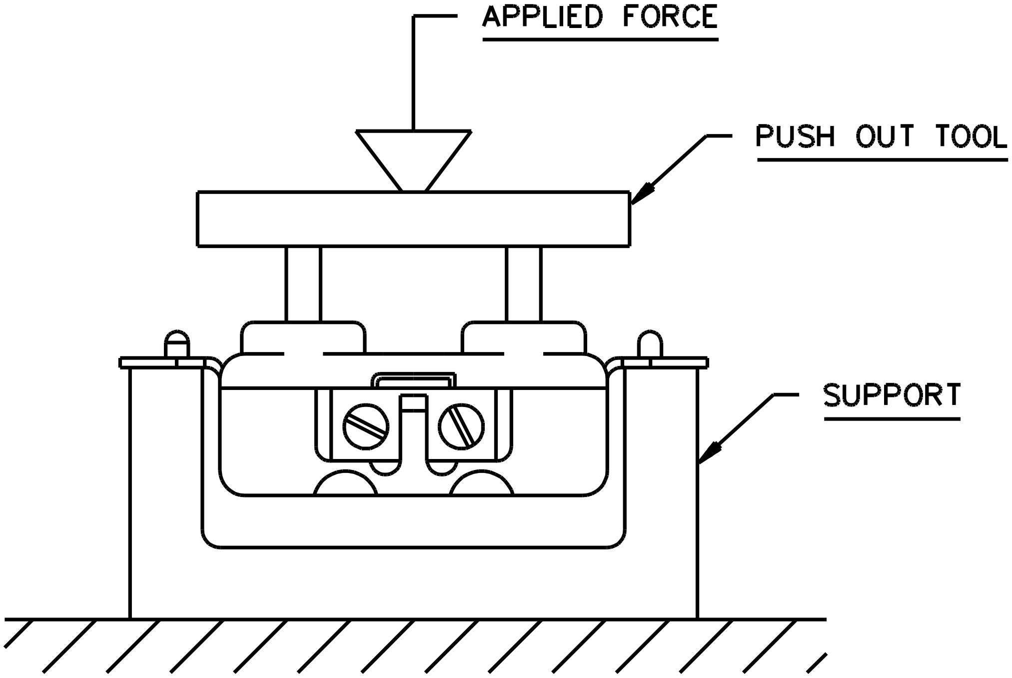
2) Metric equivalents are given in general information only and are based upon 1.00 inch = 25.4 mm.

3) Unless otherwise specified, tolerance is ±0.010 inch (0.25 mm).

4) The fixture shall be of cold rolled steel.

**Figure 124.2**

**Assembly security test method**

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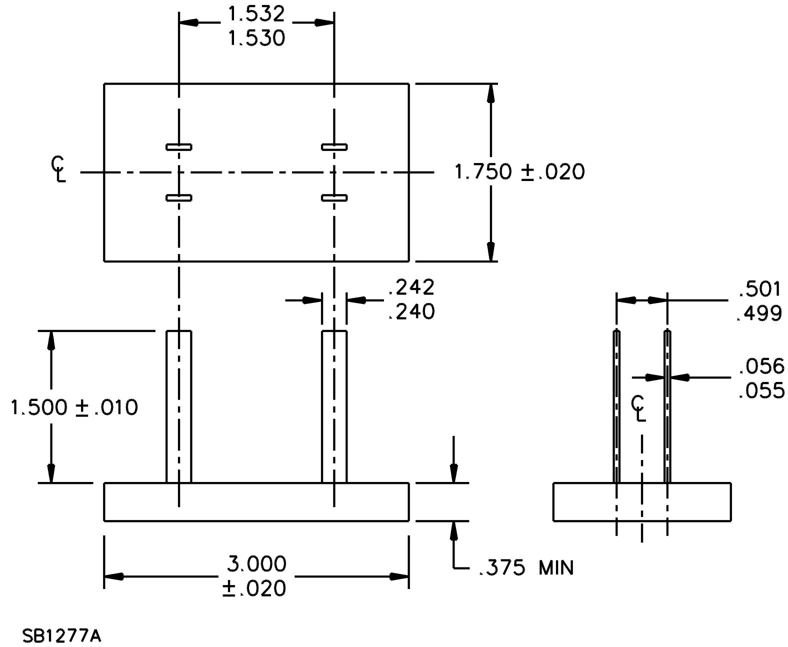
124.2 There shall not be any mechanical breakage of the receptacle that exposes live parts or separation of the face and body by more than 1/16 inch (1.6 mm), measured after removal of the applied force. There shall not be any permanent deformation of the yoke that would render the receptacle incapable of functioning as intended.

124.3 The receptacle is then to be placed in an inverted position in the test fixture and the 50 lbf (220 N) applied, as shown in Figure 124.4, for a period of 10 s by means of a bridge as shown in Figure 124.5. The criteria of 124.2 shall apply.

124.4 The receptacle shall maintain grounding continuity between the grounding terminal and ground pin. An indicating device such as an ohmmeter, a battery-and-buzzer combination, or similar device is to be used to determine compliance. Additionally it shall be capable of retaining without displacement in excess of 0.079 inch (2 mm) for 1 minute after insertion, the fully inserted test pin illustrated in Figure 125.3. For this test, each receptacle is to be placed with its face horizontal so that the downward force exerted by the pin is perpendicular to the plane of the receptacle face and tends to withdraw the pin.

**Figure 124.3**

**Pushout tool**




| Inches | mm |
|---|---|
| 0.010 | 0.25 |
| 0.020 | 0.51 |
| 0.055 | 1.40 |
| 0.056 | 1.42 |
| 0.240 | 6.10 |
| 0.242 | 6.15 |
| 0.375 | 9.52 |
| 0.499 | 12.67 |
| 0.501 | 12.73 |
| 1.500 | 38.10 |
| 1.530 | 38.86 |
| 1.532 | 38.91 |
| 1.750 | 44.45 |
| 3.000 | 76.30 |

NOTES

1) Dimensions are in inches.

2) Metric equivalents are given for general information only and are based upon 1.00 inch = 25.4 mm.

3) Blades to be parallel to each other and perpendicular to the base within 0.006 inch (0.15 mm) T.I.R.

4) Blades are to be fastened to the base in a rigid manner.

5) Sharp edges shall be removed to a maximum radius of 0.015 inch (0.38 mm).

6) The blade shall be of steel having a Rockwell Hardness of C58 to C60. The handle shall be of cold rolled steel.

7) The fixture shall be of cold rolled steel.

8) The 1.532/1.530 inch blade location and orientation is capable of being varied to accommodate the construction of the device under test.

9) The 3 inch dimension of the tool size represents a nominal value and is capable of being varied to suit the device under test.

**Figure 124.4**

**Assembly security test method (inverted)**

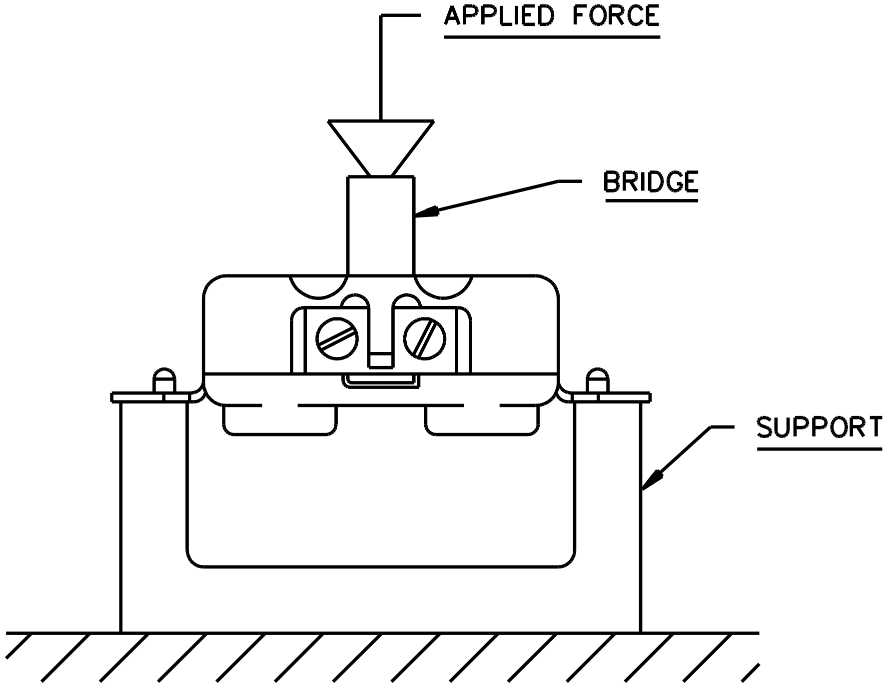



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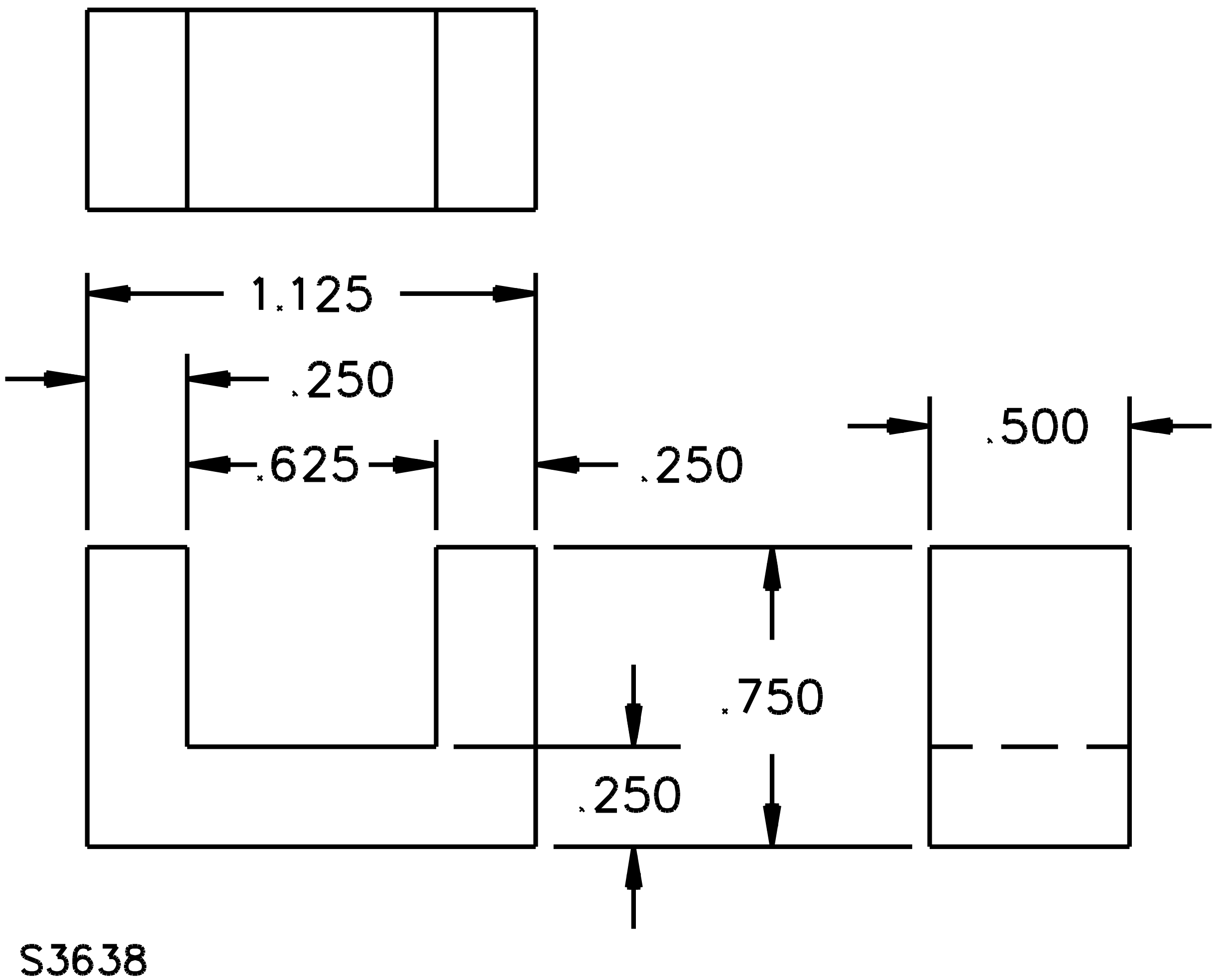
**Figure 124.5**

**Bridge**




| Inches | mm |
|---|---|
| 0.250 | 5.35 |
| 0.500 | 12.70 |
| 0.625 | 15.88 |
| 0.750 | 19.05 |
| 1.125 | 28.58 |

NOTES

1) Dimensions are in inches.

2) Metric equivalents are given for general information only and are based upon 1.00 inch = 25.4 mm.

3) Unless otherwise specified, tolerance is ±0.005 inch (0.13 mm).

4) The 0.625 inch (15.88 mm) is capable of being varied so that the tool clears the strap of the receptacle.

5) The shape of the bridge is capable of being varied to suit the back of the device being tested.

## 125 Grounding Contact Test

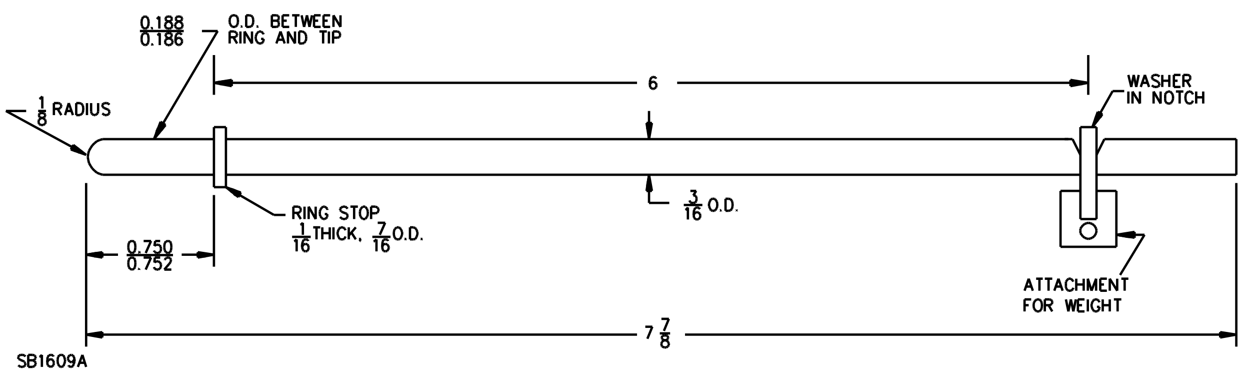
125.1 Grounding receptacles having a 5-15R, 5-20R, 6-15R, 6-20R, 7-15R, 14-15R or 15-15R configuration are to be subjected to the tests in this section.

125.2 Previously untested devices are to be used. Each device is to be mounted in a flush device box, or as otherwise intended, with its face in a vertical plane. A nonmetallic faceplate is to be installed if intended. A solid 14 AWG (2.1 $mm^2$) copper conductor is to be connected to the receptacle grounding terminal.

125.3 With the receptacle oriented to create the maximum contact displacement (possible distortion of contact affecting its contact ability), the test pin A, Figure 125.1 is to be fully inserted in the grounding contact. A 5 lb (2.27 kg) weight is to be gradually suspended form the test pin 6 inches (152 mm) from the face of the receptacle. The weight is to be applied for 1 minute, following which, the weight is to be removed. The application of the weight is to be repeated with the receptacles rotated 90, 180 and 270 degrees for a total of four applications. Usually the test is started with the grounding pin opening directly above, below or on either side of the line slots.

**Figure 125.1**

**Test pin A**




Pin material– tool steel, Rockwell Hardness C58 to C60

| inch | 1/16 | 1/8 | 3/16 | 0.186 | 0.188 | 7/16 | 0.750 | 0.752 | 6 | 7-7/8 |
|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.6 | 3.2 | 4.8 | 4.72 | 4.77 | 11.1 | 19.05 | 19.10 | 152 | 200 |

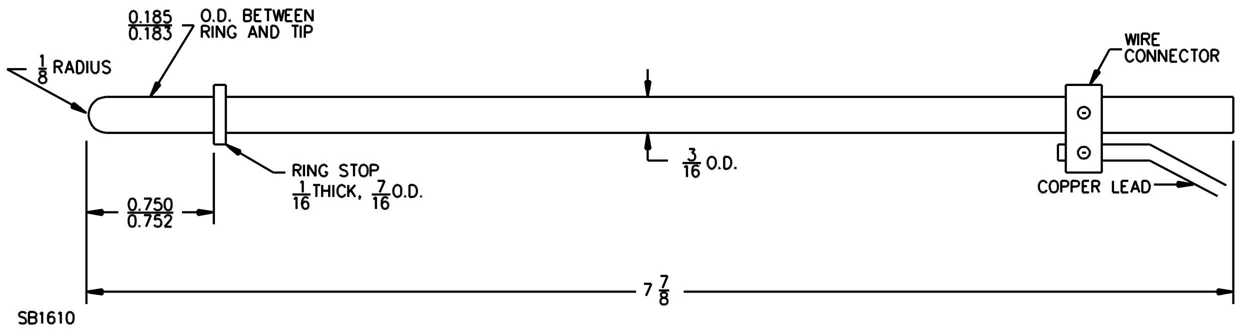
125.4 As a result of the test described in 125.3, there shall not be any breakage of the outlet face of the receptacle that would expose live parts to contact by 1/16 inch (1.6 mm) diameter rod. In addition, there shall not be any breakage or distortion of the insulating body of the receptacle that results in reduction of electrical spacings to values less than those required for the receptacle. The conditioning pin shall remain in place without extraneous support for the required 1 minute in each position.

*Exception: If breakage occurs at the base of the grounding contact opening in a controlled manner so that the breakage is clean and does not expose live parts or break internal barriers, minimal extraneous* *support of the conditioning pin is not prohibited to complete the stress conditioning on the grounding contacts.*

125.5 Each device is then to be tested for electrical continuity between the receptacle grounding contact and the fully inserted test pin B, Figure 125.2. There shall not be a loss of contact while the pin is moved by hand, without exerting undue pressure, so as to touch all internal walls and surfaces. The stop ring of the pin is to remain continuously in contact with the face of the receptacle. An indicating device, such as an ohmmeter, a battery-and-buzzer combination, or other similar device, is to be used.

**Figure 125.2**

**Test pin B**



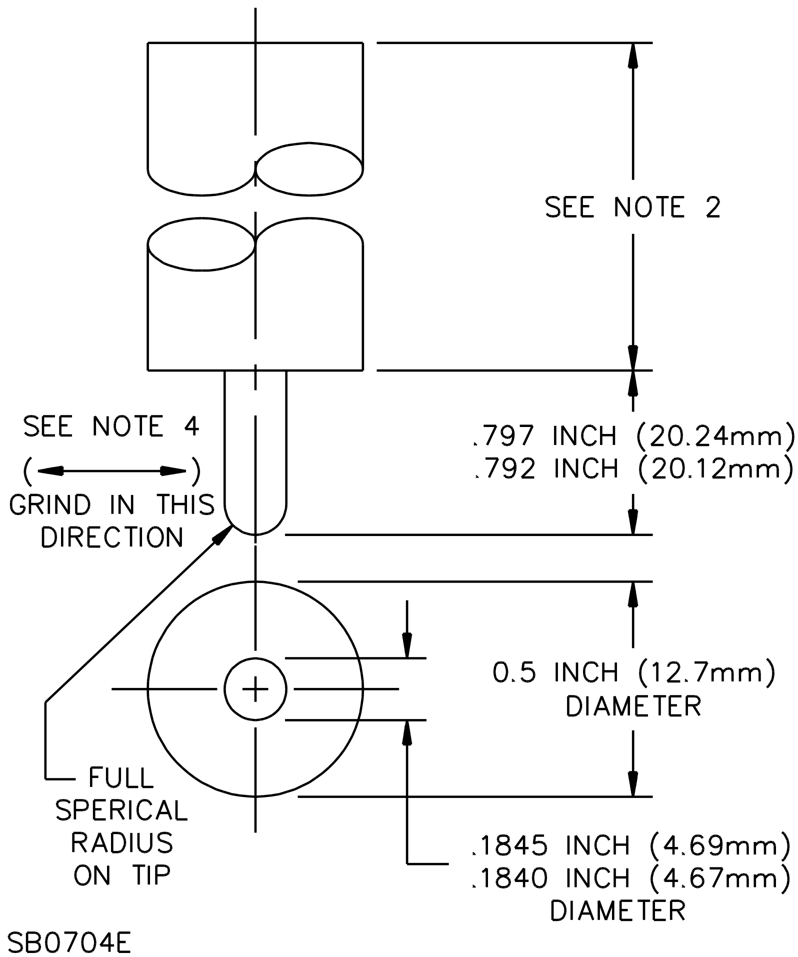

Pin material: Solid Brass Rod

| inch | 1/16 | 1/8 | 3/16 | 0.183 | 0.185 | 7/16 | 0.750 | 0.752 | 7-7/8 |
|---|---|---|---|---|---|---|---|---|---|
| mm | 1.6 | 3.2 | 4.8 | 4.65 | 4.70 | 11.1 | 19.05 | 19.10 | 200 |

125.6 Each device is then to be positioned with the receptacle outlet facing down in a horizontal position. The receptacle shall support the 2 and 4 oz. (57 and 113 g) grounding pin illustrated in Figure 125.3 and Figure 125.4, for 1 minute each when fully inserted in the grounding pin opening.

**Figure 125.3**

**2 oz (57 g) ground pin**




Material: Pin-Steel, Rockwell Hardness C58 to C60.

Handle – cold rolled steel

NOTES

1) The ground pin is to be fastened to handle in rigid manner.

2) Length not specified. Total tool weight 2 oz (57 g).

3) Axis of blade and axis of handle, must have combined concentricity and axial alignment of 0.006 maximum at tip of pin.

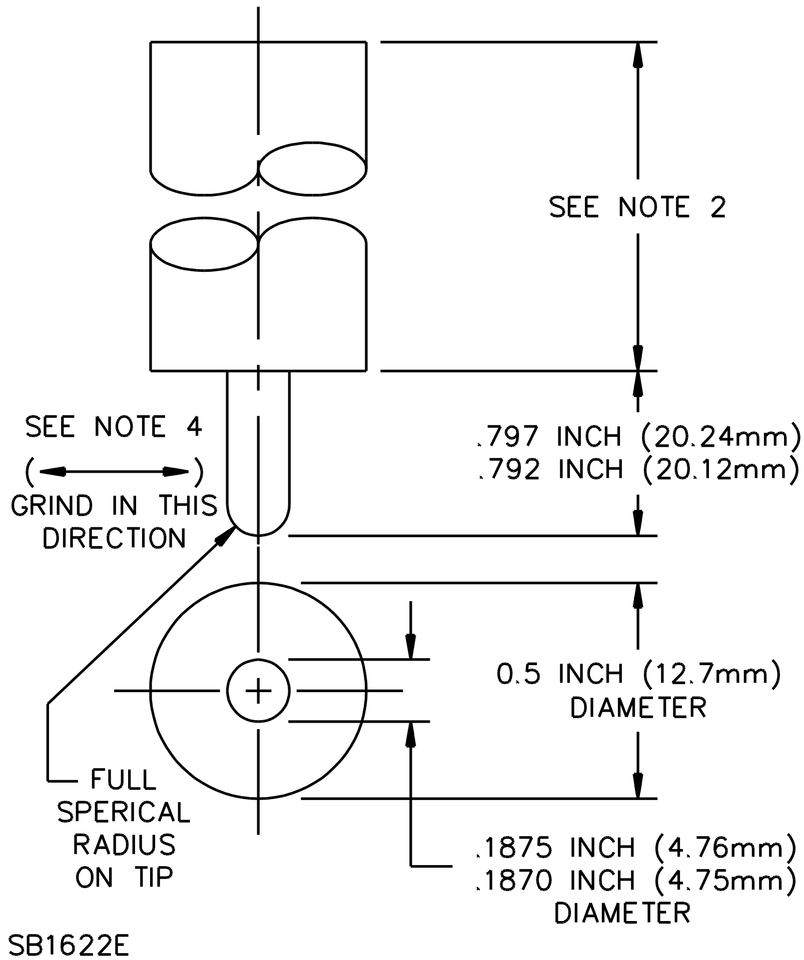
4) The blade surfaces shall not exceed a 32 microinch finish grind in a direction perpendicular to the major axis. Finish is to be determined visually using a comparative method and 10 X optical magnification.

| inch | 0.1840 | 0.1845 | 0.792 | 0.797 | 0.5 |
|---|---|---|---|---|---|
| (mm) | 4.694 | 4.686 | 20.12 | 20.24 | 12.7 |

| microinch | 32 |
|---|---|
| (nanometer) | 813 |

**Figure 125.4**

**4 oz (113 g) ground pin**




Material: Pin-Steel, Rockwell Hardness C58 to C60.

Handle – cold rolled steel

NOTES

1) The ground pin is to be fastened to handle in rigid manner.

2) Length not specified. Total tool weight 4 oz (113 g).

3) Axis of blade and axis of handle, must have combined concentricity and axial alignment of 0.006 maximum at tip of pin.

4) The blade surfaces shall not exceed a 32 microinch finish grind in a direction perpendicular to the major axis. Finish is to be determined visually using a comparative method and 10 X optical magnification.

| inch | 0.1870 | 0.1875 | 0.792 | 0.797 | 0.5 |
|---|---|---|---|---|---|
| (mm) | 4.750 | 4.762 | 20.12 | 20.24 | 12.7 |

| microinch | 32 |
|---|---|
| (nanometer) | 813 |

Pressure-Wire Terminals

## 126 General

126.1 In addition to the requirements in Sections 110 – 125, a receptacle rated 30 A or greater and employing pressure-wire terminals for field connection to both copper and aluminum branch circuit conductors shall comply with the Strength of Insulating Base Test, Section 128, and with the applicable performance requirements in the Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors, UL 486E. The test conductors and currents used in the heat cycling tests in UL 486E shall be selected in accordance with Table 126.1. The copper and aluminum test conductors to be used for all other tests in UL 486E shall be selected in accordance with Table 126.2 and Table 126.3 respectively.

*Exception: The copper test conductors for an AL-CU range and dryer receptacle intended for use with both copper and aluminum conductors rated 75°C (167°F) shall be selected in accordance with Table 126.4.*

**Table 126.1**
**Heat cycling test parameters**

| Device rating, A | Aluminum test conductor size, AWG | Heat cycling test current, A |
|---|---|---|
| 30 | 8 | 45 |
| 50 | 6 | 85 |
| 60 | 4 | 105 |
| 100 | 1 | 175 |
| 200 | 250 kCmil | 350 |

**Table 126.2**
**Copper test conductor sizes**

| Device Rating, A | Conductor size, AWG |
|---|---|
| 15 | 14 stranded |
| | 14 solid |
| | 12 stranded |
| | 12 solid |
| 20 | 12 stranded |
| | 12 solid |
| 30 | 10 stranded |
| | 10 solid |
| 50 | 6 stranded |
| 60 | 4 stranded |
| 100 | 1 stranded |
| 200 | 3/0 stranded |

**Table 126.3**
**Aluminum test conductors sizes**

| Device rating, A | Conductor size, AWG |
|---|---|
| 30 | 10 stranded<br>10 solid<br>8 stranded |
| 50 | 6 stranded<br>4 stranded |
| 60 | 4 stranded<br>3 stranded |
| 100 | 1 stranded<br>1/0 stranded |
| 200 | 250 kCmil stranded |

**Table 126.4**
**Copper test conductors for AL/CU receptacles identified for use on 75°C (167°F) wire**

| Device rating, A | Conductor size, AWG |
|---|---|
| 30 | 10 stranded<br>10 solid |
| 50 | 8 stranded<br>6 stranded |
| 60 | 6 stranded<br>4 stranded |

126.2 In addition to the requirements in Sections 110 – 125, the following types of receptacles shall comply with the Strength of Insulating Base Test, Section 128, and with the applicable performance requirements in the Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors, UL 486E:

a) A receptacle rated less than 30 A and employing setscrew-type pressure-wire terminals for field connection to copper branch circuit conductors only.

b) A receptacle rated 35 A or more and employing setscrew- or clamp-type pressure-wire terminals for field connection to copper branch circuit conductors only.

The copper test conductors to be used in these tests shall be selected in accordance with Table 126.2.

126.3 A receptacle less than 30 A and employing clamp-type pressure-wire terminals intended for use on copper branch circuit conductors only shall comply with the general requirements for receptacles contained in Sections 110 – 125, only.

## 127 Combination Wire Binding/Pressure Wire-Type Terminals

127.1 In addition to the requirements in Sections 110 – 125, a receptacle rated less than 20 A and also employing a combination wire binding/pressure wire-type terminal for field connection to copper branch circuit conductors shall comply with the Strength of Insulating Base Test, Section 128, and with the applicable performance requirements in the Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors, UL 486E.

127.2 The copper test conductors to be used in these tests shall be selected in accordance with Table 127.1.

**Table 127.1**
**Copper test conductor sizes**

| Device rating, A | Conductor size, AWG |
|---|---|
| 15 | 14 solid 14 stranded 12 solid 12 stranded |
| 20 | 12 solid 12 stranded 10 solid10 stranded |

## 128 Strength of Insulating Base Test

128.1 A receptacle employing pressure-wire terminals for field connection to branch circuit conductors shall not be damaged when 110 percent of the specified terminal tightening torque is applied to the wire securing means of the pressure-wire terminal which secures the maximum intended size conductor.

128.2 Damage is considered to have occurred if any cracking, bending, breakage or displacement of the insulating base, current-carrying parts, assembly parts, or device enclosure reduces electrical spacings to less than those required, exposes live parts, or otherwise impairs the intended secure installation and use of the device.

128.3 The terminal tightening torque to be used for this test is to be that assigned by the manufacturer in accordance with 12.4.3 and marked in accordance with Reference No. 18 of Table 193.4.

## 128A Spring Action Clamp Terminal Pull Test

128A.1 A receptacle employing spring action clamp terminals shall be subjected to the test conditions as specified in 128A.2 – 128A.6.

128A.2 Upon completion of this test, there shall not be any damage to the terminal or its securement mechanism. The spring action clamp shall remain capable of functioning as intended. There shall not be any damage, arcing or dielectric breakdown during application of the test potential. The conductor shall not pull free from the terminal during application of the test force.

128A.3 Each terminal of each device (three terminals minimum) shall be tested. Each terminal shall be wired with the smallest AWG conductor size and wired with the largest conductor size, as specified by the manufacturer. If the spring action clamp is also intended for both solid and stranded AWG conductors, both solid and stranded shall be tested.

128A.4 The conductor insulation shall be prepared by removing the insulation from the conductor according to manufacturer’s strip gauge and then inserted into the spring action clamp terminal as intended. The lever of the spring action clamp shall then be operated to the fully latched and locked position and back to the unlatched and unlocked position. This sequence of operation shall be repeated for a total of 100 cycles.

128A.5 Following the 100 cycles, the conductor shall be reattached to the spring action clamp terminal and the lever place in the latched position as intended. A static pull force as specified in Table 128A.1 shall be applied to the conductor for 1 minute in a direction perpendicular to the plane of the receptacle body, tending to remove the conductor.

**Table 128A.1**
**Test values for spring action clamp terminal pull test**

| Size of conductor<br>AWG | Pullout force<br>lbf (pounds) |
|---|---|
| 16 | 9 |
| 14 | 11.5 |
| 12 | 13.5 |
| 10 | 18.0 |
| 8 | 20.5 |
| 6 | 21 |
| 4 | 30 |

128A.6 Each device is then to be subjected to a 50 - 60 Hz essentially sinusoidal potential equal to twice the rated voltage plus 1000 V applied between live parts of opposite polarity and between live parts and grounding or dead metal parts. The test voltage is to be increased at a uniform rate and as rapidly as is consistent with its value being correctly indicated by a voltmeter, and maintained at the test potential for 1 minute.

Self-Grounding Receptacles

## 129 General

129.1 In addition to the general performance requirements for receptacles, a self-grounding receptacle shall comply with the requirements in Section 130.

## 130 Fault Current Test

130.1 When tested as described in this section, the cotton surrounding the mounting screw and the self-grounding device shall not ignite. Electrical continuity between the mounting yoke and the metal test outlet box shall be maintained. The circuit breaker shall operate as a result of this test.

*Exception: This test is not required for isolated-ground receptacles or receptacles rated more than 150 V to ground that are provided with devices intended solely to bond a metal flush plate to the metal test outlet box. Such devices are not intended for use in lieu of the bonding jumper required by the National Electrical Code, ANSI/NFPA 70.*

130.2 When the receptacle is provided with a self-grounding device on each end of the yoke, each self-grounding device is to be evaluated separately.

130.3 Each of six previously untested receptacles is to be conditioned by completely removing the mounting screw from the self-grounding device and mounting yoke and replacing it three times. The mounting screw is to be removed by exerting a straight pull (not by rotating the screw) using a pair of pliers or other tool and reinserted by exerting a straight push. When mounting screws are not provided, steel flat-headed No. 6-32 mounting screws are to be used.

130.4 Each receptacle is to be tightly installed in a metal test outlet box using the mounting screws provided with the receptacles or steel flat-headed No. 6-32 mounting screws when mounting screws are not provided. Each receptacle is then to be removed from the outlet box and replaced three times without removing the mounting screws from the mounting yoke or self-grounding device. The installations and removals are to be made using a screwdriver or other tool and engaging the screw threads in the mounting hole and self-grounding device in the intended manner.

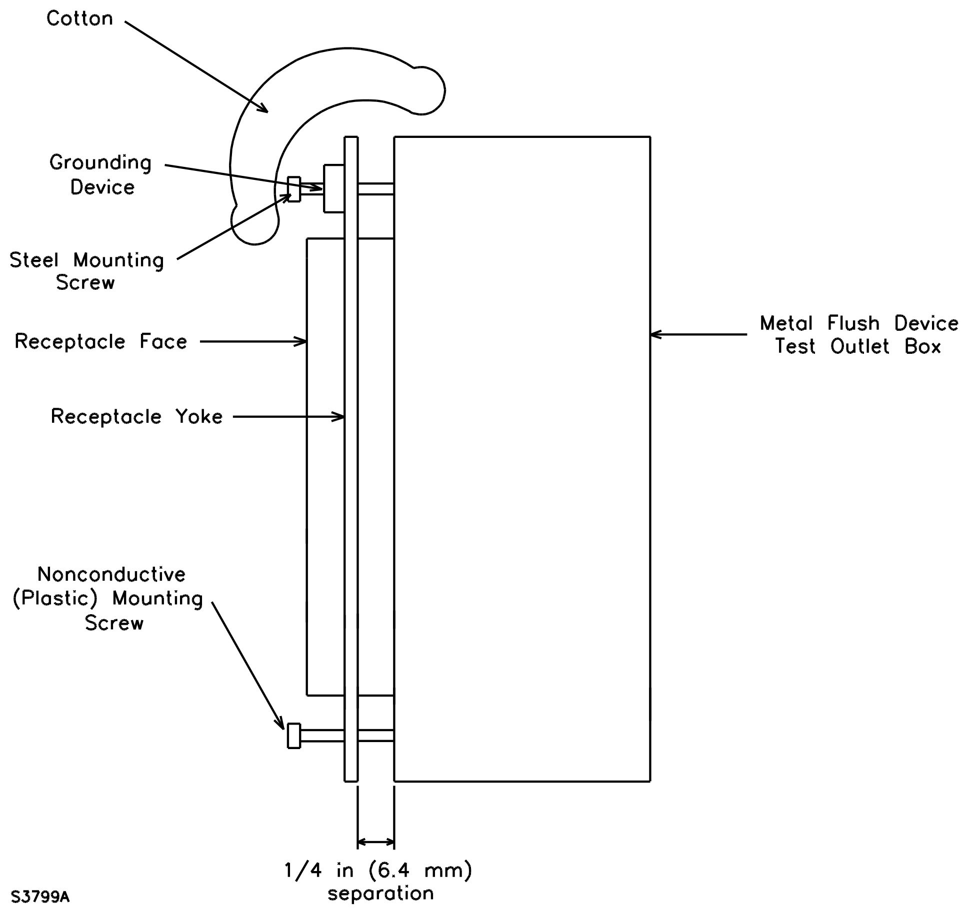
130.5 Each receptacle is then to be removed from the outlet box. A 4 foot (1.22 m) length of copper wire sized in accordance with Table 130.1 is to be connected to the grounding terminal of the receptacle and a second 4 foot (1.22 m) length is to be connected to the grounding terminal of the outlet box. Each receptacle is then to be installed in the outlet box as shown in Figure 130.1, so that the mounting yoke and all other grounded parts except the mounting screw passing through the self-grounding device are fully isolated from the outlet box. To isolate the box, the mounting screw passing through the self-grounding device is to be tightened to seat the yoke securely against the outlet box, then backed off until the yoke and the outlet box are separated by 1/4 inch (6.4 mm). The mounting screw and self-grounding device are to be loosely covered with cotton. The other end of the yoke is to be secured to the outlet box by a plastic mounting screw.

**Table 130.1**
**Grounding conductor sizes**

| Receptacle rating, A | Grounding conductor size, AWG ($mm^{2)}$ |
|---|---|
| 15 | 14 (2.1) |
| 20 | 12 (3.3) |
| 30 | 10 (5.3) |

**Figure 130.1**

**Fault current assembly**




NOTES

1) The test outlet box dimensions may vary to fit receptacle under test.

2) The test outlet box shall be either an outlet box that complies with the Standard for Metallic Outlet Boxes, UL 514A, or a test fixture made of sheet metal other than aluminum, not less than 0.0625 inch (1.59 mm) and shall employ threaded screwholes for No. 6-32 screws with a minimum of 2 full threads in the metal.

130.6 The free ends of the conductors are to be connected to a source capable of delivering a test current of 1000 A at the receptacle's rated voltage to ground with a power factor of 75 to 80 percent. A circuit breaker intended for branch circuit protection of the same rating as the receptacle under test but not less than 20 A is to be installed in series with the conductor connected to the outlet box.

130.7 After subjecting each receptacle to one application of the test current, the cotton is to be examined for ignition. Electrical continuity between the self-grounding device and the outlet box is to be checked using an ohmmeter, battery-and-buzzer combination, or other similar indicating device.

Push-In Terminals

## 131 General

131.1 In addition to the general requirements for receptacles, receptacles employing push-in terminals shall comply with the requirements in Sections 132 – 137.

131.2 Tests with receptacles that contain wire release mechanisms that activate more than one wire opening at a time, are to be tested with all single and multiple intended conductor combinations.

## 132 Pullout Test

132.1 A push-in (screwless) terminal for a factory-wired device for use with both solid and stranded conductors is to be tested as described in this Section and in Temperature Test, Section 133, using both solid and stranded conductors. Tests with stranded conductors are to include separate conductors for the maximum and minimum numbers of strands available in the wire sizes intended for use with the terminal in accordance with the manufacturer's instructions.

132.2 When tested with stranded conductors, all strands of the conductor must enter the terminal gripping area as intended without exposure of stray strands or reduction of required spacings.

132.3 A push-in (screwless) terminal shall withstand without pullout or breakage of the conductor, or of any strand of the conductor, the application of a straight pull for 1 minute as described in 132.4.

132.4 Six conductors of the intended size, either solid or stranded are to be connected to the terminals in accordance with the manufacturer's instructions. If both solid and stranded conductors are to be used, six of each type are to be tested. Each assembly is to be subjected to a pull on the wire that is to be gradually increased to 5 lbf (22 N).

## 133 Temperature Test

133.1 A push-in (screwless) terminal, for a factory-wired device, when tested as described in this Section, shall be capable of functioning without the temperature rise exceeding 30°C (54°F) based on an ambient temperature of 25°C (77°F).

133.2 For a factory-wired device, the size and type of conductors used are to be in accordance with the manufacturer's instructions. The maximum rated current is to be passed through the assemblies.

133.3 The assemblies described in 133.2 are to be tested for 30 days without interruption. The device temperature is to be measured at the end of each working day.

133.4 The test described in this section may be conducted in conjunction with the Temperature Test described in Section 113.

## 134 Conductor Insertion and Retention Test

134.1 A flush or self-contained receptacle having a 5-15R, 5-20R, 6-15R, or 6-20R configuration and provided with push-in terminals, when tested as outlined in 134.2 – 134.7 shall be capable of being wired properly without:

a) Physical damage to the receptacle, including the terminals,

b) Damage to the electrical insulation, or

c) A reduction in spacings.

134.2 For one half of the receptacles, one line terminal and one neutral terminal on a receptacle rated 125 V, or one line terminal on each pole of a 250 V receptacle, are to be tested. On the remaining receptacles, terminals of the same polarity with the break-off tab between them removed to simulate a multiwire branch circuit installation, are to be tested. The receptacles are to be wired following the manufacturer's instructions. The stripped wire is to be inserted into the terminal as far as possible.

134.3 For terminals intended to receive one or more wires under the same spring, the terminals are to be tested in each of the following wiring configurations:

a) One terminal with one wire in one wire entrance hole,

b) One terminal with one wire in the other entrance hole, and

c) One terminal with one wire in each of the two entrance holes, at the same time.

134.4 To determine compliance with 134.1 each tested terminal and wire combination is to be examined after the last wire insertion. The receptacles are to be subjected to a Dielectric Voltage- Withstand Test, as described in Section 65, except that the receptacles are not required to be subjected to the humidity conditioning described in 65.1.2. The test potential of 1000 volts plus twice the rated voltage is to be applied between:

a) Live parts of opposite polarity, and

b) Live parts and dead metal parts.

134.5 Each tested terminal and wire combination shall then withstand the application of a straight pull for 1 minute of the force in 134.6 without:

a) Pullout or breakage of the conductor, or

b) Any reduction in the electrical spacings at wiring terminals or within the device.

134.6 Each tested terminal is to be subjected to a pull on the wire that is to be gradually increased to 20 lbf (89 N) for a general-use device, or 5 lbf (22 N) for a factory-wired device.

134.7 At the completion of the test described in 134.6 there shall not be dielectric breakdown when each terminal is again tested as described in 134.4.

## 135 Conductor Push-In Test

135.1 The same flush and self-contained receptacles having a 5-15R, 5-20R, 6-15R, or 6-20R configuration used for the Conductor Insertion and Retention Test, Section 134, but with the original test wires removed, are to be tested for conductor push-in as described in 135.2, using newly stripped conductors as described in 135.3.

*Exception: For receptacles without a wire release mechanism, previously untested receptacles are to be used.*

135.2 As a result of inserting the test conductors, there shall not be:

a) Interference with the insertion of an attachment plug, or

b) Protruding of the test conductors through the device face or any other openings in the device body, or

c) Contact with grounding or dead metal parts such as the mounting yoke, or

d) Interference with the electrical connection between the contact and the blades or ground pin of a mating attachment plug, or

e) Dielectric breakdown when tested as described in 134.4 and 134.5.

135.3 Previously unused lengths of solid copper wire are to be used. Strip 2 inches of the wire insulation. The bare wire is then to be inserted until the entire length is used or further insertion is not possible. Each terminal of a receptacle is to be tested. A force sufficient to fully insert the wire is to be applied.

## 136 Terminal Abuse Test

136.1 The same flush and self-contained receptacles having a 5-15R, 5-20R, 6-15R, or 6-20R configuration used for the conductor insertion and retention test and the conductor push-in test are to be tested as described in this section. The test conductors used in the previous tests are to be removed from the receptacles using the wire release mechanism.

*Exception: For receptacles without a wire release mechanism, previously untested receptacles are to be used.*

136.2 As a result of the test described in 136.3, there shall not be any breakage or distortion of the insulating body of the receptacle that:

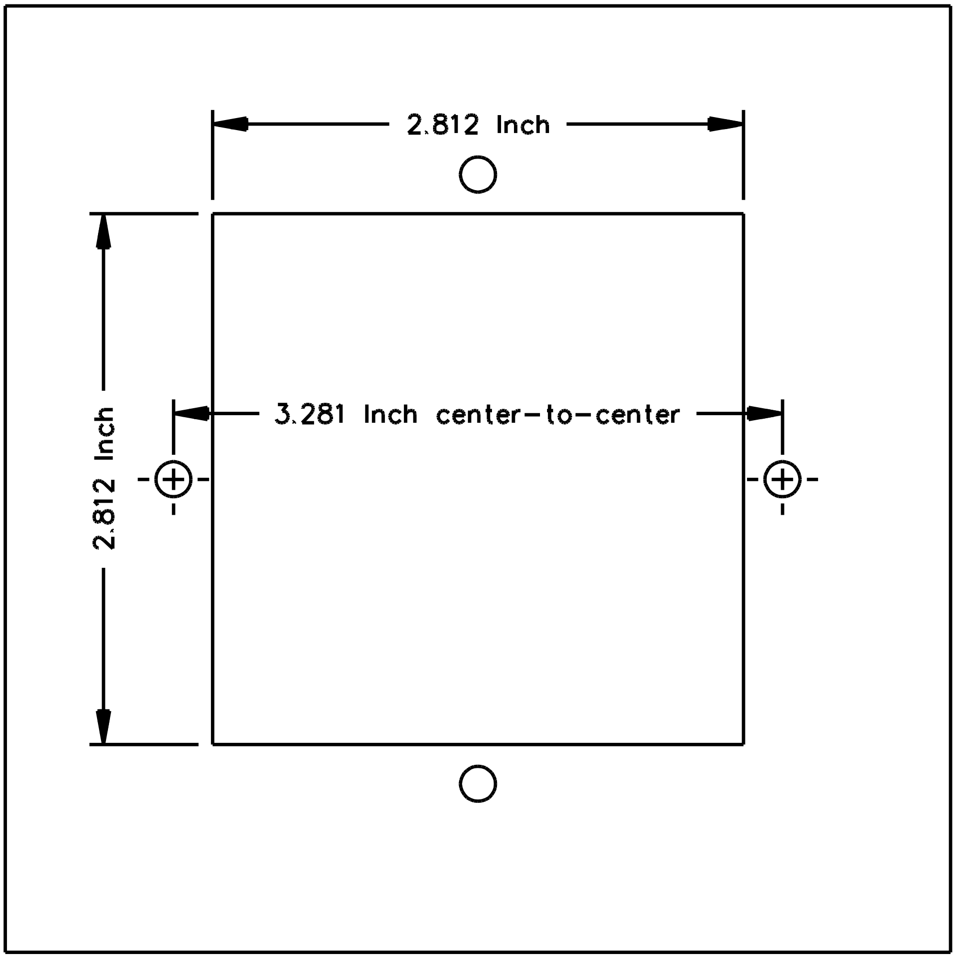
a) Would expose live parts to contact by a 1/32 inch (0.79 mm) diameter rod, or

b) Results in reduction of electrical spacings to values less than those required for the receptacle.

136.3 Each receptacle is to be mounted in the test fixture shown in Figure 136.1 with its face in a vertical plane. The test pin shown in Figure 136.2 is then to be fully inserted into the "Push-In" terminal opening. An 8-ounce (0.23-kg) weight is to be gradually suspended from the test pin 6 inches (152 mm) from the plane of the terminal opening. The weight is to be applied for one minute, following which the weight is to be removed. The application of the weight is to be repeated with the receptacle rotated 90, 180 and 270 degrees for a total of four applications per receptacle.

**Figure 136.1**

**Test fixture**

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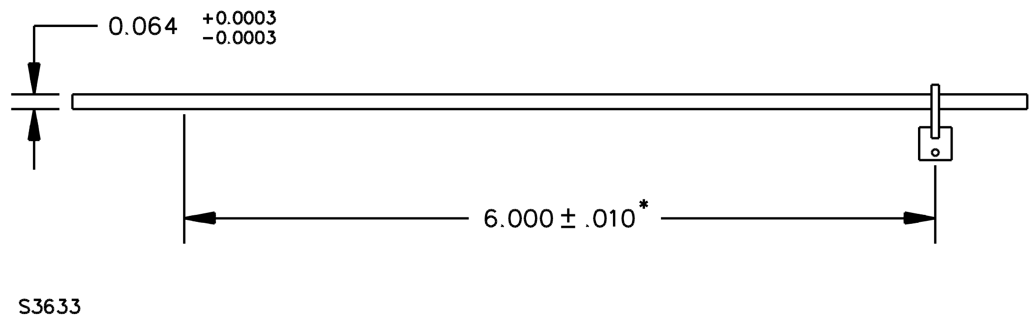
NOTE – Holes are tapped for No.6-32 Device Mounting Screws

**Figure 136.2**

**14 AWG test pin**




*Measured from plane of opening in device

NOTE – Pin material – tool steel, nominal 1/16 drill rod

## 137 Temperature Test

137.1 A push-in terminal of a flush or self-contained receptacle having a 5-15R, 5-20R, 6-15R, or 6-20R configuration shall not have a temperature rise exceeding 30°C (54°F) based on an ambient temperature of 25°C (77°F) for each test described in this section.

137.2 Separate sets of previously unused receptacles are to be assembled with the conductor sizes and types described in Temperature Test, Section 113.

137.3 For terminals intended to receive one or more wires under the same spring, the terminals are to be tested in each of the following wiring configurations:

a) One terminal with one wire in one wire entrance hole,

b) One terminal with one wire in the other entrance hole, and

c) One terminal with one wire in each of the two entrance holes, at the same time.

*Exception: For terminals intended to receive only a single wire under the same spring, only items (a) and (b) need be conducted.*

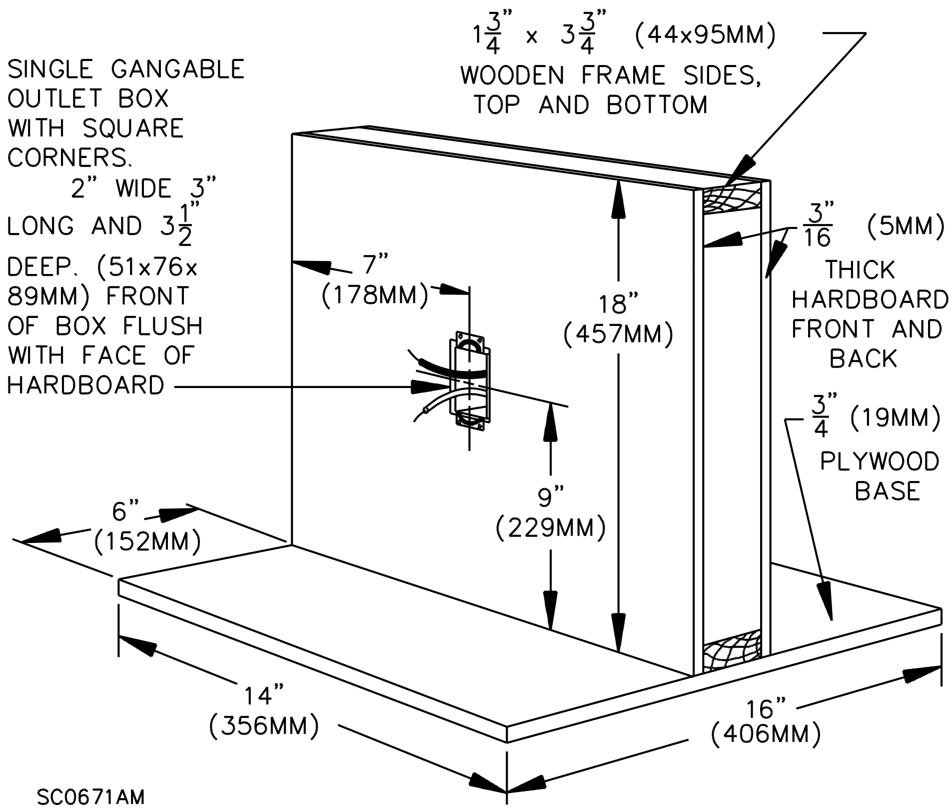
137.4 Each terminal assembly is to be conditioned by inserting and releasing a solid 14 AWG (2.1 mm$^2$) conductor of the type to be used for the temperature test sequence. Four conductors, each approximately 18 – 24 inches (457 – 610 mm) long, are to be used. The conductors are to be installed in a standard single gang outlet box, mounted and located as shown in Figure 137.1, and securely clamped at the rear of the box so that the conductors extend from the box and form pigtail leads, each 6 to 6-1/2 inches (152 – 165 mm) long, measured from the clamp to the ends of the leads. All four pigtail leads are to be inserted in the push-in wiring terminals. After all the pigtail leads have been installed, each, in turn, is to be released and removed, then reinserted in the same terminal, prior to releasing the next pigtail lead, until all four pigtail leads have been released and reinserted. This sequence is to be repeated two additional times using the pigtail leads. The outlet box is not to be used for the fourth wire insertion described in 137.5.

*Exception No. 1: For devices not intended for through-wiring, only two conductors are to be used.*

*Exception No. 2: Receptacles without a wire release mechanism are not to be subjected to the repeated wire insertion and removal conditioning.*

**Figure 137.1**

**Outlet box support fixture**




NOTES

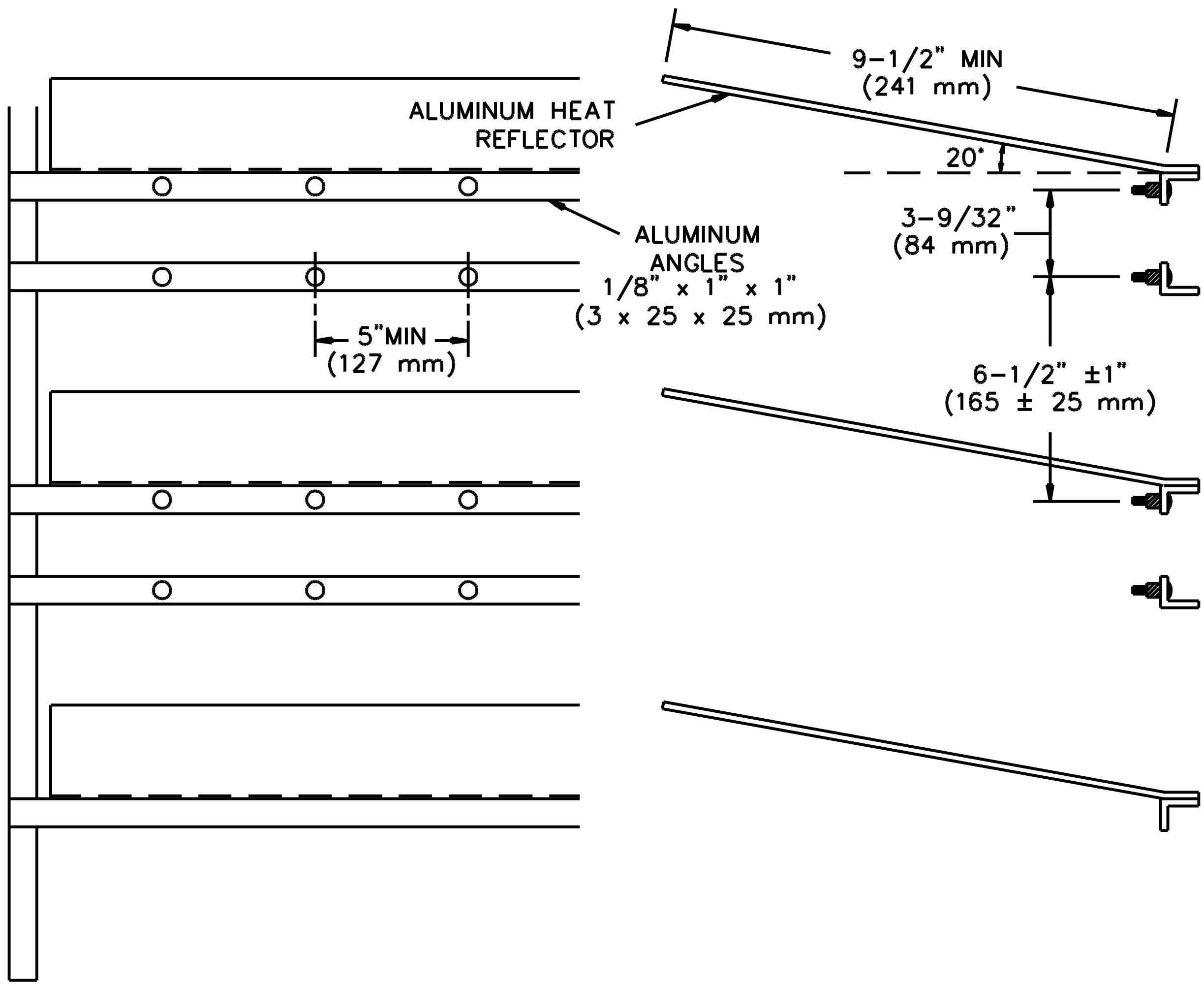
1) All dimensions are approximate.
2) The outlet box shall be securely fastened.
3) The fixture is to be placed on the floor during the test.

137.5 A fourth insertion of a newly-stripped, previously unused length of solid 14 AWG (2.1 $mm^2$) wire is to be made into each terminal and left in place. The length of each wire is to be between 24 – 27 inches (610 – 686 mm). Following the fourth wire insertion and prior to the temperature test sequence, each wire is to be subjected to a 20-lbf (89-N) pull applied in a direction perpendicular to the plane of the wire entry hole for 1 minute between the conductor and the receptacle without pullout or breakage of the conductor.

137.6 Following the pull test described in 137.5, the receptacles are to be mounted to the test frame shown in Figure 137.2 and wired in a series circuit as described in 137.7.

**Figure 137.2**

**Test fixture**

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137.7 The temperature test sequence is to be conducted using the feed-through connections without passing current through the device contacts. The length of the test wire between terminals is to be 24 – 27 inches (610 – 686 mm) and the test wire is to project straight back from the device terminals for 3-1/2 – 4-1/2 inches (89 – 114 mm), at which point the test wire may continue to project straight back or may be formed in vertical coils 1 inch (25 mm) in diameter. The spacing between coils is to be varied to permit connections to terminals.

*Exception: A device without provisions for feed-through wiring, such as a single receptacle with provision for only one wire per terminal, is to be tested using a shorting jumper across the contacts. The shorting jumper is to consist of an attachment plug having solid blades and of the appropriate configuration whose terminals are connected together by the shortest possible length of wire of the same size being used to test the terminals.*

137.8 The temperature test sequence is to consist of:

a) The temperature rise test described in 137.9 and 137.10,

b) The current cycling conditioning described in 137.11,

c) The wire disturbance conditioning described in 137.12, and

d) The temperature rise test repeated again.

Each tested receptacle is to be subjected to the tests in the order described.

137.9 Temperatures are to be measured using thermocouples attached to a bare conductor adjacent to the insulation edge when the conductor is stripped to the maximum recommended length. See 113.7. Temperatures are also to be measured on the break-off tabs, if provided. See 113.9.

137.10 The test current is to be 15 A. The temperature rise test is to continue until thermal stabilization is attained. Thermal stabilization is considered to have occurred when three successive readings, taken at intervals of not less than 10 minutes, show no further increases.

137.11 The current cycling conditioning is to consist of 168 four hour cycles. Each cycle is to consist of 3-1/2 hours with current and 1/2 hour without current. The cycling current is to be 22.5 A.

137.12 Following the heat cycling conditioning, the aluminum heat reflector panels are to be removed and each connected wire is to be subjected to a wire disturbance conditioning. In conducting the wire disturbance conditioning the test wire connected to each device terminal is to be gripped approximately 4 inches (102 mm) from the terminal. The test wire is then to be moved firmly and with a smooth motion downward from the horizontal plane through an arc of approximately 90 degrees so that the wire assumes a vertical orientation. The wire is then to be moved upward so that the wire is returned to the horizontal position. The bending operation is to be repeated, except that the test wire for each set of two receptacles is to be moved in a different direction from the other sets either left, right, up, or down, and then returned to the initial position, so that each connection to the receptacle under test is subjected to two successive applications of a force exerted in one or more directions during manipulation of the test wire. Care is to be exercised so that during the manipulation, pulling or twisting forces are not applied to the wire and adjacent receptacles are not disturbed. The heat reflector panels are to be reinstalled after the wire manipulation has been completed.

Tamper-Resistant Receptacles

## 138 General

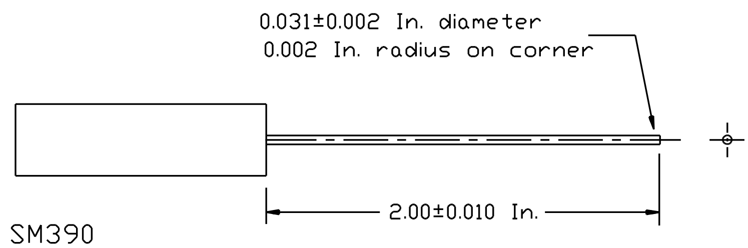
138.1 In addition to the general performance requirements for receptacles, tamper-resistant receptacles shall comply with the requirements in Sections 139 – 142.

## 139 Probe Test

139.1 A tamper-resistant receptacle shall not permit contact to be made between the probes shown in Figure 139.1 and Figure 139.2 and any live part of the receptacle through the outlet slots when tested as described in this section.

**Figure 139.1**

**Small test probe**

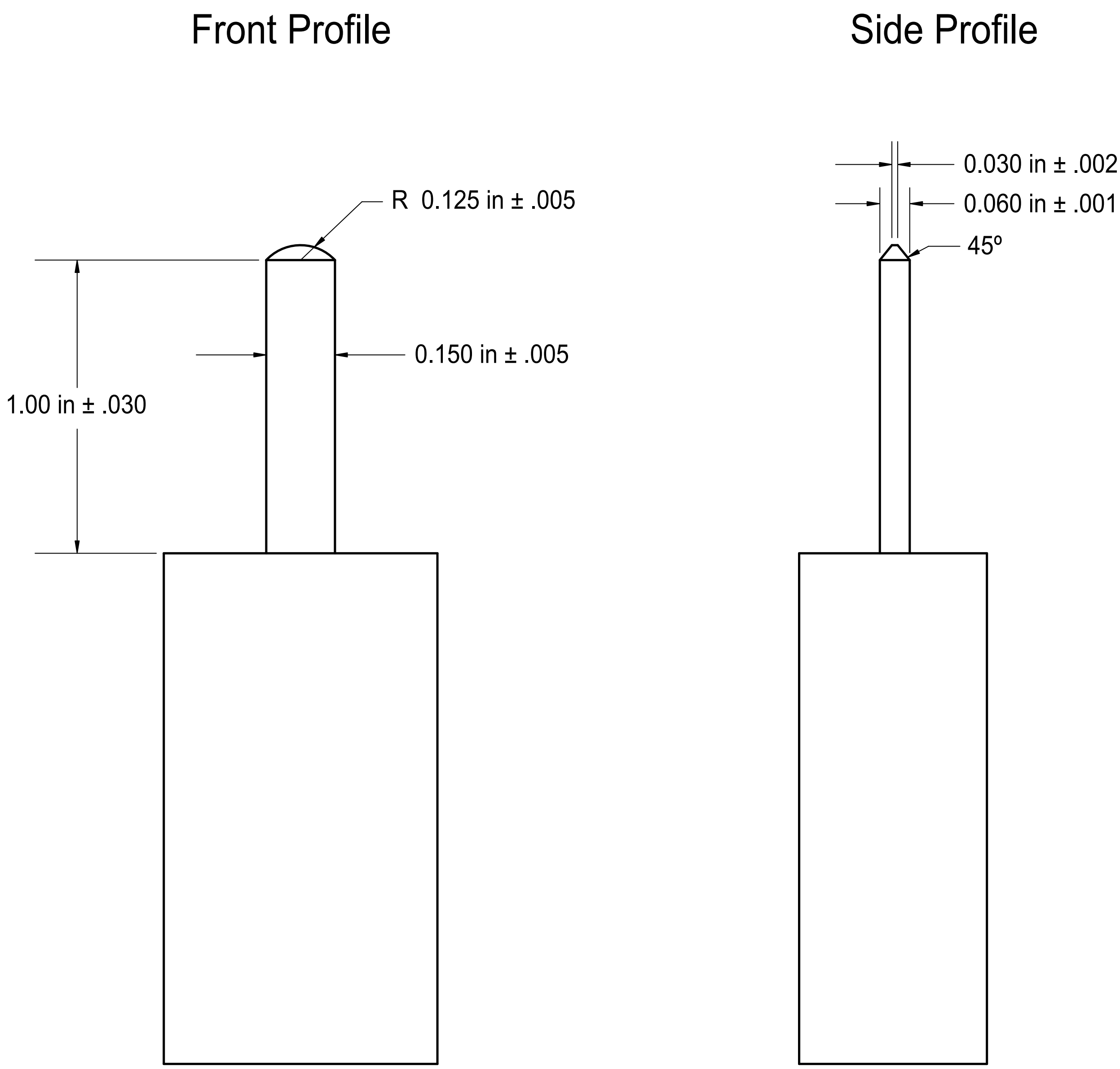



MATERIAL: Tool Steel, Rockwell Hardness C58 to C60

| inch | 0.031 ±0.002 | 2.00 ±0.010 |
| --- | --- | --- |
| mm | 0.787 ±0.051 | 50.8 ±0.25 |

**Figure 139.2**

**Large test probe**

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MATERIAL: Tool Steel, Rockwell Hardness C58 to C60

| inch | 0.030 ±0.002 | 0.060 ±0.001 | 0.125 ±0.005 | 0.150 ±0.005 | 1.00 ±0.030 |
|---|---|---|---|---|---|
| mm | 0.762 ±0.508 | 1.524 ±0.0254 | 3.175 ±0.127 | 3.81 ±0.127 | 25.4 ±0.762 |

139.2 Twelve previously untested devices are to be used for this test. The probe shown in Figure 139.1 is to be applied to each of the outlet slot openings of the receptacle with a force of 8 ounces (2.2 N) in an attempt to bypass the tamper-resistance mechanism. A suitable indicating device (such as an ohmmeter, battery-and-buzzer combination, or the like) is to be connected between the probe and the wiring terminal of the outlet slot being tested to determine whether contact is made. The probe is to be manipulated in the outlet slots in any orientation that may permit access to live parts within the receptacle.

139.3 Twelve devices previously tested in 139.2 are to be used for this test. The probe shown in Figure 139.2 is to be applied to each of the outlet slot openings of the receptacle with a force of 10 pounds (45 N) in an attempt to bypass the tamper-resistance mechanism. A suitable indicating device (such as an ohmmeter, battery-and-buzzer combination, or the like) is to be connected between the probe and the wiring terminal of the outlet slot being tested to determine whether contact is made. The probe is to be inserted in the outlet slots successively in three directions in any orientation that may permit access to live parts within the receptacle. The probe is applied for approximately 5 seconds in each of the three directions. During each application the gauge shall not be moved or rotated and shall be withdrawn when moving from one direction to the next.

## 140 Impact Test

### 140.1 General

140.1.1 A tamper-resistant receptacle shall withstand either the ball-pendulum impact or the vertical-ball impact described in this section without breakage of the receptacle face or tamper-resistance mechanism or any other damage that could increase the risk of fire or electric shock as determined in 140.1.2. The receptacle shall be capable of functioning as intended after completion of the test.

140.1.2 Upon completion of this test, each device shall:

a) Be capable of completely mating with the intended attachment plugs (both grounding and nongrounding types, rated 15 and 20 A, where applicable);

b) Be subjected to a repeated Probe Test described in Section 139;

c) Be subjected to the Dielectric Voltage-Withstand Test described in Section 142; and

d) Not crack the receptacle face or tamper-resistant mechanism area that protrudes through the faceplate such that a 1/32 in (0.8 mm) diameter rod can be inserted through the crack and contact live parts. Additionally, all other receptacle areas with the face plate removed, shall not have any crack that expose live parts or separation of the receptacle face and body halves that a 1/16 in (1.6 mm) rod can be inserted through the crack.

140.1.3 Six devices which were previously subjected to the Probe Test are to be used. One outlet face of each of the six devices is to be subjected to a single impact by a steel sphere, 2 inches (50.8 mm) in diameter, and weighing 1.18 lbs (0.535 kg) by either of the methods specified in 140.2 or 140.3.

140.1.4 In the case of either a pop-up receptacle or pop-out receptacle assembly, three of the six representative devices shall be tested in the extended position and the remaining three devices tested in the retracted position.

### 140.2 Ball-pendulum impact

140.2.1 Each device is to be mounted in a single gangable metallic flush outlet box fastened to a frame as shown in Figure 140.1. A nonmetallic flush device cover plate is to be installed on the receptacle in the intended manner. The frame shown in Figure 140.1 is to be clamped firmly in place or otherwise provided with rigid support to not permit movement during the application of the impact force.

140.2.2 The steel sphere is to be suspended by a cord and swung as a pendulum as shown in Figure 140.2, dropping through a vertical distance of 51 inches (1295 mm) to strike the outlet face surface of the receptacle with an impact of 5.0 ft-lb (6.8 joules). For duplex receptacles, three devices are to be tested using one outlet, and three using the other.

**Figure 140.1**

**Test frame**

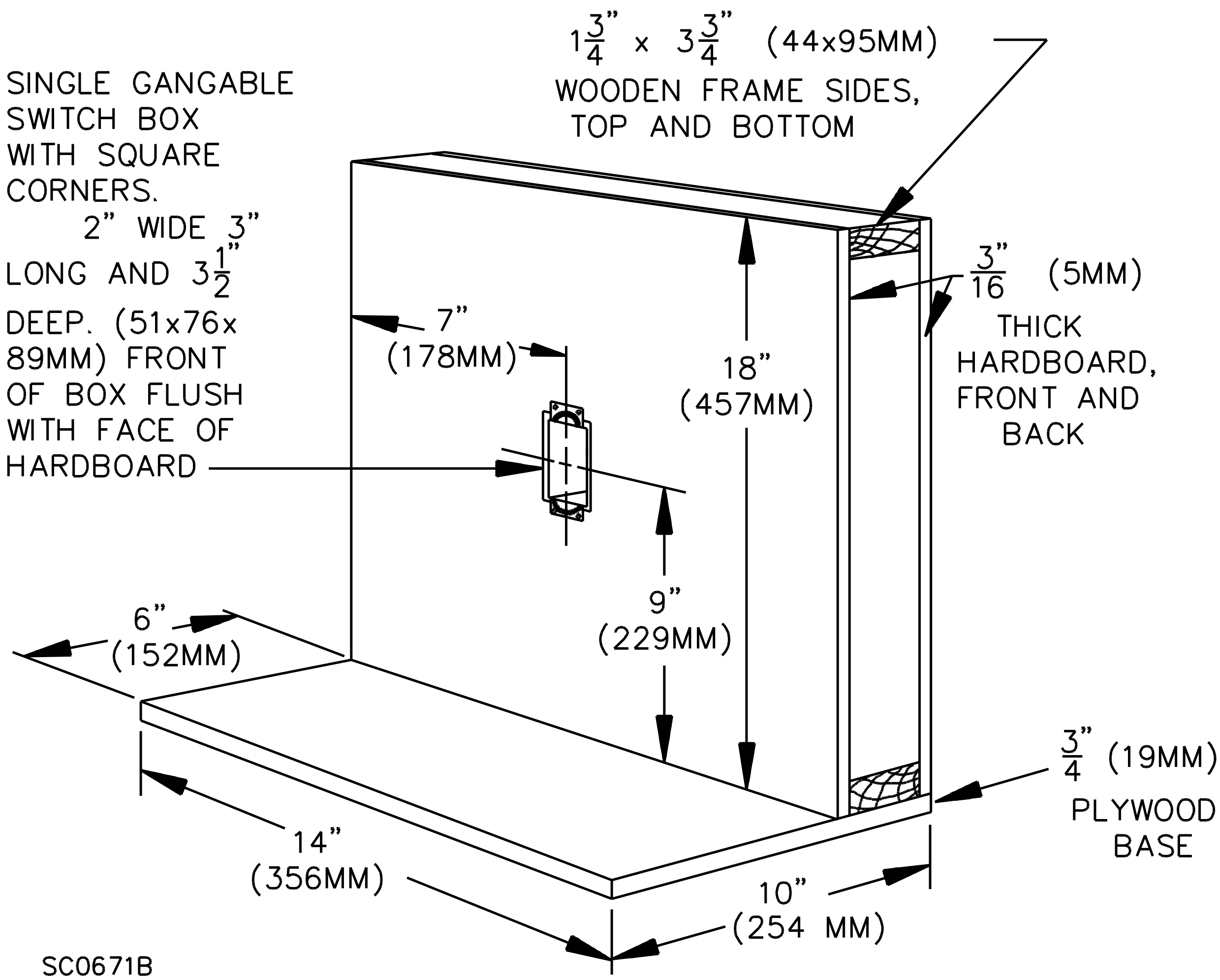
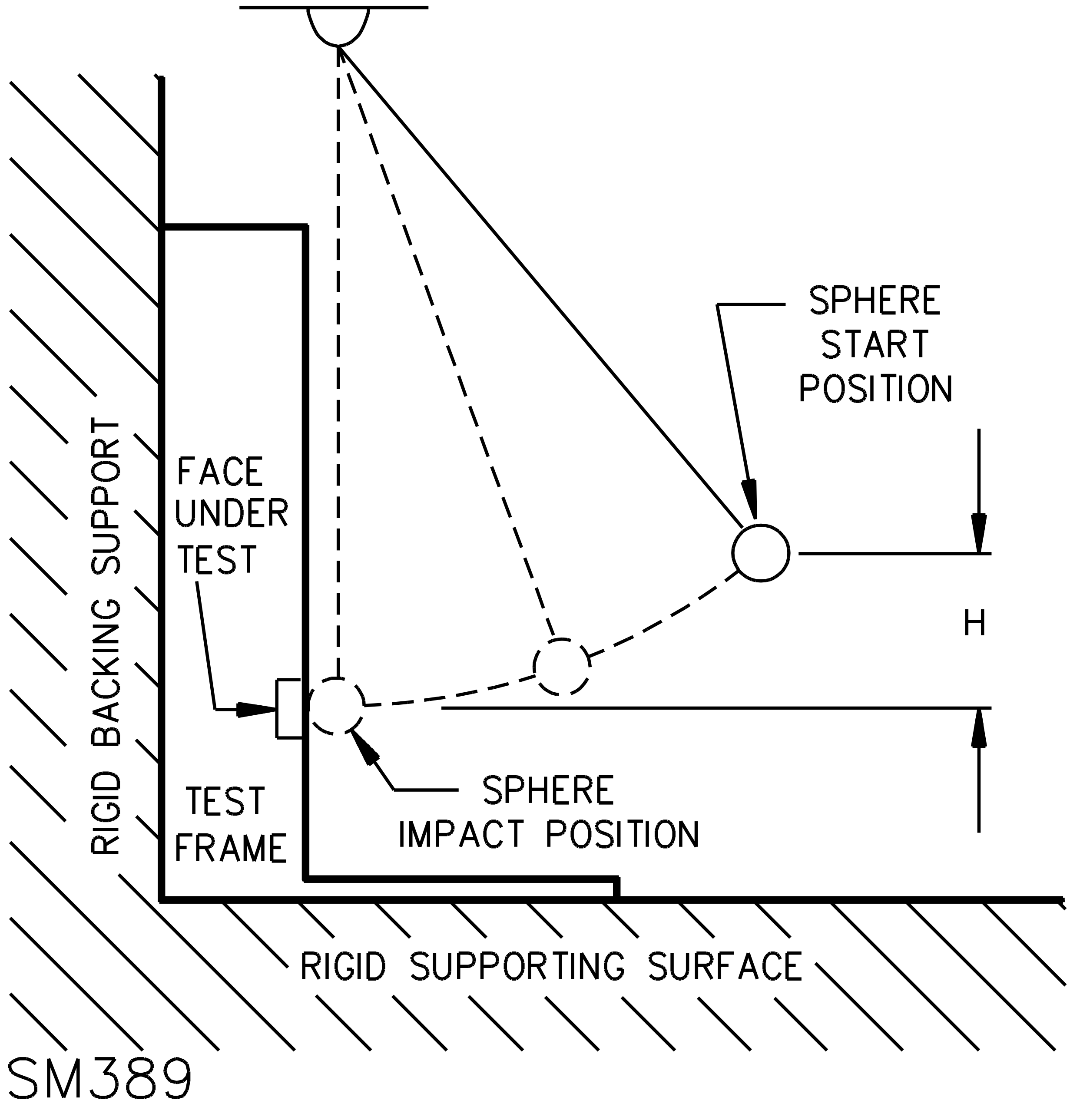


**Figure 140.2**

**Ball-pendulum impact test**




NOTES

1) H indicates a vertical distance of 51 inches (1295 mm).

2) For the ball-pendulum impact test the sphere is to contact the device when the string is in the vertical position as shown.

3) The backing surface is to consist of 3/4-inch (19 mm) plywood over a rigid surface of concrete. An equivalent non-resilient backing surface may be used.

### 140.3 Vertical-ball impact

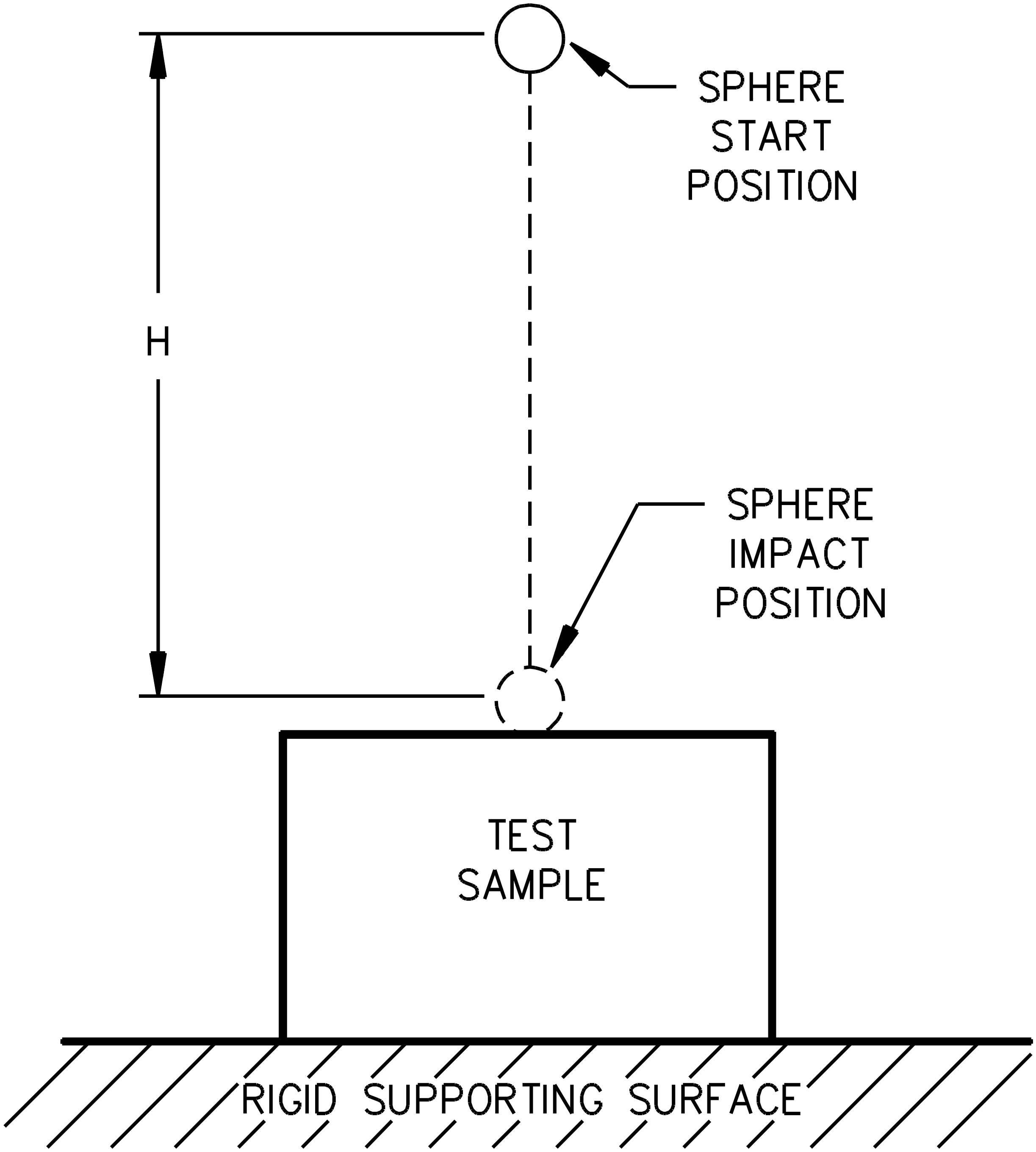
140.3.1 The devices are to be mounted to a cast metal (malleable iron) outlet box and a nonmetallic flush-device cover plate is to be installed on the receptacle in the intended manner. The receptacle, faceplate, and box are to be placed on a steel plate at least 1/2 inch (12.7 mm) thick with the outlet facing upward.

140.3.2 The steel sphere is to be dropped from a height of 51 inches (1295 mm) to impact the center of each receptacle outlet as shown in Figure 140.3. For duplex receptacles, three devices are to be tested using one outlet, and three using the other.

*Exception: For a receptacle that employs a recessed outlet (such as a clock- hanger receptacle) where the steel sphere is unable to impact the outlet slot area an alternative shape consisting of a 1in (25.4 mm) diameter steel rod with a 1 in (25.4 mm) spherical radius on one end as shown in Figure 140.4, delivering an impact of 5.0 ft-lb (6.8 joules) is permitted.*

**Figure 140.3**

**Vertical-ball impact test**

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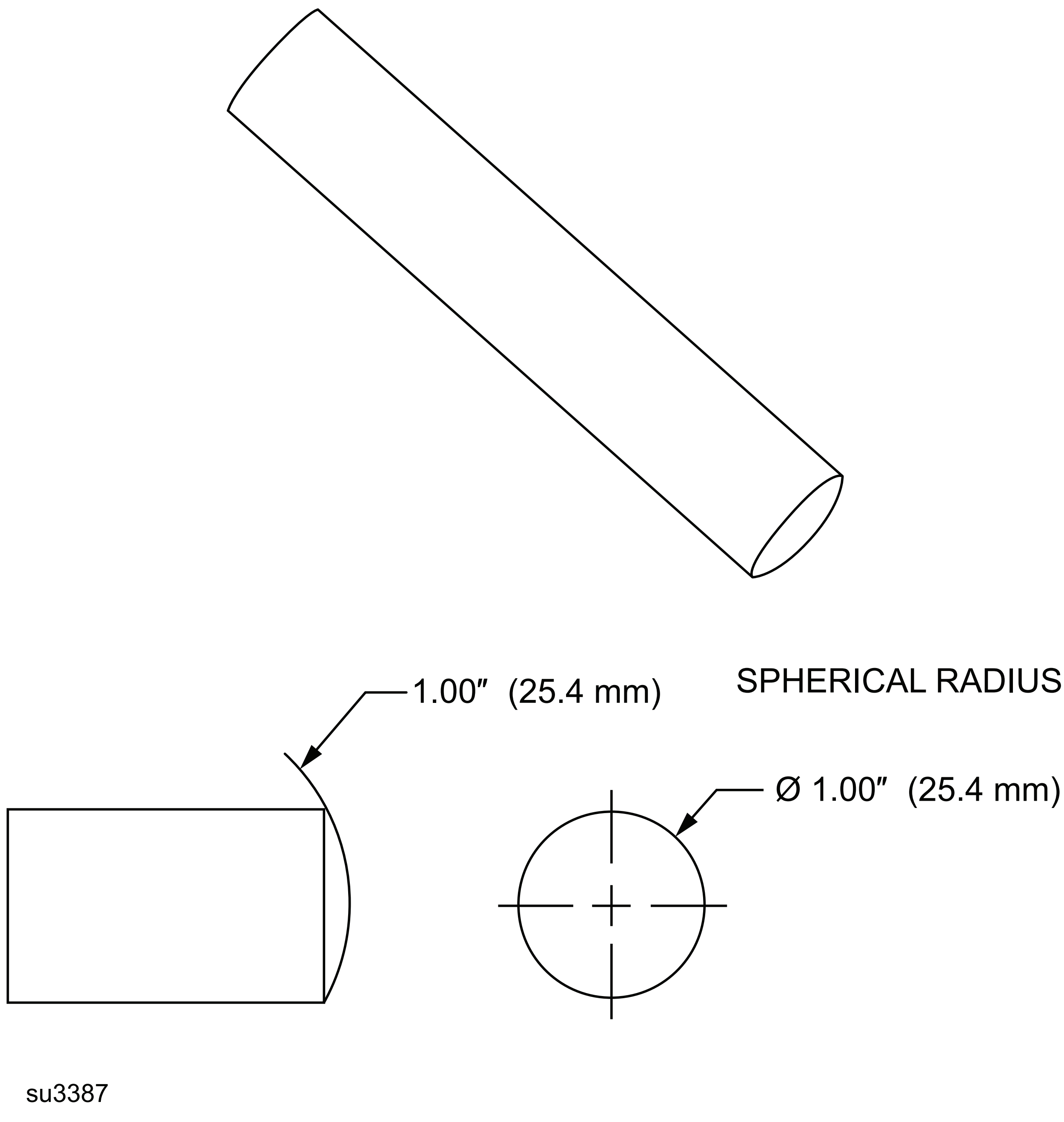
NOTES

1) H indicates a vertical distance of 51 inches (1295 mm).

**Figure 140.4**

**Vertical rod impact test**




NOTES

1) Dimensions are in inches.

2) Metric equivalents are given for general information only and are based upon 1.00 inch = 25.4 mm.

3) Length to suit total tool weight of 1.18 pounds.

4) Radius tolerance ±0.010 inches.

## 141 Mechanical Endurance Test

141.1 At the completion of this test, there shall not be any chipping, breaking or loosening of parts that could adversely affect the functioning of the device as determined in 141.2. The tamper-resistance mechanism shall be capable of performing its intended function.

141.2 Upon completion of this test, each device shall be:

a) Capable of completely mating with the intended attachment plugs (both grounding and nongrounding types, rated 15 and 20 A, where applicable);

b) Subjected to a repeated Probe Test described in Section 139; and

c) Subjected to the Dielectric-Voltage Withstand Test described in Section 142.

141.3 Six devices which were previously subjected to the Probe Test described in Section 139 are to be used. One outlet face of each device is to be tested by inserting and withdrawing 5,000 times an attachment plug having rigidly secured solid brass blades. When an equipment-grounding connection is provided in the device being tested, a grounding-type attachment plug is to be used. For duplex receptacles, three devices are to be tested using one outlet, and three using the other.

141.4 The test is to be conducted by machine. The machine is to withdraw and insert an unrestricted attachment plug with an average velocity of 30 ±3 inches/sec (760 ±75 mm/sec) in each direction during a 2-1/2 inch (64 mm) stroke measured from the full insertion position. The velocity is to be determined without the outlet device installed on the machine to remove restrictions on the plug motion.

141.5 Blades, contacts or tamper-resistance mechanisms are not to be adjusted, lubricated, or otherwise conditioned before or during the test. The attachment plug used for this test may be changed after each 1000 cycles.

## 142 Dielectric Voltage-Withstand Test

142.1 A tamper-resistant receptacle shall withstand without breakdown, for a period of one minute, the application of a 60 Hz essentially sinusoidal potential equal to twice the rated voltage of the receptacle plus 1000 V. The potential is to be applied between live parts of opposite polarity and between live parts and grounded or dead metal parts, including the mounting yoke of the receptacle.

142.2 Six devices which were previously subjected to the Probe and Impact Tests and six devices which were previously subjected to the Probe and Mechanical Endurance Tests are to be used. A mating attachment plug with solid brass blades is to be inserted into the contact openings of three of the six devices. The attachment plug shall be capable of withstanding the application of a 2500 V potential for devices rated 300 V or less and a 3500 V potential for devices rated greater than 300 V. The test potential is to be supplied from a 500 VA or larger capacity testing transformer whose output is essentially sinusoidal and can be varied. The applied potential is to be increased from zero until the required test voltage is reached and is to be held at that voltage for a period of one minute. The increase in the applied potential is to be at a uniform rate and as rapid as is consistent with its value being correctly indicated by a voltmeter.

RECEPTACLE WITH INTEGRAL ADJUSTABLE MOUNTING YOKE

## 143 Bonding (Non-Metallic Outlet Box Fault Current) Test

143.1 When tested as described in this section, the cotton surrounding the receptacle with integral adjustable mounting yoke shall not ignite. Electrical continuity between the cover plate, mounting yoke, or any other dead metal, and the grounding terminal shall be maintained. The circuit breaker shall operate as a result of this test. See 143.9.

143.2 Twelve untested receptacles are to be tested. Six of the twelve are to tested at the maximum adjustment position and six at the minimum adjustment position.

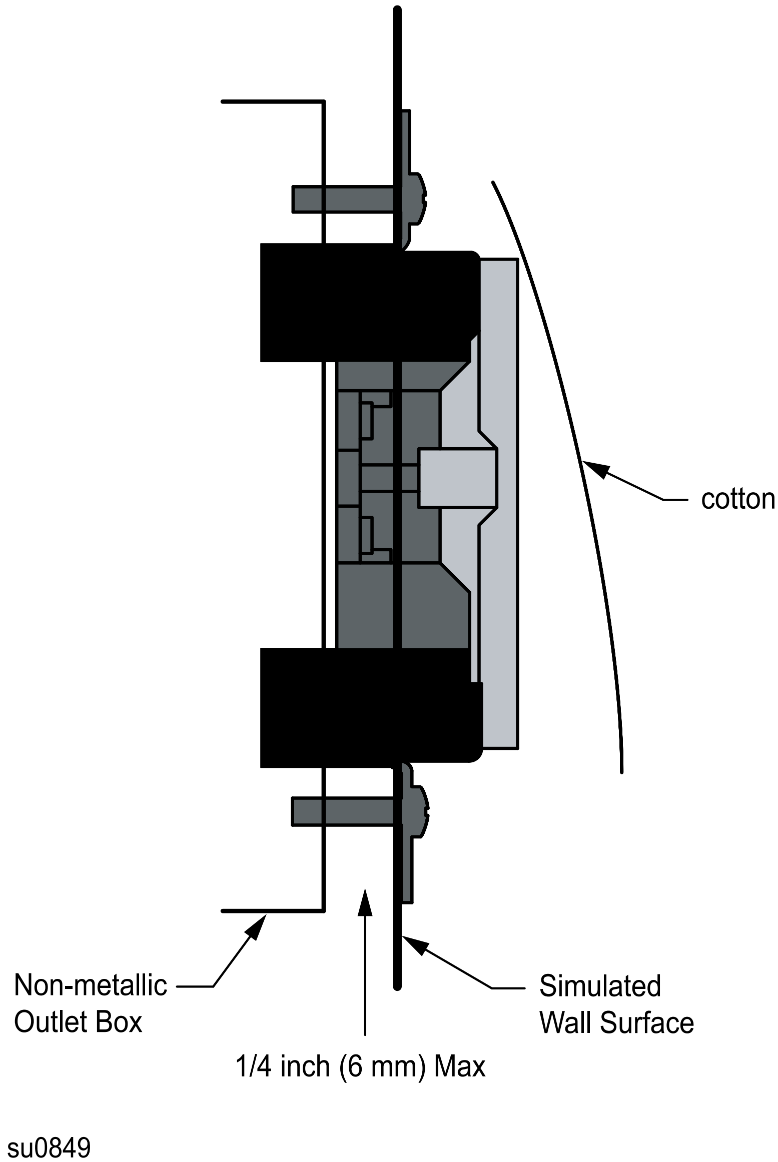
143.3 Each receptacle shall have a 4 foot (1.22 m) length of 12 AWG solid copper wire connected to the grounding terminal of the receptacle.

143.4 Each receptacle shall be mounted to a non-metallic outlet box using the mounting screws provided with the receptacles or steel flat-headed No. 6-32 mounting screws when mounting screws are not provided.

143.5 The non-metallic outlet box shall be secured to a simulated wall surface with the outlet box set back 1/4 inch (6 mm) from the simulated wall surface. See Figure 143.1.

**Figure 143.1**

**Receptacle installation**




NOTES

1) The test outlet box dimensions may vary to fit receptacle under test.

2) For the Bonding (Non-Metallic Outlet Box Fault Current) Test, Section 143, the test outlet box shall be an outlet box that complies with the Standard for Non-metallic Outlet Boxes, Flush-Device Boxes, and covers, UL 514C. For the Bonding (Metallic Outlet Box Fault Current) Test, Section 144, the test outlet box shall be an outlet box that complies with the Standard for Metallic Outlet Boxes, UL 514A.

143.6 The adjustable mounting means shall be adjusted to both the maximum and minimum position ten times.

143.7 Following the tenth cycle of adjustment, a metallic cover plate shall be secured to the receptacle as intended using the cover plate screws provided with the cover plate or steel flat-headed No. 6-32 screws of a suitable length capable of engaging at least two full threads. A 4-foot (1.22-m) length of 12 AWG stranded copper shall be connected to a ring terminal wire connector and secured under the head of a cover plate screw. The complete assembly shall be loosely covered with cotton. For a receptacle that employs a mounting means that is not integrally formed with the grounding terminal, the test shall be repeated where the ring terminal is connected under the head of the mounting screw.

143.8 The free ends of the conductors are to be connected to a source capable of delivering a test current of 1000 A at the receptacle's rated voltage to ground with a power factor of 75 to 80 percent. A circuit breaker intended for branch circuit protection of the same rating as the receptacle under test but not less than 20 A is to be installed in series with the conductor connected to the grounding terminal.

143.9 After subjecting each receptacle to one application of the test current, the cotton is to be examined for ignition. Electrical continuity between the cover plate, mounting yoke, or any other dead metal, and the grounding terminal is to be checked using an ohmmeter, battery-and-buzzer combination, or other similar indicating device.

## 144 Bonding (Metallic Outlet Box Fault Current) Test

144.1 When tested as described in this Section, the cotton surrounding the receptacle with integral adjustable mounting yoke shall not ignite. Electrical continuity between the grounding contact of the receptacle to the metallic outlet box shall be maintained. The circuit breaker shall operate as a result of this test. See 144.9.

144.2 Twelve untested receptacles are to be tested. Six of the twelve are to be tested at the maximum adjustment position and six at the minimum adjustment position.

144.3 Each receptacle shall have a mating attachment plug inserted into the receptacle outlet. In the case of a duplex receptacle, six receptacles are to be tested with an attachment plug inserted into the upper outlet and the remaining receptacles with a mating attachment plug inserted into the lower outlet. Each attachment plug shall be wired with a 4-foot (1.22-m) length of 12 AWG flexible cord connected to the grounding terminal of the attachment plug.

144.4 Each receptacle shall be mounted to a metallic outlet box using the mounting screws provided with the receptacles or steel flat-headed No. 6-32 mounting screws when mounting screws are not provided.

144.5 The metallic outlet box shall be secured to a simulated wall surface with the outlet box set back 1/4 inch (6 mm) from the simulated wall surface. See Figure 143.1.

144.6 A 4-foot (1.22-m) length of 12 AWG solid copper conductor shall be connected to the metallic outlet box.

144.7 The adjustable mounting means shall be adjusted to both the maximum and minimum position ten times.

144.8 Following the tenth cycle of adjustment, a metallic cover plate shall be secured to the receptacle as intended using the cover plate screws provided with the cover plate or steel flat-headed No. 6-32 screws of a suitable length capable of engaging at least two full threads. The complete assembly shall be loosely covered with cotton.

144.9 The free ends of the grounding conductors from the mating attachment plug and outlet box are to be connected to a source capable of delivering a test current of 1000 A at the receptacle's rated voltage to ground with a power factor of 75 to 80 percent. A circuit breaker intended for branch circuit protection of the same rating as the receptacle under test but not less than 20 A is to be installed in series with the conductor connected to the outlet box.

144.10 After subjecting each receptacle to one application of the test current, the cotton is to be examined for ignition. Electrical continuity between the grounding contact of the receptacle to the metallic outlet box is to be checked using an ohmmeter, battery-and-buzzer combination, or other similar indicating device.

## 145 Mounting Yoke Resistance Test

145.1 The total resistance between a metallic cover plate, mounting yoke, or any other dead metal, and the grounding terminal of a receptacle employing an integral adjustable mounting yoke shall not exceed 0.01 ohms when tested as described in this Section.

145.2 Six previously untested receptacles shall be conditioned by tightening and loosening the adjustment screw, or screws if more than one is provided, or any other adjustment means to both the maximum and minimum position ten times.

145.3 Compliance with 145.1 shall be determined by passing an alternating current of 22 A from a power supply of 12 V or less from a metallic cover plate and through the grounding terminal of the receptacle. The adjustment means shall be adjusted to a position resulting in the highest resistance available in the bonding path. The resulting drop in potential is to be measured between these two points. The resistance in ohms is to be determined by dividing the drop in potential in volts by the current in amperes passing between the two points. For a receptacle that employs a mounting means that is not integrally formed with the grounding terminal, the test shall be repeated between the mounting yoke or any other dead metal, and the grounding terminal of the receptacle.

POP-OUT RECEPTACLES AND POP-UP RECEPTACLE ASSEMBLIES

## 146 General

### 146.1 Pop-out receptacles

146.1.1 In addition to the general performance requirements for a flush receptacle, a pop-out receptacle shall also comply with the Mechanical Endurance Test of Section 147 prior to being subjected to the Mechanical Loading Test of Section 148.

### 146.2 Pop-up receptacle assemblies

146.2.1 In addition to the general performance requirements for a flush receptacle, a pop-up receptacle assembly shall comply with the Mechanical Endurance Test of Section 147 prior to being subjected to the Spill Test of Section 149.

146.2.2 A pop-up receptacle assembly shall also comply with Supplement SA – Enclosure Types for Environmental Protection contained in this Standard. The assembly shall have a minimum Type 2 rating.

## 147 Mechanical Endurance Test

147.1 Twelve representative devices each of a pop-out receptacle or a pop-up receptacle assembly shall be tested.

147.2 For a pop-out receptacle, each representative device shall be mounted in an outlet box secured to a vertical surface.

147.3 For a pop-up receptacle assembly, each representative device shall be secured to a horizontal surface.

147.4 Power shall not be applied to the device. The retractable means shall initially be extended and retracted back into the closed latched position. The retractable means shall then be released, fully extended and then fully retracted for one cycle of operation. The above extension and retraction cycle shall be repeated for a total of 10,000 cycles at a cycling rate as fast as permitted by the construction of the unit.

147.5 At the conclusion of the cycling, each representative device shall be subjected to the Dielectric Withstand Test of Section 65, with no humidity conditioning.

147.6 Six of the twelve representative devices previously subjected to Dielectric Withstand Test shall then be subjected to the Temperature Test of Section 113.

147.7 For a pop-out receptacle, the remaining six representative devices shall then be subjected to the Mechanical Load Test of Section 148.

147.8 For a pop-up receptacle assembly, the remaining six representative devices shall then be subjected to the Spill Test of Section 149.

## 148 Mechanical Load Test

148.1 This test shall be conducted on six representative devices of a pop-out receptacle.

148.2 Six representative devices of a pop-out receptacle shall be mounted in an outlet box rigidly secured to a vertical surface. Power shall not be applied to the device. The retractable assembly shall be initially extended and retracted back into the closed latched position. The retractable assembly shall then be released to the fully extended position. A static 220 N (50 lbf) is to be applied to the top extended portion of the receptacle for 1 minute. The test shall be repeated with the force applied in each of the remaining directions.

148.3 There shall not be any mechanical breakage of the receptacle that exposes live parts or separation of the assembly more than 1/16 inch (1.6 mm), measured after removal of the applied force. There shall not be any permanent deformation of the assembly that would render the receptacle incapable of functioning as intended.

148.4 Each representative device shall be subjected to the Dielectric Withstand Test of Section 65, with no humidity conditioning.

## 149 Spill Test

149.1 The same six representative devices subjected to Mechanical Endurance Testing shall be secured to a counter surface in accordance with the manufacturer's installation instructions. The pop-up receptacle assembly shall be fully extended. Any covers provided shall be opened to their most disadvantageous position. Covers that tend to close themselves shall be allowed to fall to their natural resting position. If more than one outlet is enclosed by such a self-closing cover, a single power supply cord shall be mated with one of the receptacle outlets and the cord shall exit from behind the cover.

149.2 A container measuring 7-1/8 in. (181 mm) inner diameter by 9-7/8 in. (251 mm) tall shall be filled with 1/2 gallon (1.89 l) of saline solution, consisting of 8 grams (0.28 oz) of table salt per liter of distilled water. The container shall be placed on the counter surface with its base 12 in. (304.8 mm) from the representative device, and facing the receptacle. The container shall then tipped over all at once. An effort shall be made to direct the spill toward the most disadvantageous area of the assembly.

149.3 One minute after the container of water is tipped over, each representative device shall be subjected to the Dielectric Withstand Test of Section 65, with no humidity conditioning.

149.4 The test shall be repeated with the pop-up receptacle fully retracted in the closed latch position.

Pin-Type or Insulation-Displacement Terminals

## 150 General

150.1 In addition to the general performance requirements for receptacles, receptacles employing pin-type or insulation-displacement terminals shall comply with the requirements in Section 151.

## 151 Heat Cycling and Vibration Tests

### 151.1 General

151.1.1 Following the Heat Cycling and Vibration Tests described in this section, each fixture, equipment, or appliance outlet have pin-type or insulation-displacement terminals shall comply with the thermal stability criteria described in 151.5.1 and not have demonstrated a temperature rise of more than 100°C (180°F).

151.1.2 Following the manufacturer's instructions, six representative fixture, equipment, or appliance outlets are to be assembled onto the wire of the size and type recommended by the manufacturer. Solid copper wire is to be used unless otherwise specified in the instructions.

151.1.3 The devices are to be connected with 24 to 27 inches (610 to 686 mm) of cable between each device and wired in series so that the test current passes through the connection point of the entering conductor, the device internal structure, and the exiting conductor.

151.1.4 Three of the devices are to be mounted to a test rack constructed of cast-iron angles not smaller than 1/8 by 1-1/4 by 1-1/4 inch (3.2 by 31.8 by 31.8 mm) welded to form a rigid assembly. Mounting holes are to be provided for attachment of the test rack to a vibration platform.

151.1.5 The contacts of the devices under test are to be connected together by means of an attachment plug inserted therein. The plug is to have rigidly attached blades, and the terminals of the plug are to be short-circuited by means of the shortest feasible lengths of Type T or Type RH wire.

### 151.2 Heat cycling test

151.2.1 Each heating cycle is to consist of 1-1/2 hours "on" time and 1/2 hour "off" time with a total of 500 cycles on each device. The test current is to equal 200 percent of the current rating of the device.

151.2.2 The temperature rises are to be measured using thermocouples placed on the blades of the attachment plug, as close as possible to the face of the plug.

151.2.3 Temperature readings are to be obtained by means of thermocouples consisting of 28 – 32 AWG (0.08 – 0.032 $mm^2$) iron and constantan wires. It is a common practice to employ thermocouples consisting of 30 AWG (0.05 $mm^2$) iron and constantan wires with a potentiometer type of indicating instrument. This equipment is to be used if a referee measurement of temperature is necessary.

151.2.4 The temperature of the connection is to be recorded at the following intervals: commencing with the 25th cycle and approximately every 25 cycles thereafter for a total of five measurements (approximately 125 cycles). This yields 5 data points for each device tested.

### 151.3 Vibration test

151.3.1 Following approximately 125 cycles of heat cycling as described in 151.2.1 – 151.2.4, the three devices mounted to the test rack are to be disconnected from the circuit and subjected to vibration testing as described in 151.3.2.

151.3.2 Each device mounted to the test rack is to be fastened to a vibration platform and subjected to the following conditioning:

a) Simple harmonic motion of amplitude 0.03 inch (0.76 mm), 0.06 inch (1.52 mm) peak-to-peak, with the frequency varied uniformly in one minute from 10 to 55 and back to 10 cycles per second.

b) Vibration applied for two hours in each of three mutually perpendicular directions for a total of 6 hours of testing.

151.3.3 At the conclusion of the vibration conditioning, each device is to be reconnected to the test circuit to complete the approximately 375 remaining cycles of the Heat Cycling Test, as described in 151.4.1, for a total of 500 cycles.

### 151.4 Heat cycling test (Continued)

151.4.1 The remaining 6 data points for each device are to be obtained by recording the temperature of the connection at the following intervals:

a) Approximately every 45 cycles for a total of three measurements (approximately 135 cycles), and then

b) Approximately every 80 cycles for a total of three measurements (approximately 240 cycles).

### 151.5 Calculations

151.5.1 The thermal stability is to be evaluated as follows: for each thermocouple location

a) Find the average temperature rise for all 11 data points obtained (from 151.2.4 and 151.4.1), and

b) Find the deviation of each of the 11 data points from the calculated average.

None of the 11 data points shall deviate above the average temperature by more than 10°C (18°F). There shall not be a temperature rise greater than 100°C (180°F) above the room ambient temperature on any device during the heat cycling test.

Receptacles Employing a Separable Terminal Assembly

## 152 General

152.1 In addition to the general performance requirements for a receptacle, a receptacle that employs a separable terminal assembly shall also comply with the requirements in Sections 153 – 161.

## 153 Retention of Tab Connection Test

153.1 A receptacle employing a separable terminal assembly and having rectangular blade tabs shall be subjected to the test described in this section. There shall be no displacement more than 0.079 in (2 mm) for each individual lead terminal and blade tab.

*Exception: A separable terminal assembly having a pin construction where the pin is formed in a shape that provides a self-retaining locking feature is not required to be subjected to this test.*

153.2 Representative terminals are to be removed from their enclosure. Once removed, each individual terminal and lead assembly is to be inserted and attached to the receptacle as intended. The receptacle shall be supported on a horizontal steel plate with the individual terminal leads projecting downward. A static 0.5 lbf (2.2 N) shall be applied to individual conductors for one minute in a direction perpendicular to the plane of the receptacle body, tending to remove the individual lead terminal from the tab on the receptacle.

## 154 Separable Connector Pull Test

154.1 A receptacle employing a separable terminal assembly shall be subjected to the test described in this section. There shall be no displacement more than 0.079 in (2 mm) of the special purpose connector from the back of the receptacle body.

154.2 Representative receptacles employing a separable terminal shall have their latching or locking features defeated from either the connector or the body of the receptacle. The connector is then to be inserted and attached to the receptacle as intended, but without the locking feature. The receptacle shall be supported on a horizontal steel plate with the connector projecting downward. A static 3 lbf (13.3N) shall be applied to all conductors simultaneously for one minute in a direction perpendicular to the plane of the receptacle body, tending to remove the connector from the body of the receptacle.

## 155 Mold Stress Relief Test

155.1 The special purpose connector of a receptacle employing a separable terminal assembly shall be subjected to the Mold Stress Relief Test, Section 63, except the test shall be performed for a 72-hour period at a temperature of 90°C (194°F).

## 156 Dielectric Voltage-Withstand Test

156.1 A receptacle employing a separable terminal assembly shall withstand without breakdown a 50 – 60 Hz essentially sinusoidal potential applied as described in 156.3 for one minute, immediately following the humidity conditioning described in 156.2, between the following:

a) Live parts of opposite polarity, and

b) Live parts and grounding or dead metal parts including both the equipment grounding path and the mounting means of an isolated-ground receptacle.

156.2 The same representative receptacles previously subjected to the Mold Stress Relief Test in Section 155 are to be used. The devices are then to be placed into an environmental chamber and subjected to the following conditions:

a) 4 hours at a temperature of 75 ±1°C (167 ±1.8°F) at a relative humidity of 92 ± 3 percent;

b) 16 hours at a temperature of 75 ±1°C (167 ±1.8°F) at a relative humidity of 40 ±3 percent; and

c) 4 hours at a temperature of 30 ±1°C (86 ±1.8°F) at a relative humidity of 60 ± 3 percent.

156.3 Upon completion of the humidity conditioning, the special purpose connectors are to be inserted and assembled to mating receptacles as intended and mating attachment plugs with solid blades are to be inserted into the contact openings of three of the six receptacles. The device is to be tested by means of a 500 VA or larger capacity transformer whose output voltage is essentially sinusoidal and can be varied. The applied potential is to be increased from zero until the required test level is reached, and is to be held at that level for one minute. The increase in the applied potential is to be at a uniform rate and as rapid as is consistent with its value being correctly indicated by a voltmeter. The test potential is to be 2000 V for devices rated 300 V or less and 3000 V for devices rated greater than 300 V.

156.4 The mating attachment plugs used in 156.2 are to be capable of withstanding the application of a 2500 V potential for devices rated 300 V or less and a 3500 V potential for devices rated greater than 300 V.

156.5 If the output of the test-equipment transformer is less than 500 volt-amperes, the equipment is to include a voltmeter in the output circuit to indicate the test potential directly.

## 157 Grounding Contact Temperature Test

157.1 The acceptability of the grounding path in a receptacle employing a separable terminal assembly shall be demonstrated by a temperature rise not exceeding 30°C (54°F) when subjected to the test described in this section.

157.2 The devices previously subjected to the Mold Stress Relief Test, Section 155, and the Dielectric Voltage-Withstand Test, Section 156, are to be wired in a series circuit through the grounding conductor path of the tested outlet of each device and a mating attachment plug having solid plug blades. The test current is to be 25 A (125 percent of the maximum branch-circuit rating to which a 15 or 20 A receptacle could be connected). Each receptacle is to be wired using 12 AWG (3.3 $mm^2$) solid or stranded copper wire. Attachment plugs are to be wired using 12 AWG (3.3 $mm^2$) flexible cord. Temperatures are to be measured after 1 hour on the grounding contact of the connector or on the conductor as close as possible to the entry (exit) of the conductor to (from) the special purpose connector. The current is then to be reduced to 22 A (110 percent of the maximum branch circuit rating) and the test continued until thermal equilibrium is reached. A temperature is considered to be stabilized when three consecutive readings, taken at 5-minute intervals, indicate no further rise above the ambient temperature. The temperature rise over room ambient shall not exceed 30°C (54°F) at any time.

## 158 Resistance Test

158.1 A receptacle employing a separable terminal assembly shall be subjected to the test described in this section. The total resistance between the mated attachment plug grounding terminal and receptacle grounding lead shall not exceed 0.01 ohms when tested as follows.

158.2 The devices previously subjected to the Grounding Contact Temperature Test, Section 157, are to be used for this test.

158.3 Compliance with 158.1 is to be determined by passing an alternating current of 22 A from a power supply of 12 V or less from the attachment plug grounding terminal to the receptacle grounding lead. The resulting drop in potential is to be measured between these two points. The resistance in ohms is to be determined by dividing the drop in potential in volts by the current in amperes passing between the two points.

## 159 Latching Mechanism Test

159.1 The latching mechanism used to secure a special purpose connector to a receptacle of a separable terminal assembly construction shall be subjected to the conditions as specified in 159.3 – 159.5.

159.2 Upon completion of this test, there shall not be any damage to the connector or its latching mechanism. The latching mechanism shall remain capable of functioning as intended. There shall not be any damage, arcing or dielectric breakdown during application of the test potential. The connector shall not pull free from the mated receptacle during application of the test force.

159.3 The latching mechanism shall be operated to lock the special purpose connector to the receptacle. The locking means shall then be operated to release the special purpose connector and the mating receptacle shall be withdrawn. This sequence shall be repeated for a total of 100 cycles.

159.4 Following the 100 cycles, the special purpose connector shall be reattached to the receptacle and locked in place as intended. A static 89 N (20 lbf) is to be applied to all conductors of the special purpose connector simultaneously for 1 minute in a direction perpendicular to the plane of the receptacle body, tending to remove the special purpose connector.

159.5 Each device is then to be subjected to a 50 – 60 Hz essentially sinusoidal potential equal to twice the rated voltage plus 1000 V applied between live parts of opposite polarity and between live parts and grounding or dead metal parts. An insulated body is to be wrapped in foil. The test voltage is to be increased at a uniform rate and as rapidly as is consistent with its value being correctly indicated by a voltmeter, and maintained at the test potential for 1 minute.

## 160 Short Circuit Test

160.1 A receptacle employing a separable terminal assembly shall be subjected to the test described in this section. The fuse shall open when the test circuit is closed and there shall not be any ignition of the cotton.

160.2 The receptacle is to be installed in a metallic outlet box and metallic cover plate. Surgical cotton shall be placed at all openings surrounding the cover plate. The receptacle is to be wired as intended in a test circuit capable of delivering 2000 A rms when the mating attachment plug terminals are shorted. The line and neutral terminals of the receptacle shall be wired to the supply terminals using a total of 4 ft (1.22 m) of 12 AWG (3.3 $mm^2$) wire.

160.3 The open circuit test voltage shall be between 100 and 105 percent of the voltage rating of the device under test. A mating attachment plug employing solid blade grounding-type attachment plug with a 2-ft (0.61-m) length of flexible cord having 12 AWG (3.3 $mm^2$) conductors with the bared ends of the ungrounded and grounded conductors twisted together, soldered, and insulated. A 20-A fuse for branch circuit protection is to be connected between the receptacle line terminal and one supply terminal. The test circuit shall be closed on the mated devices.

## 161 Continuity Impedance Test

161.1 A previously untested receptacle employing a separable terminal assembly shall be subjected to the test described in 161.2. The voltage drop between the individual conductor leads and blade inserted into the corresponding outlet contact shall not be greater than 4 volts.

161.2 To determine whether a receptacle employing a separable terminal assembly complies with 161.1, the receptacle is to be connected to a nominal 60 hertz source capable of continuously delivering 20 A through the individual conductor leads and blade inserted into the corresponding outlet contact for 4 minutes. Immediately following the 4 minutes, the voltage measurement shall be recorded.

Receptacles Employing Rotatable Outlets

## 162 General

162.1 In addition to the general performance requirements for a receptacle, a receptacle that employs a rotatable outlet or outlets shall also comply with the requirements in Sections 163 – 167.

## 163 Rotational Endurance Test

163.1 Six representative receptacles employing a rotatable outlet or outlets are to be connected to the load at rated voltage and current. A mating plug cap is to be inserted into tested swivel outlet.

163.2 While energized, the rotatable outlet is to be rotated mechanically for 10,000 complete cycles at a rate of not more than ten operations per minute without interruption. The direction of rotation is to be alternated between a clockwise and a counter clockwise direction for each rotation. Each cycle is to consist of a full range rotation. Each complete rotation is considered a cycle regardless of direction.

163.3 Immediately following endurance rotation, the representative devices are to be examined for breakage or cracking. Additionally, the receptacle outlet shall accept a mating attachment plug to verify acceptance of the mating plug of the applicable configuration.

163.4 At the conclusion of the 10,000 cycles, continuity between each terminal, including ground, and its respective contact shall be checked using a suitable indicating device (such as a ohmmeter, battery-and-buzzer combination, or similar device). Each receptacle outlet (upper and lower) shall be slowly rotated as intended to confirm that continuity is maintained in all possible positions.

## 164 Temperature Test

164.1 Following the Rotational Endurance Test, Section 163, the same six representative devices shall be subjected to the Temperature Test, Section 113.

## 165 Dielectric Voltage-Withstand Test

165.1 Following the Temperature Test, Section 113, the same six representative devices shall be subjected to a 50 – 60 Hz essentially sinusoidal potential applied between live parts of opposite polarity and between live parts and grounding or dead metal parts, in accordance with the Dielectric Voltage-Withstand Test, Section 65.

## 166 Resistance Test

166.1 Following the Dielectric Voltage Withstand Test, Section 65, the same six representative devices shall be subjected to the Resistance Test, Section SC23. The resistance shall be measured between the plug grounding pin and the receptacle grounding terminal with current flowing through the ground path.

## 167 Fault Current Test

167.1 Following the Resistance Test, Section SC23, the same six representative devices shall be subjected to the Fault Current Test, Section SC24.

Self-Contained Receptacles

## 168 General

168.1 In addition to the general performance requirements, a self-contained receptacle shall comply with the requirements in Sections 169 – 180 as specified in Table 59.5.

168.2 For self-contained receptacles employing insulation displacement terminals, the Temperature Test, Section 113 is to be performed following the Pullout Test in Section 170.

## 169 Heat Cycling and Vibration Tests

### 169.1 General

169.1.1 Following the Heat Cycling and Vibration Tests described in this section, a self-contained receptacle shall:

a) Meet the thermal stability criteria described in 169.4.1 and

b) Not have displayed a temperature rise of more than 100°C (180°F).

*Exception: Self-contained receptacles for connection to only copper wire employing crimp, screw-terminal, or pressure-wire connector constructions are not required to be tested for heat cycling or vibration.*

169.1.2 Ten self-contained receptacles rated 15 A are to be assembled onto two conductor 14 AWG nonmetallic sheathed cable with ground and copper conductors. Ten devices rated 20 A are to be assembled onto two-conductor 12 AWG nonmetallic sheathed cable with ground and copper conductors.

169.1.3 The devices are to be connected with 24 to 27 inches (610 to 686 mm) of cable between each device and wired in series so that the test current passes through the connection point of the entering conductor, the device internal structure, and the exiting conductor. See 169.2.2 and 169.2.3 (mentioning splice and nonsplice connections). See 169.3.2 – 169.3.4 for devices to be vibration tested.

### 169.2 Heat cycling test

169.2.1 Each heating cycle is to consist of 1-1/2 hours "on" time and 1/2 hour "off" time with a total of 500 cycles on each device. The test current is to be 53 A for those devices being tested with 12 AWG cable and 40 A for those devices being tested with 14 AWG cable.

169.2.2 The temperature rises are to be measured using thermocouples placed on the internal wire termination structure, as close as practicable to the wire termination point. If the design of the device is such that splicing connections are intended (see manufacturer's instructions) all devices are to be so wired using the minimum number of possible connection points for each wire (a splicing connector is where the incoming wires terminate in the device and a second set of conductors originate in the same device).

169.2.3 If a splicing connection is not intended, modified devices may be necessary so that unrelated variables will not influence the test results. For example, the line and neutral wire terminations may have to be jumped by a 14 AWG (2.1 $mm^2$) copper wire soldered in place or 12 AWG (3.3 $mm^2$) copper wire for devices tested with No. 12 wire, or an equivalent means. Modifications are not to provide any increase in overall thermal or electrical conductivity, mechanical strength, and so forth, beyond that of the basic unmodified device construction.

169.2.4 The temperature of the connection is to be recorded at the following intervals, which may be approximate:

a) Commencing with the 25th cycle and every 25 cycles thereafter for a total of five measurements (125 cycles),

b) Then every 45 cycles for a total of three measurements (135 cycles), and finally

c) Every 80 cycles for a total of three measurements (240 cycles).

This yields a total of 11 data points for each device tested.

169.2.5 Temperature readings are to be obtained by means of thermocouples consisting of 28 – 32 AWG (0.08 – 0.032 mm$^2$) iron and constantan wires. It is a common practice to employ thermocouples consisting of 30 AWG (0.05 mm$^2$) iron and constantan wires with a potentiometer type of indicating instrument. This equipment will be used if a referee measurement of temperature is necessary.

### 169.3 Vibration test

169.3.1 Following approximately 125 cycles of heat cycling (as described in 169.2.1 – 169.2.5), six devices from each group of ten (for a total of 12) are to be disconnected from their circuit and subjected to vibration conditioning.

169.3.2 Five of each of the six devices are to be mounted (prior to the start of the Heat Cycling Test) to a special test rack constructed of cast-iron angles not smaller than 1/8 by 1-1/4 by 1-1/4 inch (3.2 by 31.8 by 31.8 mm) welded to form a rigid assembly. Mounting holes are to be provided for attachment to the vibration platform. Insulating strips or clamps are to be provided to secure the wires between devices at 6 – 8 inches (152 – 203 mm) from the point at which they exit the device, and located in the same plane as the mounting means for the device.

169.3.3 The devices are to be rigidly mounted to the fixture by their mounting means. Equivalent methods of mounting such as bolting or clamping the devices to the frame may be used.

169.3.4 The sixth device of each group is to be mounted by its normal mounting means in the center of a 21 inch square (533 mm square) piece of panel board having the minimum intended thickness for use with the device. The panel board is then to be bolted to a test rack similar to that described in previous paragraphs but sized so that the panel board is supported around its periphery (approximately 21 inches on each side). Clearance holes through the test rack are to be provided for the test wires opposite where they exit the device. Additional support for the test wire is not to be provided.

169.3.5 Each device is then to be subjected to the following vibration conditioning.

a) Simple harmonic motion of amplitude 0.03 inch (0.06 inch peak-to-peak) with the frequency varied uniformly between 10 and 55 and back to 10 cycles per second in one minute.

b) Vibration applied for two hours in each of three mutually perpendicular directions for a total of 6 hours of testing.

169.3.6 At the conclusion of the Vibration Test in 169.3.1 – 169.3.5, all test devices are to be reconnected to their respective circuits to complete the remaining 375 cycles of the Heat Cycling Test (for a total of 500 cycles).

### 169.4 Calculations

169.4.1 The thermal stability is to be evaluated as follows: for each thermocouple's location;

a) Find the average temperature rise for all 11 data points obtained (from 169.2.4) and

b) Find the deviation of each of the 11 data points from the calculated average.

None of the 11 data points shall deviate above the average temperature by more than 10°C (18°F). There shall not be a temperature rise greater than 100°C (180°F) above the room ambient temperature on any device during the Heat Cycling Test.

## 170 Cable Pullout Test

170.1 After being subjected to the Cable Pullout Test in 170.2, a self-contained receptacle shall not exhibit:

a) Any visible indications of conductor pullout,

b) Damage to the cable insulation, or

c) Any loosening of the assembly that would enable the cable to be removed by flexing or bending following the removal of the test force.

170.2 Six receptacles rated 15 A are to be installed onto two-conductor 14 AWG copper cable with ground, and six receptacles rated 20 A installed onto 12 AWG copper cable with ground. The cable installation is to be in accordance with the manufacturer's instructions. Wiring terminals having a screw-actuated clamping means are to be fully tightened and then loosened one full turn before application of the test force. Each cable is then to be subjected to a force of 60 lbf (267 N) applied perpendicular to the plane of the cable entrance (along the wire) for five minutes. Devices are to be rigidly supported by their mounting means during testing.

## 171 Conductor Pullout Test

171.1 Following the test pull described in 171.2, no conductor shall be displaced from its connection or connections to a self-contained receptacle.

171.2 Three devices rated 15 A are to be installed with a single 14 AWG (Type TW) copper conductor connected to each terminal. Three devices rated 20 A are to be similarly installed but with a single 12 AWG copper Type TW conductor connected to each terminal. Each conductor is to be subjected to a pull of 20 lbf (89 N) gradually applied perpendicular to the plane of the wire entrance hole (along the wire) and sustained for 1 minute. Any parts necessary for proper installation of wire in the termination are to be used.

## 172 Mounting Strength Test

### 172.1 General

172.1.1 Following the test in 172.4.1, a self-contained receptacle shall not exhibit:

a) A permanent displacement of more than 1/8 inch (3.18 mm) from the plane of the wall; or

b) Any damage which might adversely affect the intended function of the device.

### 172.2 Receptacles mounted directly in panels

172.2.1 Six self-contained receptacles that are intended to be directly mounted in paneling are to be installed in a test wall made using paneling of the minimum thickness for which the device is intended. The paneling is to be supported (typically with a stud) 6 inches (152 mm) from one edge of the opening in which the device is to be installed. Each of the receptacles is then to be tested as described in 172.4.1.

### 172.3 Receptacles supported by mounting brackets

172.3.1 Each of six self-contained receptacles that is intended to be supported from a frame construction mounting bracket is to be installed as intended and tested as described in 172.4.1.

### 172.4 Testing

172.4.1 Testing is to be accomplished as follows:

a) A 50 lbf (222 N) is to be applied for a period of 5 minutes to each of two devices in a direction perpendicular to the face of the mounting surface along the center line of the receptacle, tending to push it into the mounting opening.

b) A 50 lbf (222 N) is to be applied to each of two previously untested receptacles as described in (a) above but in the opposite direction (tending to pull the receptacle out of the opening).

c) A 60 lbf (267 N) is to be applied to the nonmetallic sheathed cable of each of two previously untested devices in a downward direction from where the cables exit.

## 173 Wall-Mounting Secureness Test

173.1 A self-contained receptacle intended to be installed in a wall without the support of a frame-construction mounting bracket is to be tested as described in this section. After testing, each device shall remain secure to the extent that there is no displacement of the device, with respect to the wall, exceeding 1/4 inch (6.35 mm).

173.2 Three devices are to be tested following their installation, as shown, in the test wall illustrated in Figure 173.1. Three devices are to be tested similarly but with the receptacle installed in a direction perpendicular to that of the first 3 devices. Each device is to be attached, without the nonmetallic cable installed, to the test wall in accordance with the instructions provided by the manufacturer. An eyelet is to be fastened to the face of the device for the purpose of attaching the test wire and applying the test force. The eyelet may be bolted, cemented, or otherwise fastened. The device may be altered to accommodate the eyelet provided that it does not affect test results.

173.3 A force of at least 22 lbf (97.8 N) is to be applied consecutively in opposite directions at an angle of 30 ±2 degrees from the face of the wall as illustrated in Figure 173.2. The force is to be abruptly applied within 0.10 seconds and maintained for at least 0.40 second before it is abruptly removed. Two consecutive pulls, one in each direction, constitute one test cycle. The test is to be conducted for 5000 cycles at a rate of 30 – 60 cycles per minute.

**Figure 173.1**

**Test wall**

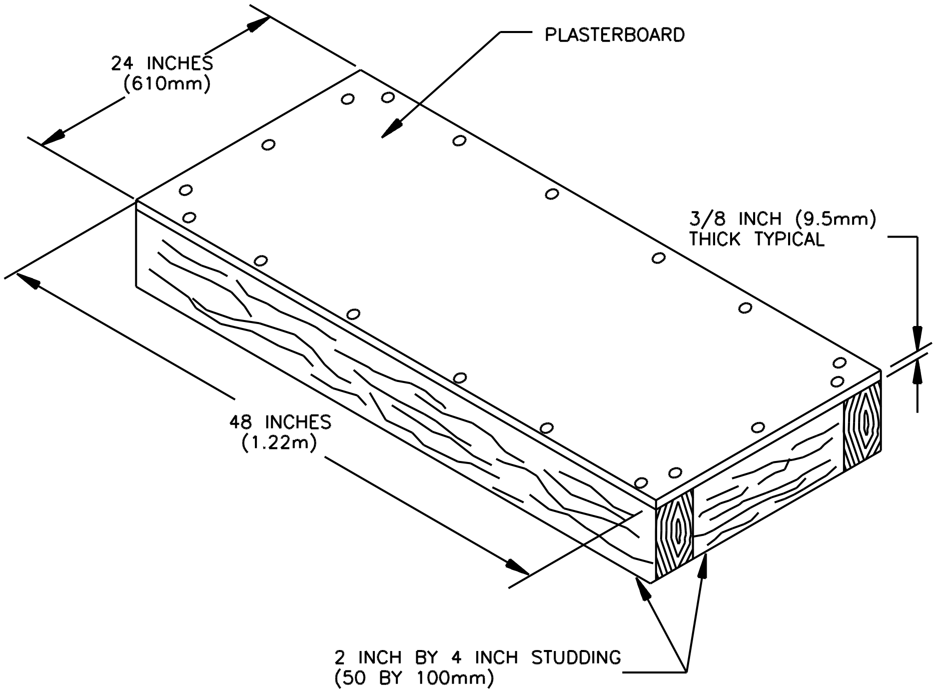



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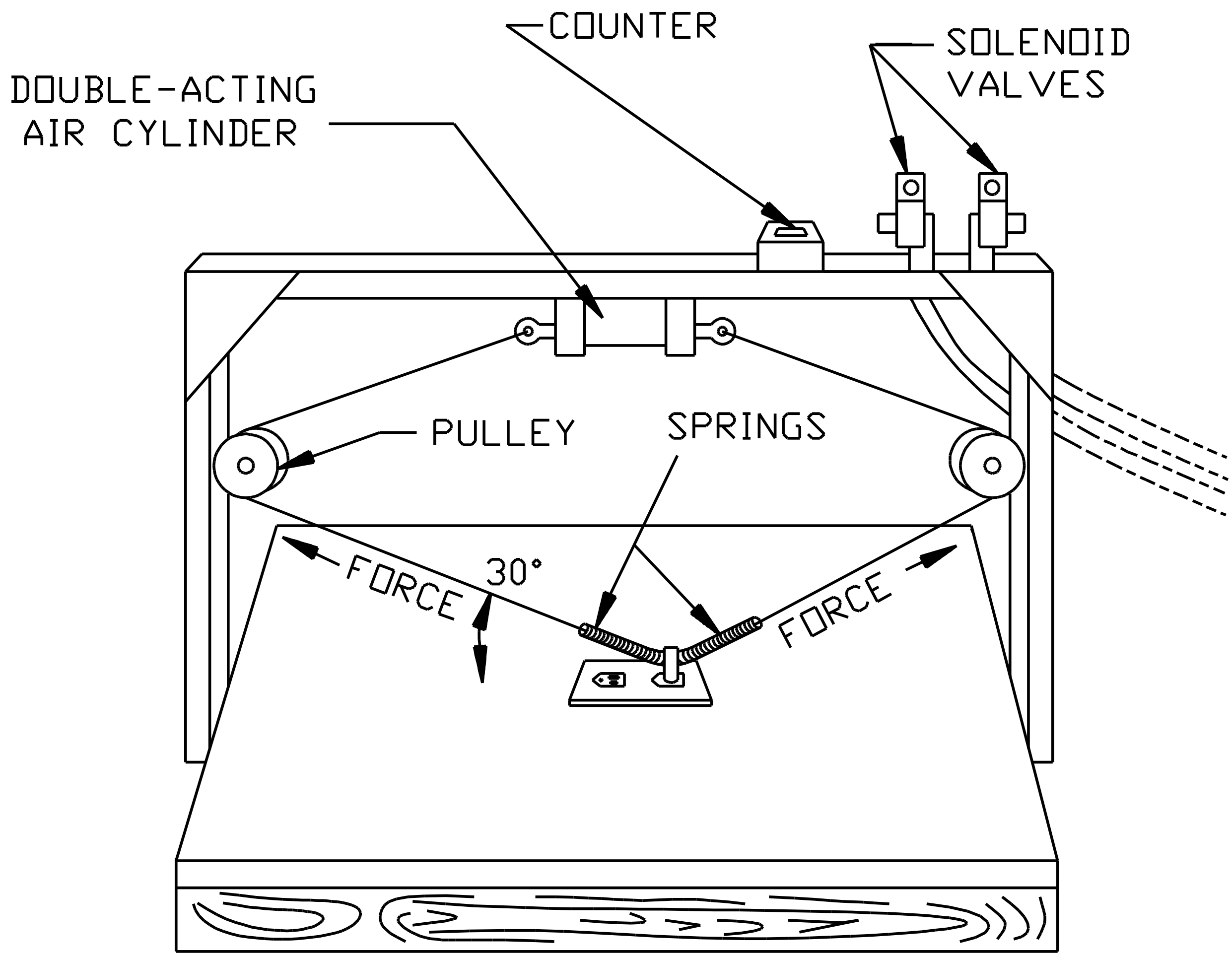
**Figure 173.2**

**Wall mounting secureness test**

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NOTE – The springs shown above have the following characteristics:

a) Free (unexpanded) length of 4 inches (102 mm),

b) Outer diameter of 1 inch (25 mm),

c) Wire diameter of 0.105 inch (2.7 mm), and

d) Spring constant of 11.5 lb/in (205 g/m).

## 174 Assembly Security Test

### 174.1 General

174.1.1 Following the Assembly Security Tests in 174.2 and 174.3 (Methods A and B, respectively) there shall not be any mechanical breakage of a self-contained receptacle or separation of the face and rear portions that would interfere with the intended functioning of the device.

174.1.2 The receptacles are to be examined for compliance with 174.1.1 within 5 minutes after the removal of the force.

### 174.2 Method A

174.2.1 Three self-contained receptacles are to be mounted as illustrated in Figure 174.1. A 100 lbf (445 N) is to be applied as shown by means of a rigid steel push-out tool, as illustrated in Figure 174.2, inserted into the slots of the receptacles.

**Figure 174.1**

**Application of assembly security test**

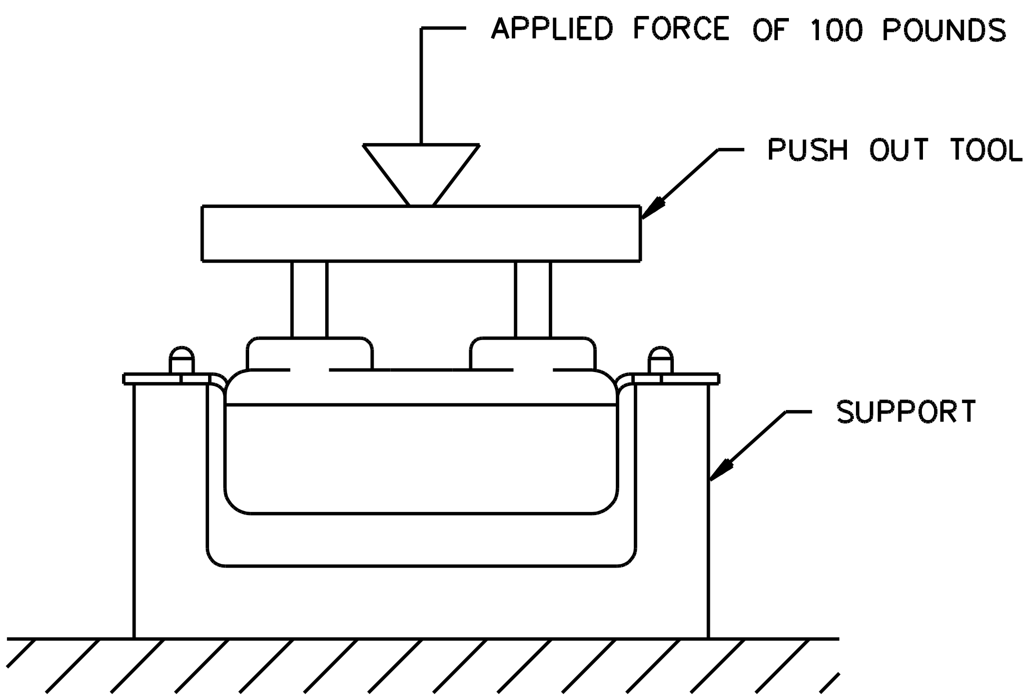


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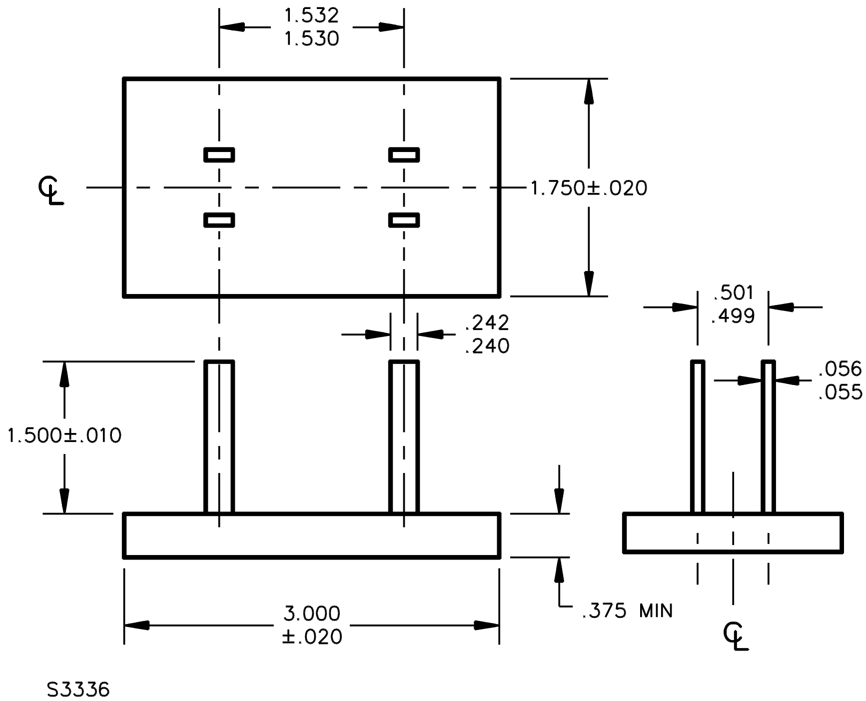
**Figure 174.2**

**Fixture for assembly security test**

(All dimensions in inches)




### 174.3 Method B

174.3.1 Six self-contained receptacles rated 15 A are to be installed on two conductor 14 AWG copper cable with ground and the cable subjected to a 50 lbf (222 N) applied perpendicular to the cable's entry into the device in a direction tending to separate the rear section from the front section. Six self-contained receptacles rated 20 A are to be similarly tested using two conductor 12 AWG copper cables with ground. The force is to be applied for one minute.

## 175 Field Replacement Test

175.1 A self-contained receptacle that is intended to be replaced in the field with a conventional outlet box and receptacle is to be installed on a typical wall panel of the minimum thickness intended in accordance with the manufacturer's instructions. The self-contained receptacle is then to be removed from the wall. A conventional outlet box and receptacle are then to be installed.

175.2 Installation of the conventional outlet box and receptacle shall be readily accomplished by using wall support tabs furnished with the box or "old work" brackets. The opening in the wall around the replacement outlet box shall be such that it is entirely covered when a standard-sized (not oversized) flush plate is installed.

## 176 Fault Current Withstand Test

176.1 After subjecting a self-contained receptacle to the Fault Current Withstand Test described in this section:

a) There shall not be any damage to the cable that could render it incapable of being used in the installation of a similar self-contained replacement-type receptacle or a conventional outlet box and receptacle; and

b) The circuit breaker shall operate in each case.

176.2 Typical installations of the self-contained receptacle are to be made in the intended manner, using the maximum and minimum cables (conductor sizes). Each installed device is to be connected using 4 feet (1.22 mm) of the maximum size wire to a 60 Hz power supply capable of delivering 1000 A at 120 V when the system is short-circuited at the test terminals. The test circuit is to have a thermal-type or an inverse-time molded-case type circuit breaker connected in one ungrounded line between the test terminals and the receptacle. The breaker rating should correspond to the rating of the wire used in the test. Each of three devices is to be tested by applying the test current to the device by inserting into a device opening an attachment plug whose terminals are connected using a short length of conductor. This procedure is then to be repeated on the same devices using a 200 A, 120 V circuit.

## 177 Knockouts Test

177.1 Knockouts provided on a self-contained receptacle shall remain intact when subjected to a 10 lbf (44.5 N) for one minute applied perpendicular to the plane of the knockout. The force is to be applied, by means of a mandrel with a 1/4 inch (6.4 mm) diameter flat end, at the point considered most likely to displace the knockout.

177.2 Knockouts shall be readily removable without breakage of the insulating body of the enclosure or sharp edges becoming present. Knockouts shall be displaced by means of a screwdriver or by using other conventional tools.

## 178 Creep Test

178.1 A self-contained receptacle shall be capable of withstanding the Cable Pullout Test described in Section 170 following the oven conditioning described in 178.2.

178.2 Self-contained receptacles employing thermoplastic material are to be assembled as a splice installation onto nonmetallic sheathed cable of the maximum AWG size conductor intended for use. Each device is then to be conditioned in an air-circulating oven for 300 hours at 90°C (194°F).

## 179 Mold Stress Test

179.1 Following the aging conditioning described in 179.2 and once the device has cooled to room temperature, a self-contained receptacle shall not exhibit:

a) A change in any overall dimension greater than 10 percent; or

b) An opening larger than 1/32 inch (0.8 mm) at any joint.

179.2 The self-contained receptacles employing thermoplastic material, unassembled and without cable installed, are to be conditioned in a circulating-air oven for a period of 7 hours at 90°C (194°F). Upon cooling to room temperature, the joint openings are to be measured after installation on cable as intended.

## 180 Specimen Flammability Test

### 180.1 General

180.1.1 Insulating materials employed in a self-contained receptacle are to be subjected to this test. A total of fifteen specimens for each material is to be tested as follows:

a) Five in the as-received state using method A,

b) Five following seven days of conditioning in an air oven at 90.0 ±1.0°C (194.0 ±1.8°F) using Method A, and

c) Five in the as-received state using Method B.

*Exception No. 1: Molded phenolic or urea formaldehyde insulating material is not required to be subjected to this test.*

*Exception No. 2: An insulating material having a minimum V-2 is not required to be subjected to this test. See 45.1(b)(1).*

### 180.2 Method A

180.2.1 When tested as described for V-2 material in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, each 5.0 by 0.50 inch (127 by 12.7 mm) specimen shall:

a) Not burn with flaming combustion for more than 30 seconds after each withdrawal of the test flame.

b) Not burn with flaming or glowing combustion up to the holding clamp, and

c) Not burn with glowing ember for more than 50 seconds after the second withdrawal of the test flame.

### 180.3 Method B

180.3.1 When tested as described for HB material in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, each 5.0 by 0.50 inch (127 by 12.7 mm) specimen shall cease to burn before the flame reaches the reference mark located 4.0 inches (102 mm) from its free end.

CURRENT TAPS

### All Devices

## 181 General

181.1 The performance of a current tap wired to flexible cord is to be investigated by means of the tests described in Sections 60 – 109 and Section 182, as specified in Table 59.6.

## 182 Contact Security Test

182.1 The female contacts of a current tap having a 1-15R configuration shall remain inaccessible to contact after the current tap has been tested as described in this section.

182.2 The current tap is to be rigidly supported in the blades-up position. The current tap is to be positioned and supported so as not to restrict possible displacement of the female contacts, breakage of the enclosure, or both. Each blade, in turn, is to be individually subjected to a force of 30 lbf (133 N) applied gradually along the longitudinal axis of the blade in a direction towards the plug face. The 30 lbf (133 N) is to be maintained for a period of 1 minute.

182.3 The same devices are to be retested as described in 182.2 subjecting both blades, in combination, to a single applied force of 40 lbf (178 N) for a period of 1 minute.

FLATIRON AND APPLIANCE PLUGS

## 183 General

183.1 The performance of a flatiron or appliance plug is to be evaluated by means of the tests described in Sections 60 – 69 and Sections 184 – 191 as specified in Table 59.7 on sets of six representative devices.

183.2 A switching mechanism in a flatiron or appliance plug shall comply with the requirements in the Standard for General-Use Snap Switches, UL 20. The devices for the snap-switch tests are to be devices that have not been subjected to any other tests.

## 184 Millivolt Drop Test

184.1 In a previously untested switchless flatiron or appliance plug, the drop in potential between a wiring terminal and the corresponding male pin shall not be greater than 50 mV while maximum rated current is flowing. This requirement applies also to a plug that incorporates a switching mechanism, except that the millivolt drop applies only to the female contacts.

184.2 To determine whether a flatiron or appliance plug complies with the requirement in 184.1, the plug is to be wired in the intended manner and connected to any convenient d-c potential. The load connections for the plug are to consist of a pair of standard stainless-steel male pins mounted on a sheet of insulating material and provided with terminals to which an adjustable noninductive load can be connected. The dimensions and spacings of pins are provided in Table 55.1. With the plug applied to the pins as it would be in service and with maximum rated current flowing through the circuit, the drop in potential is to be measured between each wiring terminal of the plug (use the line side of each female contact in a plug with a switching mechanism) and the corresponding terminal on each male pin.

## 185 Overload Test

185.1 A flatiron or appliance plug shall perform acceptably when operated manually at a rate not greater than 6 cycles per minute for 50 cycles of making and breaking a direct current of 150 percent of the 250 V current rating for the plug. The device shall remain capable of functioning as intended and there shall not be any undue pitting or burning of the contacts.

185.2 Devices which have been subjected to the millivolt-drop test are to be tested as described in this section.

185.3 A pair of pins intended for use with the plug being tested is to be mounted on an insulating support and connected to a noninductive resistive load that will draw the required test current at the rated voltage.

185.4 Each plug is to be wired with heater cord, connected to a nominal 250 V d-c supply (238 to 262 V), and then successively applied and withdrawn from the pins as it would be in service until the 50 cycles have been completed. Neither the plug nor the pins are to be serviced in any manner during the test. The plug is to be withdrawn each time by the application of a steady pull on the cord.

## 186 Heating Test

186.1 The insulating material used in a flatiron or appliance plug shall be capable of withstanding a temperature of 200°C (392°F) for a period of 72 hours without warping, cracking, blistering, softening, or showing any other indication of serious deterioration.

186.2 Devices which have been subjected previously to the millivolt-drop and overload tests are to be subjected to air at the specified temperature. The test devices may be heated in any oven, the temperature of which can be regulated and measured properly. The oven is to be brought up to the required temperature before the devices are positioned within on their contact ends.

## 187 Millivolt Drop Test Repeated

187.1 The millivolt-drop test is to be repeated following the heating test on flatiron or appliance plugs that have been subjected previously to the millivolt-drop, overload, and heating tests. The potential drop between a wiring terminal and the corresponding male pin shall not be greater than 100 mV. See also 184.1 and 184.2.

## 188 Crushing Test

188.1 An appliance plug rated 5 A at 250 V and 10 A at 125 V shall be capable of withstanding a crushing force of 125 lbf (556 N) for 1 minute as described in this Section without cracking or breaking. Other plugs shall be capable of withstanding a force of 150 lbf (667 N) similarly applied.

188.2 Plugs are to be employed that have not been previously subjected to any of the tests in Sections 184 – 187. Each untested plug is to be laid flat on a 1/2 inch (12.7 mm) or thicker horizontal maple block. The force is to be applied by means of a horizontal 3/4 inch diameter (19.1 mm) round rod. The force is to be transmitted to the rod by means of the weight and lever of a testing machine. The force is to be applied gradually. The rod is to be aligned at right angles to the major axis of the plug, midway between the points at which the plug contacts the supporting surface.

## 189 Mechanical Endurance Test

189.1 After a flatiron or appliance plug that is rated 5 A at 250 V and 10 A at 125 V, and that has been oven conditioned at 200°C (392°F) for 24 hours, is dropped by machine in the manner described in this section, it shall not:

a) Crack or break to the extent that it becomes unfit for use or exposes live parts to unintentional contact, or

b) Experience any displacement of current-carrying parts or loosening of the cord at the wiring terminals.

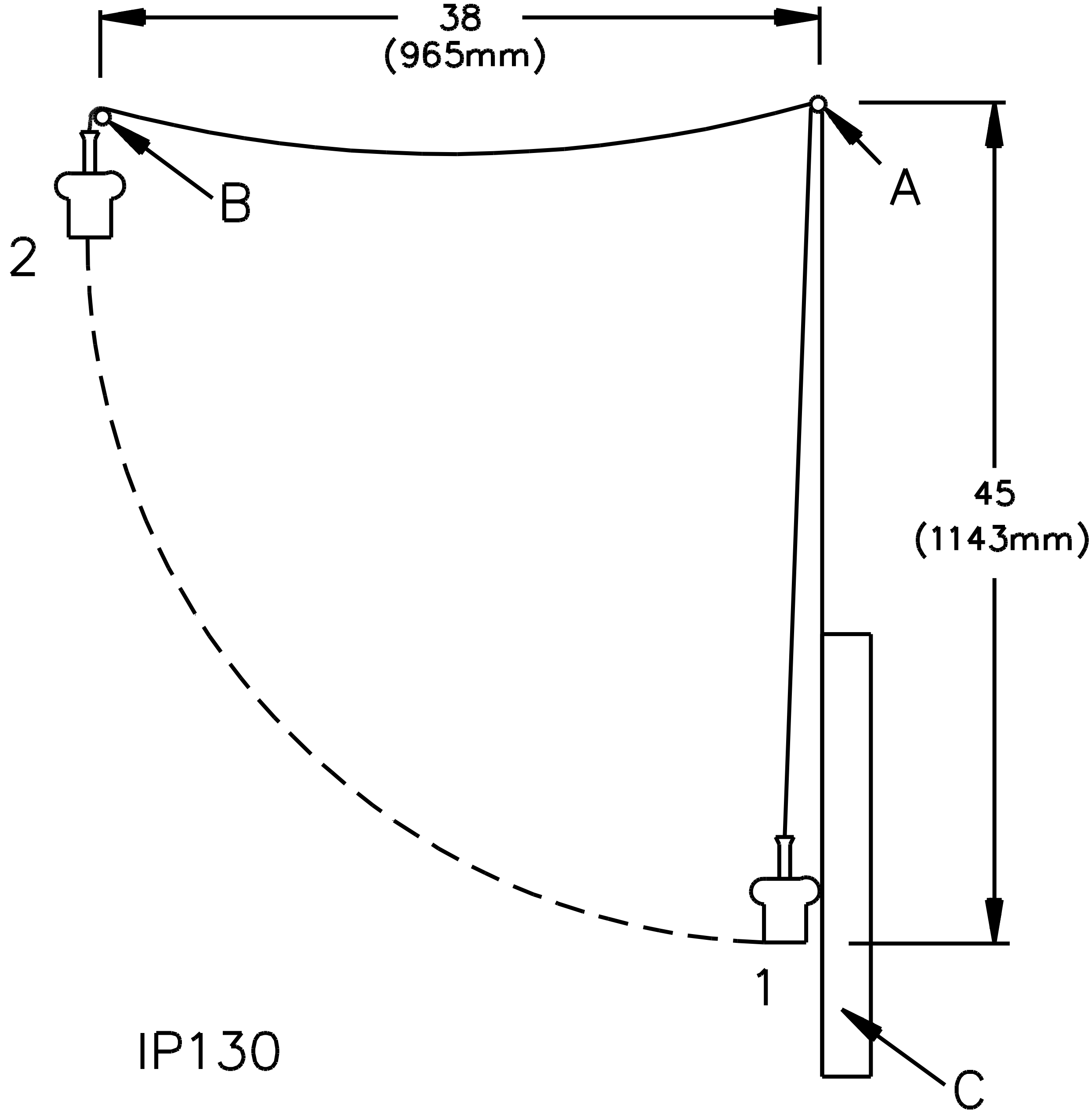
189.2 If an unacceptable result occurs that is attributable directly to a broken switch handle or a release button, the test may be repeated to determine whether the handle or button will break on nonoven-conditioned devices. If the handle or button does not break, and none of the causes for rejection given in 189.1 occur, the mechanical endurance of the plug is acceptable.

189.3 Previously untested devices are to be used. Three plugs that include a switch are to be tested with the switch in the off position. The three remaining devices are to be tested with the switch in the on position.

189.4 Although the details of the machinery to accomplish the impacts are not specified, the test is to be conducted as follows. Each plug is to be wired with 18 AWG (0.82 $mm^2$) Type HPD cord, the free end of which is to be passed through and knotted behind a bushing located at the point labeled A in Figure 189.1. The cord is to be free to rotate in the bushing. Initially, the cord and plug are to hang freely and rest in the position labeled 1 in Figure 189.1 against the vertical face of the block C, which is a 1-1/2 – 2 inch thick (38.1 – 50.8 mm) piece of maple that is high and wide enough so that a plug will not strike near one of the edges of the block. The grain is to run vertically. The plane of the face of block C is to contain point A. The distance from the bushing to the contact end of the plug is to be 45 inches (1.14 m). Lifting member B of the machine is to lift the plug by the cord to the position labeled 2 in Figure 189.1. At this point the edge of member B furthest from point A is to be 38 inches (0.97 m) from the plane of the face of block C on a line perpendicular to the plane at point A. The cord is to be released from member B and the plug is to fall freely to strike block C. The machine is to repeat the operation continuously for the required number of cycles. Screws employed to hold plug halves together are to be replaced and tightened whenever they fall out. Generally, screws that have been tightened every 200 cycles will not loosen sufficiently to fall out.

**Figure 189.1**

**Mechanical endurance test**




NOTES

A – Supporting bushing

B – Lifting Member

C – Maple block

1 and 2 – See 189.4

189.5 A switchless plug is acceptable if the average number of drops without damage is not less than 1000 for the six devices tested without any of the devices determined to be unacceptable within the first 500 drops. In computing the average, 1300 drops is to be used for any device which performs acceptably for more than 1300 drops.

189.6 A plug incorporating a switch is acceptable if the average number of drops without damage is not less than 500 for the six devices tested without any of the devices determined to be unacceptable within the first 250 drops. In computing the average, 650 drops is to be used for any device which performs acceptably for more than 650 drops.

## 190 Accelerated Aging Test

190.1 If a rubber guard is employed in a flatiron or appliance plug, the rubber compound shall not show any visible deterioration after being subjected to accelerated aging in which the guard is maintained at a temperature of 120.0 ±1.0°C (248.0 ±1.8°F) in an oven for a period of 96 hours. Following the oven conditioning, the guard shall not shown any cracks after being subjected to 5000 cycles of flexing by a machine as described in this section.

190.2 The guard is to be assembled to the body of the plug, and the assembly wired in the intended manner with a 2 – 3 ft (0.61 – 0.91 m) length of heater cord. With the plug held stationary, the guard is to be flexed by moving the cord back and forth in a plane through an angle of approximately 180 degrees.

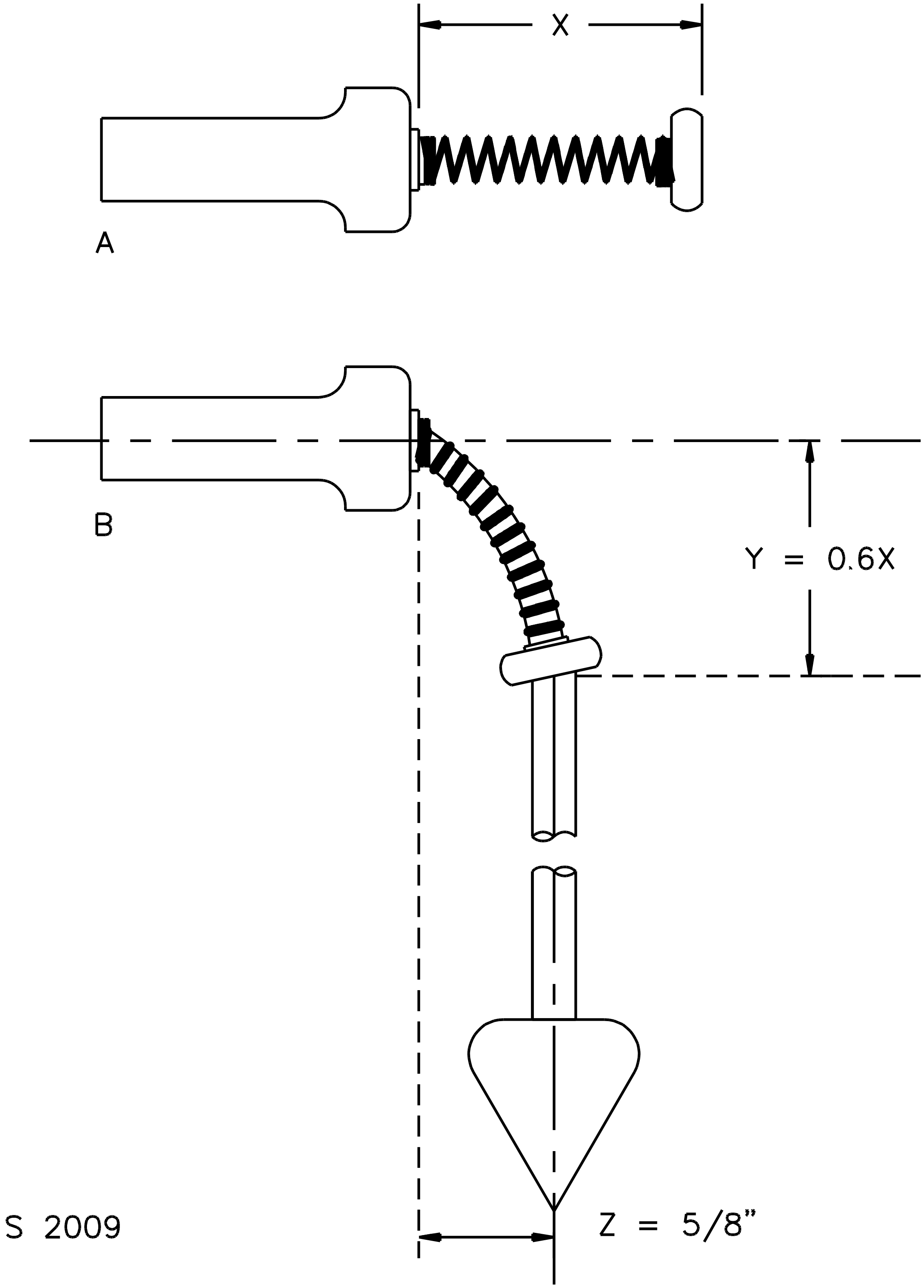
## 191 Cord Guard Test

191.1 To determine if a guard complies with the requirement in 53.3 it is to be tested with a 3 lb (1.36 kg) weight similar to a plumb bob attached to a short length of heater cord that is wired to the plug in the intended manner. The flatiron or appliance plug is to be mounted rigidly in a horizontal position as indicated in part A of Figure 191.1. Dimension X is to be measured with the axis of the cord and guard coincidental with the axis of the plug with no force being applied to the cord. The weight is to bend the guard as indicated in part B of Figure 191.1 under which conditions dimension Y is to not be less than 60 percent of dimension X and dimension Z is to not be less than 5/8 inch (15.9 mm).

*Exception: A guard is not required to comply with this requirement if, upon investigation, it is found to provide protection equivalent to that provided by a guard that does comply. See also 53.3.*

**Figure 191.1**

**Test of cord guard**




| inch | 5/8 |
|---|---|
| mm | 15.9 |

## RATINGS

### 192 Details

192.1 A general-use device shall be rated in amperes and volts. When the contact configuration of the device is one of the configurations illustrated in Wiring Devices – Dimensional Specifications, ANSI/NEMA WD6, or in the Standard for Wiring Device Configurations, UL 1681, the device shall be given only the rating shown in the configuration. Otherwise, the device shall be given one or more of the ratings in Table 192.1. See 6.1, 192.4, and 192.5.

*Exception No. 1: Plugs, cord connectors, and current taps for use on flexible cords, or that are provided with fuses, are permitted to have a lower current rating than that shown in the configuration.*

*Exception No. 2: A device that is a combination of special-use devices as described in 192.2 is not required to comply with this requirement.*

**Table 192.1**
**Ratings of general-use devices**

| Ratings |
|---|
| 10A, 250V and 15 A, 125V |
| |
| 15 A, 125 V |
| 15 A, 250 V |
| 15 A, 277 V ac |
| |
| 20 A, 125 V |
| 20 A, 250 V |
| 20 A, 277 V ac |
| |
| 30 A, 250 V |
| |
| 50 A, 250 V |
| |
| 60 A, 250 V |
| |
| 75 A, 250 V |
| 75 A, 480 V ac |
| 75 A, 600 V ac |
| 75 A, 600 V |
| |
| 100 A, 250 V |
| 100 A, 480 V ac |
| 100 A, 600 V ac |
| 100 A, 600 V |
| |
| 200 A, 250 V |

**Table 192.1 Continued on Next Page**

**Table 192.1 Continued**

| Ratings |
|---|
| 200 A, 480 V ac |
| 200 A, 600 V ac |
| 200 A, 600 V |

192.2 A special-purpose receptacle or cord connector may be rated in accordance with test performance results and the anticipated conditions of end use, and may be rated in horsepower in addition to the required ampere rating.

192.3 A flush receptacle or attachment plug of a configuration specified in Table 192.2 shall have a horsepower rating in accordance with the table. A cord connector, appliance, equipment or fixture outlet, surface-mount receptacle, or current tap of a configuration specified in Table 192.2 and assigned a horsepower rating shall be rated in accordance with the table. See 94.1.1, 94.3.1 – 94.3.3 and 117.1.1, 117.3.1 – 117.3.3.

**Table 192.2**
**Horsepower ratings for NEMA configurations**

| NEMA configuration | AC HP rating[a] |
|---|---|
| 1-15 | 0.5 |
| | |
| 2-15 | 1.5 |
| 2-20 | 2 |
| 2-30 | 2 |
| | |
| 5-15 | 0.5 |
| 5-20 | 1 |
| 5-30 | 2 |
| 5-50 | 2 |
| | |
| 6-15 | 1.5 |
| 6-20 | 2 |
| 6-30 | 2 |
| 6-50 | 3 |
| | |
| 7-15 | 2 |
| 7-20 | 2 |
| 7-30 | 3 |
| 7-50 | 5 |
| | |
| 10-20 | 2 L-L |
| | 1 L-N |
| 10-30 | 2 L-L |
| | 2 L-N |
| 10-50 | 3 L-L |
| | 2 L-N |

**Table 192.2 Continued on Next Page**

**Table 192.2 Continued**

| NEMA configuration | AC HP rating[a] |
|---|---|
| 11-15 | 2 |
| 11-20 | 3 |
| 11-30 | 3 |
| 11-50 | 7.5 |
| 14-15 | 1.5 L-L |
| | 0.5 L-N |
| 14-20 | 2 L-L |
| | 1 L-N |
| 14-30 | 2 L-L |
| | 2 L-N |
| 14-50 | 3 L-L |
| | 2 L-N |
| 14-60 | 3 L-L |
| | 2 L-N |
| 15-15 | 2 |
| 15-20 | 3 |
| 15-30 | 3 |
| 15-50 | 7.5 |
| 15-60 | 10 |
| 18-15 | 2 |
| 18-20 | 2 |
| 18-30 | 3 |
| 18-50 | 7.5 |
| 18-60 | 7.5 |
| L1-15 | 0.5 |
| L2-20 | 2 |
| L5-15 | 0.5 |
| L5-20 | 1 |
| L5-30 | 2 |
| L6-15 | 1.5 |
| L6-20 | 2 |
| L6-30 | 2 |
| L7-15 | 2 |
| L7-20 | 2 |
| L7-30 | 3 |

**Table 192.2 Continued on Next Page**

## Table 192.2 Continued

| NEMA configuration | AC HP rating[a] |
|---|---|
| L8-20 | 3 |
| L8-30 | 5 |
| L10-20 | 2 L-L |
| | 1 L-N |
| L10-30 | 2 L-L |
| | 2 L-N |
| L11-15 | 2 |
| L11-20 | 3 |
| L11-30 | 3 |
| L12-20 | 5 |
| L12-30 | 10 |
| L14-20 | 2 L-L |
| | 1 L-N |
| L 14-30 | 2 L-L |
| | 2 L-N |
| L15-20 | 3 |
| L15-30 | 3 |
| L16-20 | 5 |
| L16-30 | 10 |
| L 18-20 | 2 |
| L18-30 | 3 |
| L19-20 | 5 |
| L19-30 | 10 |
| L21-20 | 2 |
| L21-30 | 3 |
| L22-20 | 5 |
| L22-30 | 10 |
| L25-30R | 2 |
| L26-30R | 7.5 |

[a] The phase to phase horsepower ratings are noted by "L-L". The phase to neutral ratings are identified by "L-N".

192.4 If a device includes a snap switch that controls an outlet, the overall rating of the device shall not be higher than the rating of the switch.

192.5 If a two-wire device includes a pilot-lamp lampholder of the candelabra- or miniature-base size, the overall rating of the device shall not be more than 125 V.

192.6 A device shall be rated for disconnecting use only, not for current rupturing, if the potential rating is higher than 250 V dc. A device may be rated for disconnecting use only, not for current rupturing, if the current rating is greater than 60 A ac, dc, or ac-dc. See 94.1.1 and 117.1.1.

192.7 An appliance or flatiron plug shall be rated 5 A at 250 V and 10 A at 125 V if the spacing between centers of the contacts is 11/16 inch (17.5 mm) or less. However, if the spacing between centers of the contacts is more than 11/16 inch (17.5 mm), an appliance plug shall be rated 10 A at 250 V and 15 A at 125 V. See 6.1.

## MARKINGS AND INSTRUCTIONS

### 193 General

#### 193.1 Details

193.1.1 All markings and instructions required by this section shall be legibly and permanently marked and readily visible in the specified location.

193.1.1.1 Markings and instructions that are alternatively permitted on a stuffer sheet, information sheet etc. may be provided via a manufacturer’s web site. The web address shall be marked on the device, packaging and/or information sheet. The web address may be in the form of a Uniform Resource Locator (URL - http://www.___.com/___/ ), or as a Quick Response Code (QRcode). The web address link shall take the user to an internet page containing the required information or a direct link to the required information. The file shall be a file format that is commonly used and may be downloadable. This does not apply to markings that are specified to be located on the device or the packaging/container only (not a stuffer sheet) but this information may be repeated on the web site.

193.1.2 A marking shall be die stamped, ink stamped, painted, molded, or otherwise applied in a manner determined to be indelible in accordance with the Standard for Marking and Labeling Systems, UL 969. Other contrasting methods providing equivalent prominence and permanence meet the intent of the requirement.

193.1.3 An attachment plug shall be provided with all applicable markings and instructions described in Table 193.1.

**Table 193.1**
**Markings and instructions applicable to attachment plugs and attachment fitting**

| Description | Reference | Marking | Location |
|---|---|---|---|
| All plugs | 1 | a) The manufacturer's name, trade name or trademark, or other descriptive marking by which the organization responsible for the device is to be identified. A traceable code is not prohibited when the device is identified by the brand or trademark owned by a private labeler.<br>b) The catalog number or an equivalent designation.<br>c) The electrical rating in amps and volts.A device rated for use on alternating current circuits only shall be identified by one of the following means:<br>1) The letters "AC",<br>2) The words "AC Only",<br>3) The symbol "∿",<br>4) A frequency marking (for example, "60 Hertz"),<br>5) A phase marking such as "Φ", the letters "ph" or "PH", or the word "phase". For multiphase devices that are intended for use only on a wye system, the marking shall also include the word "wye", or the letter "Y.<br>*Exception No. 1: A fuseless attachment plug having a 1-15P or 5-15P configuration is not required to be marked with its electrical rating.*<br>*Exception No. 2: An attachment plug of a configuration specified in Table 192.2 is not required to be marked with its horsepower rating.* | On the device where visible after installation.<br>*Exception: The catalog number is not prohibited from appearing on the unit container when the product is too small, or where the legibility is difficult to attain, or where several catalog numbers use common parts* |
| Plugs produced at more than one factory | 2 | A distinctive marking, not prohibited from being in code, identifying the device as the product of a particular factory. | On device |
| Plugs requiring strip length information. See 9.1.3. | 3 | Strip length information for the intended conductors. | On the device near the wiring terminals, or on a separate instruction sheet provided. |
| Plugs intended for field wiring | 4 | a) The intended flexible-cord types (such as Type S, SJ, SJT, HPN, and SPT-1). A cord identification referring to the generic (trade) names for each family of cords (such as Hard Service Cord, Vacuum Cleaner Cord, and Parallel Cord) is not prohibited when all types of cords identified in the family can be utilized with the device.<br>b) The conductor size or sizes.<br>c) The total number of conductors.<br>d) The overall cord diameter range, if the device is intended to be utilized with a limited range of the cord diameters available for a cord type. | On the device, on the smallest unit container, or on a stuffer sheet provided with each device |

**Table 193.1 Continued on Next Page**

## Table 193.1 Continued

| Description | Reference | Marking | Location |
|---|---|---|---|
| | | The information is not prohibited from being combined in an abbreviated format (such as wire sizes 18/3 SV to 14/3 SJ, 0.230 – 0.450 inch diameter). The conductor sizes, total number of conductors and overall diameters shall be included individually or as a range with the appropriate cord types. | |
| Plugs with pin-type terminals for field assembly on flexible cord | 5 | a) Instructions for assembling the device to the cord. Details shall be provided, including pictorial representation, to enable proper assembly by an inexperienced person.<br>b) The words "CAUTION – Risk of electric shock. Do not strip wires. Cut off end of cord cleanly." or an equivalent wording following the word CAUTION and any other specific instructions concerning cord preparation.<br>c) Instructions concerning the cord type or types to be used. A description shall be provided of any type of cord that may not be physically excluded but which is not intended to be used (for example, not for use with Type TPT extra-flexible cord such as used on electric shavers). There are some cord groups that are not distinguishable by marking and, where one of these cords is recommended, all shall be capable of proper use or be physically excluded.<br>d) If the device is polarized, the words "CAUTION – Risk of electric shock. Proper polarization must be maintained. Examine the cord carefully before assembling this product. If one of the wires is marked with stripes, grooves or ridges on the outer surface of the insulation, attach that wire to the white or silver-colored terminal. If neither wire is marked, strip a small amount of insulation from the end of both wires and check to see whether either of the wires is white in color. If so, the white wire should be connected to the white or silver-colored terminal. After identifying the white wire, cut end of cord cleanly before attaching the wires to the terminals." or an equivalent wording following the word CAUTION.<br>e) Electrical rating in volts, amperes and wattage corresponding to the ampacity of the cord. If more than one size or type of cord is intended to be used, the electrical rating shall be indicated for each type cord. | On an instruction card attached to the device in such a manner that the device is unable to be readily removed. The use of a blister pack or equivalent securing of the device to the instruction card meets the intent of the requirement. However, the friction attachment of a device to the card shall not be employed. |
| Plugs with nongrounding configurations (other than 1-15, 1-20, 1-30, 2-15, 2-20, 2-30) | 6 | "CAUTION: This device is not for grounding use. Connect only to nongrounding circuits." | On the device where visible during installation, on the smallest unit container, or on a stuffer sheet provided with each device |

Table 193.1 Continued on Next Page

## Table 193.1 Continued

| Description | Reference | Marking | Location |
|---|---|---|---|
| Plugs with locking configurations | 7 | "Turn and pull" or an equivalent wording. | On the device where visible during use |
| Plugs with Fig. C1.1 configuration located in the Standard for Wiring Device Configurations, UL 1681 | 8 | "Hospital only." See Exception to 15.3.6. | On the device where visible after installation. |
| Plugs with Fig. C1.2 – C1.5 configurations located in the Standard for Wiring Device Configurations, UL 1681 | 9 | "CAUTION: To Avoid Electric Shock – Review premises carefully and do not use if this slot or blade configuration (design) is already in a circuit having a rating differing from the rating of this device." | On the device where visible during installation, on the smallest unit container, or on a stuffer sheet provided with each device |
| Armored plugs with grounded covers | 10 | "Cover grounded" or with an equivalent statement.<br>*Exception No. 1: The marking is not required if the grounding connection is readily visible.*<br>*Exception No. 2: The marking is not required for an attachment plug of the type described in 11.6.* | On the device |
| Plugs with fuses (other than plug or cartridge type for branch circuit protection) | 11 | "Use only with a ___ volt fuse." The potential to be used in the marking shall be the potential rating of the fuse for which the device is intended. | On the device where visible during fuse replacement |
| Plugs with fuses where the fuse can be removed after the plug has been inserted in receptacle. See the Exception to 15.4.6. | 12 | "Disconnect power before replacing fuses" or an equivalent wording. | On the device where visible during fuse replacement |
| Stage plugs complying with ANSI/ESTA E1.24 dimensional requirements (See 15.3). | 13 | "ANSI E1.24" configuration and "type" where "type" is as identified in Annex A of ANSI E1.24, or an equivalent wording. | On the device. |
| Stage plugs of the configurations 5T20, 5T30, 5T60 and 5T100 complying with ANSI/ESTA E1.24. | 14 | "CAUTION: Risk of Electric Shock – only intended for use on grounded-neutral electrical circuits " | On the device where visible during installation, or on the smallest unit container, or on a stuffer sheet provided with each device. |
| Configurable attachment plug | 15 | Electrical rating and blade configuration for each identified configuration | On the device, in the case where separable face disks are used, see 17.4.6 for details. |

Table 193.1 Continued on Next Page

**Table 193.1 Continued**

| Description | Reference | Marking | Location |
|---|---|---|---|
| Configurable attachment plug | 16 | Instructions for assembling the device to the cord. Details shall be provided, including pictorial representation, to enable proper assembly | On the smallest unit container or on a stuffer sheet provided with each device. |
| Attachment fitting for use with a Luminaire Support Receptacle with a 50 lb. support rating | 17 | Luminaire Support 50 lb. Max | On the device, on the package or on an Instruction sheet included with the device |
| | | Not removable or interchangeable with another fixture | On the device, visible during installation |
| | | Mate only with Model [model or catalog number] | On the device, visible during installation |
| Attachment fitting for use with a ceiling-suspended fan support receptacle with a 35 lb. support rating | 18 | Fan Support 35 lb. Max | On the device, visible during installation |
| | | Not removable or interchangeable with another fixture | On the device, visible during installation |
| | | Mate only with Model [model or catalog number] | On the device, visible during installation |
| Attachment fitting for use with a ceilingsuspended fan support receptacle with a 50 lb. support rating | 19 | Fan Support 50 lb. Max | On the device, visible during installation |
| | | Not removable or interchangeable with another fixture | On the device, visible during installation |
| | | Mate only with Model [model or catalog number] | On the device, visible during installation |
| Attachment fitting for use with a ceilingsuspended fan support receptacle with a 70 lb. support rating | 20 | Fan Support 70 lb. Max | On the device, visible during installation |
| | | Not removable or interchangeable with another fixture | On the device, visible during installation |
| | | Mate only with Model [model or catalog number] | On the device, visible during installation |
| Plugs employing spring-action clamp terminals. | 21 | Installation instructions for assembly of conductors to the terminals. Instructions shall include a pictorial description of the placement of the stripped conductor within the channels/guides of the enclosure. | On the smallest unit container, or on a stuffer sheet provided with each device |

193.1.4 An inlet shall be provided with all applicable markings and instructions described in Table 193.2.

**Table 193.2**
**Markings and instructions applicable to inlets (motor attachment plugs)**

| Description | Reference | Marking | Location |
|---|---|---|---|
| All inlets | 1 | a) The manufacturer's name, trade name or trademark, or other descriptive marking by which the organization responsible for the device is to be identified. A traceable code is not prohibited when the device is identified by the brand or trademark owned by a private labeler. | On the device where visible after installation *Exception: The catalog number is not prohibited from appearing on the unit container when the product is too small, or where the legibility is difficult to attain, or where several catalog numbers use common parts* |

**Table 193.2 Continued on Next Page**

## Table 193.2 Continued

| Description | Reference | Marking | Location |
|---|---|---|---|
| | | b) The catalog number or an equivalent designation.<br>c) The electrical rating. A device rated for use on alternating current circuits only shall be identified by one of the following means:<br>1) The letters "AC",<br>2) The words "AC Only",<br>3) The symbol "∿",<br>4) A frequency marking (for example, "60 Hertz"),<br>5) A phase marking such as "Φ", the letters "ph" or "PH", or the word "phase". For multiphase devices that are intended for use only on a wye system, the marking shall also include the word "wye", or the letter "Y.<br>*Exception: An inlet of a configuration specified in Table 192.2 is not required to be marked with its horsepower rating.* | |
| Inlets produced at more than one factory | 2 | A distinctive marking, not prohibited from being in code, by which the device can be identified as the product of a particular factory. | On the device |
| Inlets with non conductive mounting means. See 19.1 and 19.4 | 3 | "CAUTION – Mounting means not grounded. Grounding wire connection required" or an equivalent wording following the word CAUTION. | On the device where visible during installation |
| Inlets with pressure-wiring terminals or binding screw terminals for field wiring on a branch circuit | 4 | The value of tightening torque assigned in accordance with 12.4.3 and 12.2.7. | On the device where visible during installation, on the smallest unit container, or on an information sheet packed in the smallest unit container |
| Inlets with nongrounding configurations (other than 1-15, 1-20, 1-30, 2-15, 2-20, 2-30) | 5 | "CAUTION: This device is not for grounding use. Connect only to nongrounding circuits." | On the device where visible during installation, on the smallest unit container, or on a stuffer sheet provided with each device |
| Inlets with Figure C1.1 configuration located in the Standard for Wiring Device Configurations, UL 1681 | 6 | "Hospital only." See Exception to 15.3.6. | On the device where visible after installation |
| Inlets with Figure C1.2 – C1.5 | 7 | "CAUTION: To Avoid Electric Shock – Review premises carefully and do not use if this slot or blade configuration (design) is already in a | On the device where visible during installation, on the smallest unit container, or on a stuffer sheet provided with each device |

Table 193.2 Continued on Next Page

**Table 193.2 Continued**

| Description | Reference | Marking | Location |
|---|---|---|---|
| configurations located in the Standard for Wiring Device Configurations, UL 1681 | | circuit having a rating differing from the rating of this device." | |
| Inlets with fuses (other than plug or cartridge type for branch circuit protection) | 8 | "Use only with a ___ volt fuse." The potential to be used in the marking shall be the potential rating of the fuse for which the device is intended. | On the device where visible during fuse replacement |
| Stage inlets complying with ANSI/ESTA E1.24 dimensional requirements (See 15.3). | 9 | "ANSI E1.24" configuration and "type" where "type" is as identified in Annex A of ANSI E1.24, or an equivalent wording. | On the device. |
| Stage inlets of the configurations 5T20, 5T30, 5T60 and 5T100 complying with ANSI/ESTA E1.24. | 10 | "CAUTION: Risk of Electric Shock – only intended for use on grounded-neutral electrical circuits" | On the device where visible during installation, or on the smallest unit container, or on a stuffer sheet provided with each device. |
| Inlets employing a combination wire binding/pressure wire-type terminals for field wiring on a branch circuit | 11 | Installation instructions for assembly of conductors to the terminals. Instructions shall include a pictorial description of the placement of the stripped conductor within the channels/ guides of the enclosure | See 193.2.5 and 193.2.6 |
| Inlets employing spring-action clamp terminals | 12 | Installation instructions for assembly of conductors to the terminals. Instructions shall include a pictorial description of the placement of the stripped conductor within the channels/guides of the enclosure. | On the smallest unit container, or on a stuffer sheet provided with each device. |

193.1.5 A cord connector shall be provided with all applicable markings and instructions described in Table 193.3.

**Table 193.3**
**Marking and instructions applicable to cord connectors**

| Description | Reference | Marking | Location |
|---|---|---|---|
| All cord connectors | 1 | a) The manufacturer's name, trade name or trademark, or other descriptive marking by which the organization responsible for the device is to be identified. A traceable code is not prohibited when the device is identified by the brand or trademark owned by a private labeler. | On the device where visible after installation *Exception: The catalog number is not prohibited from appearing on the unit container when the product is too small, or where the legibility is difficult to attain, or where several catalog numbers use common parts.* |

**Table 193.3 Continued on Next Page**

## Table 193.3 Continued

| Description | Reference | Marking | Location |
|---|---|---|---|
| | | b) The catalog number or an equivalent designation.<br>c) The electrical rating. A device rated for use on alternating current circuits only shall be identified by one of the following means:<br>1) The letters "AC",<br>2) The words "AC Only",<br>3) The symbol "$\sim$",<br>4) A frequency marking (for example,<br>5) A phase marking such as "Φ", the letters "ph" or "PH", or the word "phase". For multiphase devices that are intended for use only on a wye system, the marking shall also include the word "wye", or the letter "Y". | |
| Cord connectors produced at more than one factory | 2 | A distinctive marking, not prohibited from being in code, by which the device can be identified as the product of a particular factory. | On the device |
| Cord connectors intended for disconnecting use only | 3 | "For disconnecting use only," or "Not for current rupturing," or an equivalent statement. | On the device where visible during use |
| Cord connectors requiring strip length information. See 9.1.3 | 4 | Strip length information for the intended conductors. | On the device near the wiring terminals or on a separate instruction sheet provided with each device. |
| Cord connections intended for field wiring | 5 | a) The intended flexible-cord types (such as type S, SJ, SJT, HPN, and SPT-1). A cord identification referring to the generic (trade) names for each family of cords (such as Hard Service Cord, Vacuum Cleaner Cord, and Parallel Cord) is not prohibited when all types of cords identified in the family can be utilized with the device.<br>b) The conductor size or sizes.<br>c) The total number of conductors.<br>d) The overall cord diameter range, if the device is intended to be utilized with a limited range of the cord diameters available for a cord type. The information is not prohibited from being combined in an abbreviated format (such as wire sizes 18/3 SV to 14/3 SJ, 0.230 – 0.450 inch diameter). The conductor sizes, total number of conductors and overall diameters shall be included individually or as a range with the appropriate cord types. | On the device, on the smallest unit container, or on a stuffer sheet provided with each device |

Table 193.3 Continued on Next Page

## Table 193.3 Continued

| Description | Reference | Marking | Location |
|---|---|---|---|
| Cord connectors with pin-type terminals for field assembly on flexible cord | 6 | a) Instructions for assembling the device to the cord. Details shall be provided, including pictorial representation, to enable proper assembly by an inexperienced person.<br>b) The words "CAUTION – Risk of electric shock. Do not strip wires. Cut off end of cord cleanly." or an equivalent wording following the word CAUTION and any other specific instructions concerning cord preparation.<br>c) Instructions concerning the cord type or types to be used. A description shall be provided of any type of cord that may not be physically excluded but which is not intended to be used (for example, not for use with Type TPT extra-flexible cord such as used on electric shavers). There are some cord groups that are not distinguishable by marking and, where one of these cords is recommended, all shall be capable of proper use or be physically excluded.<br>d) If the device is polarized, the words "CAUTION – Risk of electric shock. Proper polarization must be maintained. Examine the cord carefully before assembling this product. If one of the wires is marked with stripes, grooves or ridges on the outer surface of the insulation, attach that wire to the white or silver-colored terminal. If neither wire is marked, strip a small amount of insulation from the end of both wires and check to see whether either of the wires is white in color. If so, the white wire should be connected to the white or silver-colored terminal. After identifying the white wire, cut end of cord cleanly before attaching the wires to the terminals." or an equivalent wording following the word CAUTION.<br>e) Electrical rating in volts, amperes and wattage corresponding to the ampacity of the cord. If more than one size or type of cord is intended to be used, the electrical rating shall be indicated for each type cord. | On an instruction card attached to the device in such a manner that the device is unable to be readily removed. The use of a blister pack or equivalent securing of the device to the instruction card meets the intent of the requirement. However, the friction attachment of a device to the card shall not be employed. |
| Cord connectors with nongrounding configurations (1-15, 1-20, 1-30, 2-15, 2-20, 2-30) | 7 | "CAUTION: This device is not for grounding use. Connect only to nongrounding circuits." | On the device where visible during installation, on the smallest unit container, or on a stuffer sheet provided with each device |
| Cord connectors with locking configurations | 8 | "Turn and pull" or an equivalent wording. | On the device where visible during use. |
| Cord connectors with Fig. C1.1 configuration located in the Standard for Wiring Device | 9 | "Hospital only." See Exception to 15.3.6. | On the device where visible after installation |

Table 193.3 Continued on Next Page

## Table 193.3 Continued

| Description | Reference | Marking | Location |
|---|---|---|---|
| Configurations, UL 1681 | | | |
| Cord connectors with Figure C1.2 – C1.5 configurations located in the Standard for Wiring Device Configurations, UL 1681 | 10 | "CAUTION: To Avoid Electric Shock – Review premises carefully and do not use if this slot or blade configuration (design) is already in a circuit having a rating differing from the rating of this device." | On the device where visible during installation, on the smallest unit container, or on a stuffer sheet provided with each device |
| Armored cord connectors with grounded covers | 11 | "Cover grounded" or an equivalent statement. *Exception No. 1: The marking is not required if the grounding connection is readily visible.* *Exception No. 2: The marking is not required for a cord connector of the type described in 11.6.* | On the device |
| Cord connectors with spring-actuated latching mechanism | 12 | A statement instructing the user how to disengage the latching mechanism so that a mated attachment plug can be removed from the cord connector outlet. | On the device where visible during use |
| Stage cord connectors complying with ANSI/ESTA E1.24 dimensional requirements (See 15.3). | 13 | "ANSI E1.24" configuration and "type" where "type" is as identified in Annex A of ANSI E1.24, or an equivalent wording. | On the device. |
| Stage connectors of the configurations 5T20, 5T30, 5T60 and 5T100 complying with ANSI/ESTA E1.24. | 14 | "CAUTION: Risk of Electric Shock – only intended for use on grounded-neutral electrical circuits" | On the device where visible during installation, or on the smallest unit container, or on a stuffer sheet provided with each device. |
| Cord Connectors employing spring-action clamp terminals. | 15 | Installation instructions for assembly of conductors to the terminals. Instructions shall include a pictorial description of the placement of the stripped conductor within the channels/guides of the enclosure. | On the smallest unit container, or on a stuffer sheet provided with each device |

193.1.6 A receptacle shall be provided with all applicable markings and instructions described in Table 193.4.

## Table 193.4
## Marking and instructions applicable to receptacles

| Description | Reference | Marking | Location |
|---|---|---|---|
| All receptacles | 1 | a) The manufacturer's name, trade name or trademark, or other descriptive marking by which the organization responsible for the device is to be identified. A traceable code is not prohibited when the device is identified by the brand or trademark owned by a private labeler.<br>b) The catalog number or an equivalent designation.<br>c) The electrical rating. A device rated for use on alternating current circuits only shall be identified by one of the following means:<br>1) The letters "AC",<br>2) The words "AC Only",<br>3) The symbol "∿",<br>4) A frequency marking (for example, "60 Hertz"),<br>5) A phase marking such as "Φ", the letters "ph" or "PH", or the word "phase". For multiphase devices that are intended for use only on a wye system, the marking shall also include the word "wye", or the letter "Y".<br>*Exception: A receptacle of a configuration specified in Table 192.2 is not required to be marked with its horsepower rating* | On the device where visible after installation. See 193.2.4 for location details.<br>*Exception No. 1: The catalog number is not prohibited from appearing on the unit container when the product is too small, or where the legibility is difficult to attain, or where several catalog numbers use common parts.*<br>*Exception No. 2: The installation instructions for 5-15R, 5-20R, 6-15R, and 6-20R flush receptacles shall be located as specified in 193.2.5. See also Reference No. 23 in this table.* |
| Receptacles produced at more than one factory | 2 | A distinctive marking, not prohibited from being in code, by which the device can be identified as the product of a particular factory. | On the device |
| Receptacles requiring strip length information. See 9.1.3 | 3 | Strip length information for the intended conductors. | On the device near the wiring terminals, or on a separate instruction sheet provided with each device. |
| Receptacles not intended for interrupting current | 4 | "CAUTION – Risk of Electric Shock. Do Not Disconnect Under Load" or an equivalent statement following the word "CAUTION". | On the device where visible while the device is in the mated condition |
| Receptacles with fuses (other than plug or cartridge type for branch circuit protection | 5 | "Use only with a ___ volt fuse." The potential to be used in the marking shall be the potential rating of the fuse for which the device is intended. | On the device where visible during fuse replacement |
| Receptacles with TT-R configuration | 6 | "Recreational Vehicle use only" | On the device where visible after installation |
| Receptacles with Figure C1.1 | 7 | A grounding, locking-type receptacle with the configuration shown in Figure C3.8 for use in | On the device where visible after installation |

**Table 193.4 Continued on Next Page**

## Table 193.4 Continued

| Description | Reference | Marking | Location |
|---|---|---|---|
| configuration located in the Standard for Wiring Device Configurations, UL 1681 | | hospitals only shall be marked "Hospital only." See Exception to 15.3.6. | |
| Receptacles with nonconductive mounting means. See 29.1.2. | 8 | "CAUTION – Mounting means not grounded. Grounding wire connection required" or an equivalent wording following the word CAUTION. | On the device where visible during installation |
| Isolated-ground receptacles | 9 | An orange colored triangle with sides 5/32 inch (4.0 mm) or more in length. The triangle is not required to be a contrasting shade of orange if the face of the receptacle is orange colored. | On the device where visible after the receptacle and cover plate are installed |
| | | "Isolated Ground" and "CAUTION – Mounting means not grounded. Grounding wire connection required," or with an equivalent wording following the word "CAUTION." | On the device where visible during installation |
| | | A statement indicating its intended use to reduce electrical noise (electromagnetic interference) by purposely insulating the grounding circuit from any metallic wiring system. | On the device, on the smallest unit container, or on a stuffer sheet provided with each device. |
| Display receptacles | 10 | "Display Receptacle" or equivalent wording. The words "Floor Receptacle" are not considered to be equivalent. | On the device where visible during installation |
| Receptacles with push-in terminals | 11 | a) Instructions for releasing the wire from the terminal connection, that shall be located where readily visible during wiring and rewiring,<br>b) "Solid wire only" unless the terminal is intended for both solid and stranded wire,<br>c) Instructions to strip the insulation from conductors a specific length where readily visible during installation,<br>d) Instructions for connecting properly sized wire where readily visible during installation. | On the device where visible during installation |
| CO/ALR receptacles | 12 | "CO/ALR" | On the device where visible after installation |
| | | "Replace Only With CO/ALR Device". | On the device where visible during installation |
| AL-CU devices | 13 | A receptacle rated 30 A or greater which is intended for use with aluminum conductors or copper and aluminum conductors shall be marked "AL-CU". | On the device where visible after installation |
| AL-CU receptacles for use on 75°C wire | 14 | A receptacle rated 30 A or greater which is intended for use with aluminum conductors or copper and aluminum conductors rated 75 °C (167 °F) shall be marked "AL-CU, 75 °C". | On the device where visible after installation |
| Receptacles rated greater than 30A, and 100 A or less for | 15 | A receptacle intended for use with conductor sizes based on the ampacity of wire rated 75°C, may be marked: "Suitable for use with | On the device where visible during installation, or on the smallest unit container, or on an information sheet packed in the smallest unit container. |

Table 193.4 Continued on Next Page

**Table 193.4 Continued**

| Description | Reference | Marking | Location |
|---|---|---|---|
| use on copper conductors only, intended for use with conductor sizes based on the ampacity of wire rated 75°C. See 118.1.4(d) | | Conductors sized to 75°C ampacities" or equivalent. | |
| Tamper-resistant receptacles | 16 | The phrase "Tamper Resistant" or the letters "TR". The letters "TR" shall be a minimum of 3/16 inch (4.8 mm) in height. | On the device where visible after installation with the cover plate removed |
| Self-contained receptacles | 17 | Installation instructions that include the following:<br>a) Manufacturer's name and complete address<br>b) Catalog number or its equivalent.<br>c) Intended conductor material, cable type, and cable size.<br>d) Limitations for use – for example, "mobile homes".<br>e) Necessary installation instructions such as:<br>1) Wall or ceiling limitations (material, thickness),<br>2) Cable preparation (required slack, tools),<br>3) Selection of wiring material,<br>4) Bracket references, and<br>5) Maximum 2.125-inch (54-mm) slit length for nonmetallic sheathed cable being prepared for installation. | On the smallest unit package, tag or stuffer sheet provided with each device. |
| | | A device not capable of being replaced with a conventional outlet box and receptacle shall be marked with:<br>a) The type of receptacle necessary for replacement purposes, and<br>b) Instructions for disassembly prior to replacement. | On the device where visible after installation |
| | | A device intended for replacement with similar devices without the use of special tools shall be specifically marked to indicate this. | On the device where visible after installation |
| Receptacles with pressure-wiring terminals or binding screw terminals for field wiring on branch circuits | 18 | The value of tightening torque assigned in accordance with 12.4.3 and 12.2.7. | On the device where visible during installation, on the smallest unit container, or on an information sheet packed in the smallest unit container. |
| Receptacles with nongrounding configurations | 19 | "CAUTION: This device is not for grounding use. Connect only to nongrounding circuits." | On the device where visible during installation, on the smallest unit container, or on a stuffer sheet provided with each device. |

**Table 193.4 Continued on Next Page**

## Table 193.4 Continued

| Description | Reference | Marking | Location |
|---|---|---|---|
| (other than 1-15, 1-20, 1-30, 2-15, 2-20, 2-30) | | | |
| Receptacles with Figure C1.2 – C1.5 configurations located in the Standard for Wiring Device Configurations, UL 1681 | 20 | "CAUTION: To Avoid Electric Shock – Review premises carefully and do not use if this slot or blade configuration (design) is already in a circuit having a rating differing from the rating of this device." | On the device where visible during installation, on the smallest unit container, or on a stuffer sheet provided with each device. |
| Flush receptacles with 1-15R configuration | 21 | "REPLACEMENT USE ONLY ON EXISTING CIRCUITS WITH NO MEANS FOR GROUNDING," or the equivalent. | On the smallest unit container |
| 15 and 20 A flush receptacles with wire-binding screws, back-wired pressure plates (clamp terminals), and/or push-in terminals for use with copper wire only | 22 | a) "Notice – Use only copper or copper-clad wire with this device",<br>b) "Notice – Connect only copper or copper-clad wire to this device", or<br>c) "Notice – Use only devices marked CO/ALR with aluminum wire".<br>*Exception: When the device itself carries the marking, one of the following abbreviated markings or the symbol shown in Figure 193.1 meets the intent of the requirement.*<br>a) "Use copper wire only",<br>b) "Cu wire only",<br>c) "Use copper or copper-clad wire only", or<br>d) "Cu and Cu-clad wire only".<br>The marking on the device shall be legible with letters at least 1/16 inch (1.6 mm) high.<br>When molded, the circles and bar of the marking described in Figure 193.1 shall be formed by lines that have twice the width and thickness of the lines used for the letters "CU" and "AL" within the circles. | On the device, on a stuffer sheet, or on the smallest unit container for individually packaged devices; on the device for devices packed for bulk shipment |
| 5-15R, 5-20R, 6-15R and 6-20 R flush receptacles with only push-in terminals | 23 | "15 ampere branch circuits only" and "14 AWG solid copper conductors only", or equivalent wording. | On the device where visible during installation |
| | | "For use on 15 ampere branch circuits only and with 14 AWG solid copper conductors only", or equivalent wording. | On the smallest unit container |
| | 24 | Installation instructions which include a reference to the maximum 15 A branch circuit overcurrent protector rating and limitation to 14 AWG solid copper branch circuit conductors for a receptacle employing push-in terminals. | See 193.2.5 and 193.2.6 |
| 5-15R, 5-20R, 6-15R and 6-20R flush receptacles with combination push-in and | 25 | "Push-in terminals for use on 15 ampere branch circuits only and with 14 AWG solid copper conductors only" or equivalent wording. | On the device where visible during installation |

Table 193.4 Continued on Next Page

## Table 193.4 Continued

| Description | Reference | Marking | Location |
|---|---|---|---|
| wire-binding screw terminals | | "Push-in terminals for use on 15 ampere branch circuits only and with 14 AWG solid copper conductor only. Do not use push-in terminals on a 20 ampere branch circuit." | On the smallest unit container |
| 5-15R, 5-20R, 6-15R and 6-20R flush receptacles with combination push-in and wire-binding screw terminals | 26 | Installation instructions which include a reference to the maximum 15 A branch circuit overcurrent protector rating and limitation to 14 AWG solid copper branch circuit conductors for a receptacle employing push-in terminals. | See 193.2.5 and 193.2.6 |
| 5-15R, 5-20R, 6-15R, and 6-20R flush receptacles with push-in terminals with a wire release mechanism | 27 | Installation instructions which include instructions regarding reuse or rewiring for a receptacle employing push-in terminals with a wire-release mechanism. | See 193.2.5 and 193.2.6 |
| 5-15R, 5-20R, 6-15R, and 6-20R flush receptacles with push-in terminals without a wire release mechanism | 28 | "Push-in terminals not for reuse", or with an equivalent wording, where visible during installation. | On the device where visible during installation |
| | 29 | Installation instructions which include the phrase "Do not re-use or rewire push-in terminals" or equivalent wording for a receptacle employing push-in terminals that are not provided with a wire release mechanism. | See 193.1.5 and 193.1.6. |
| All 5-15R, 5-20R, 6-15R and 6-20 R flush and self-contained receptacles | 30 | Date or other dating period of manufacture not exceeding any three consecutive months.<br><br>An abbreviated date of manufacture or a nationally accepted conventional code or code affirmed by the manufacturer is not prohibited provided that the code does not repeat in less than 20 years, and does not require reference to the production records of the manufacturer to determine when the receptacle was manufactured. | On the device |
| All 5-15R, 5-20R, 6-15R and 6-20 R flush receptacles | 31 | Installation instructions that contain all of the information needed for installation and use as intended, including the following:<br><br>a) The manufacturer's name or trademark.<br><br>b) The words "To Install", "Installation Instructions", or the equivalent.<br><br>c) Branch circuit conductor wire size for each terminal construction provided on the receptacle. A reference to sizing the branch circuit conductors in accordance with the National Electrical Code meets the intent of the requirement when the instructions also contain a cautionary marking restricting installation to a qualified person. This information is not required for a receptacle employing wire leads.<br><br>d) Branch circuit conductor strip length. A strip gauge marked on the device meets the | See 193.2.5 and 193.2.6 |

Table 193.4 Continued on Next Page

## Table 193.4 Continued

| Description | Reference | Marking | Location |
|---|---|---|---|
| | | intent of the requirement; however, when the installation instructions are provided on a separate sheet or container, the instructions shall either reproduce or make specific reference to the strip gauge marked on the device. This information is not required for a receptacle employing wire leads.<br>e) Wire lead strip length, when the receptacle is provided with wire leads. This information is not required when the wire leads are pre-stripped.<br>f) Directions for attaching the line, grounded (neutral) and grounding conductors to the appropriate terminals or leads of the receptacle. The words "White Wire", white or silver-colored terminal, "Black Wire", "Bare or Green Wire", "Equipment Grounding Conductor", or equivalent identifiers or abbreviations marked adjacent to the appropriate terminals on the device or on a wiring diagram meet the intent of the requirement. | |
| All Flush Receptacles provided with separable terminal assembly | 32 | "Do Not Disconnect Under Load" or an equivalent statement. | On the device where visible during installation. |
| All Flush Receptacles provided with separable terminal assembly | 33 | “USE ONLY WITH _________ SERIES RECEPTACLE ” or equivalent statement where the blank includes the manufacturer’s name and product series designation. | On both the receptacle and special purpose connector where visible during installation. |
| Pop-Out Receptacle | 34 | "CAUTION: Risk of Electric Shock. Not intended to be installed in a counter top or a similar work surface" or an equivalent wording following the word CAUTION. | On the device where visible during installation and also marked on the smallest unit shipping container. |
| Pop-Up Receptacle Assembly | 35 | "Suitable for installation in a counter top or a similar work surface" or an equivalent wording. | On the device where visible during installation and also marked on the smallest unit shipping container. |
| Stage receptacles complying with ANSI/ESTA E1.24 dimensional requirements (See 15.3). | 36 | "ANSI E1.24" configuration and "type" where "type" is as identified in Annex A of ANSI E1.24, or an equivalent wording. | On the device. |
| Stage receptacles of the configurations 5T20, 5T30, 5T60 and 5T100 complying with ANSI/ESTA E1.24. | 37 | "CAUTION: Risk of Electric Shock – only intended for use on grounded-neutral electrical circuits" | On the device where visible during installation, or on the smallest unit container, or on a stuffer sheet provided with each device. |

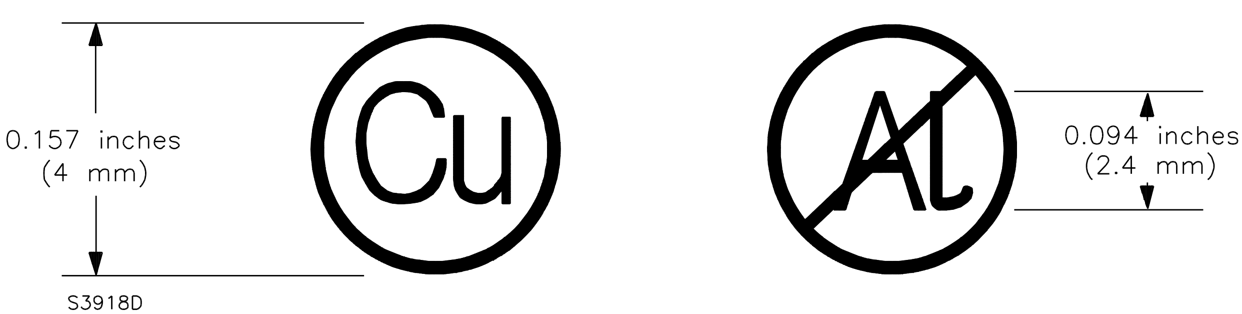
Table 193.4 Continued on Next Page

## Table 193.4 Continued

| Description | Reference | Marking | Location |
|---|---|---|---|
| Receptacles employing a combination wire binding/pressure wire-type terminals for field wiring on a branch circuit | 38 | Installation instructions for assembly of conductors to the terminals. Instructions shall include a pictorial description of the placement of the stripped conductor within the channels/ guides of the enclosure | See 193.2.5 and 193.2.6 |
| Lighted Receptacle | 39 | "Indoor Use Only" | Marked on device where visible during installation. See 42A.2 Exception No. 1. |
| Inlets employing spring-action clamp terminals. | 40 | Installation instructions for assembly of conductors to the terminals. Instructions shall include a pictorial description of the placement of the stripped conductor within the channels/guides of the enclosure. | On the smallest unit container, or on a stuffer sheet provided with each device. |
| Luminaire Support Receptacle 50 lb. support rating | 41 | Luminaire Support 50 lb. Max | On the device, visible during installation |
| Ceiling-suspended fan support receptacle with a 35 lb. support rating | 42 | Fan Support 35 lb. Max | On the device, visible **AFTER** installation |
| Ceiling-suspended fan support receptacle with a 50 lb. support rating | 43 | Fan Support 50 lb. Max | On the device, visible **AFTER** installation |
| Ceiling-suspended fan support receptacle with a 70 lb. support rating | 44 | Fan Support 70 lb. Max | On the device, visible **AFTER** installation |

**Figure 193.1**

**Non-CO/ALR marking**




NOTE – Alternate methods of marking are not prohibited provided an equivalent prominence is achieved.

193.1.7 A current tap intended for use on flexible cord shall be provided with all applicable markings and instructions described in Table 193.5.

**Table 193.5**
**Markings and instructions applicable to current taps wired on flexible cord**

| Description | Reference | Marking | Location |
|---|---|---|---|
| All current taps | 1 | a) The manufacturer's name, trade name or trademark, or other descriptive marking by which the organization responsible for the device is to be identified. A traceable code is not prohibited when the device is identified by the brand or trademark owned by a private labeler.<br>b) The catalog number or an equivalent designation.<br>c) The electrical rating. A device rated for use on alternating current circuits only shall be identified by one of the following means:<br>1) The letters "AC",<br>2) The words "AC Only",<br>3) The symbol "∿",<br>4) A frequency marking (for example, "60 Hertz"),<br>5) A phase marking such as "Φ", the letters "ph" or "PH", or the word "phase". For multiphase devices that are intended for use only on a wye system, the marking shall also include the word "wye", or the letter "Y". | On the device where visible after installation<br>*Exception: The catalog number is not prohibited from appearing on the unit container when the product is too small, or where the legibility is difficult to attain, or where several catalog numbers use common parts* |
| Current taps produced at more than one factory | 2 | A distinctive marking, not prohibited from being in code, by which the device can be identified as the product of a particular factory. | On the device |
| Current taps requiring strip information. See 9.1.3 | 3 | Strip length information for the intended conductors. | a) On the device near the wiring terminals, or<br>b) On a separate instruction sheet provided with each device. |
| Current taps intended for field wiring | 4 | a) The intended flexible-cord types (such as type S, SJ, SJT, HPN, and SPT-1). A cord identification referring to the generic (trade) names for each family of cords (such as Hard Service Cord, Vacuum Cleaner Cord, and Parallel Cord) is not prohibited when all types of cords identified in the family can be utilized with the device.<br>b) The conductor size or sizes<br>c) The total number of conductors.<br>d) The overall cord diameter range, if the device is intended to be utilized with a | On the device, on the smallest unit container, or on a stuffer sheet provided with each device. |

**Table 193.5 Continued on Next Page**

## Table 193.5 Continued

| Description | Reference | Marking | Location |
|---|---|---|---|
| | | limited range of the cord diameters available for a cord type.<br>The information is not prohibited from being combined in an abbreviated format (such as wire sizes 18/3 SV to 14/3 SJ, 0.230 – 0.450 inch diameter). The conductor sizes, total number of conductors and overall diameters shall be included individually or as a range with the appropriate cord types. | |
| Current taps with pin-type terminals intended for field assembly on flexible cord | 5 | a) Instructions for assembling the device to the cord. Details shall be provided, including pictorial representation, to enable proper assembly by an inexperienced person.<br>b) The words "CAUTION – Risk of electric shock. Do not strip wires. Cut off end of cord cleanly." or an equivalent wording following the word CAUTION and any other specific instructions concerning cord preparation.<br>c) Instructions concerning the cord type or types to be used. A description shall be provided of any type of cord that may not be physically excluded but which is not intended to be used (for example, not for use with Type TPT extra-flexible cord such as used on electric shavers). There are some cord groups that are not distinguishable by marking and, where one of these cords is recommended, all shall be capable of proper use or be physically excluded.<br>d) If the device is polarized, the words "CAUTION – Risk of electric shock. Proper polarization must be maintained. Examine the cord carefully before assembling this product. If one of the wires is marked with stripes, grooves or ridges on the outer surface of the insulation, attach that wire to the white or silver-colored terminal. If neither wire is marked, strip a small amount of insulation from the end of both wires and check to see whether either of the wires is white in color. If so, the white wire should be connected to the white-colored terminal. After identifying the white wire, cut end of cord cleanly before attaching the wires to the terminals." or an equivalent wording following the word CAUTION.<br>e) Electrical rating in volts, amperes and wattage corresponding to the ampacity of the cord. If more than one size or type of cord is intended to be used, the electrical rating shall be indicated for each type cord. | On an instruction card attached to the device in such a manner that the device is unable to be readily removed. The use of a blister pack or equivalent securing of the device to the instruction card meets the intent of the requirement. However, the friction attachment of a device to the card shall not be employed. |
| Current taps for disconnecting use only | 6 | "For disconnecting use only," or "Not for current rupturing," or an equivalent statement. | On the device |

Table 193.5 Continued on Next Page

**Table 193.5 Continued**

| Description | Reference | Marking | Location |
|---|---|---|---|
| Current taps with fuses (other than plug or cartridge type for branch circuit protection) | 7 | "Use only with a ___ volt fuse." The potential to be used in the marking shall be the potential rating of the fuse for which the device is intended. | On the device where visible during fuse replacement |
| Current taps with fuses where the fuse can be removed after the blades have been inserted in receptacle. See the Exception to 15.4.6. | 8 | "Disconnect power before replacing fuses" or an equivalent wording. | On the device where visible during fuse replacement |

193.1.8 A flatiron or appliance plug shall be provided with all applicable markings and instructions described in Table 193.6.

**Table 193.6**
**Marking and instructions applicable to flatiron and appliance plugs**

| Description | Reference | Marking | Location |
|---|---|---|---|
| All flatiron and appliance plugs | 1 | a) The manufacturer's name, trade name or trademark, or other descriptive marking by which the organization responsible for the device is to be identified. A traceable code is not prohibited when the device is identified by the brand or trademark owned by a private labeler.<br>b) The catalog number or an equivalent designation.<br>c) The electrical rating. A device rated for use on alternating current circuits only shall be identified by one of the following means:<br>1) The letters "AC",<br>2) The words "AC Only",<br>3) The symbol "∿",<br>4) A frequency marking (for example, "60 Hertz"),<br>5) A phase marking such as "Φ", the letters "ph" or "PH", or the word "phase". For multiphase devices that are intended for use only on a wye system, the marking shall also include the word "wye", or the letter "Y. | On the device where visible after installation. *Exception: The catalog number is not prohibited from appearing on the unit container when the product is too small, or where the legibility is difficult to attain, or where several catalog numbers use common parts.* |

**Table 193.6 Continued on Next Page**

**Table 193.6 Continued**

| Description | Reference | Marking | Location |
|---|---|---|---|
| Flatiron and appliance plugs produced at more than one factory | 2 | A distinctive marking, not prohibited from being in code, by which the device can be identified as the product of a particular factory. | On the device. |
| Flatiron and appliance plugs intended for field wiring | 3 | a) The intended flexible-cord types (such as type S, SJ, SJT, HPN, and SPT-1). A cord identification referring to the generic (trade) names for each family of cords (such as Hard Service Cord, Vacuum Cleaner Cord, and Parallel Cord) is not prohibited when all types of cords identified in the family can be utilized with the device.<br>b) The conductor size or sizes.<br>c) The total number of conductors.<br>d) The overall cord diameter range, if the device is intended to be utilized with a limited range of the cord diameters available for a cord type.<br>The information is not prohibited from being combined in an abbreviated format (such as wire sizes 18/3 SV to 14/3 SJ, 0.230 – 0.450 inch diameter). The conductor sizes, total number of conductors and overall diameters shall be included individually or as a range with the appropriate cord types. | On the device, on the smallest unit container, or on a stuffer sheet provided with each device. |

193.1.9 An angle or shroud adapter for use with attachment plugs and cord connectors shall be provided with all applicable markings and instructions described in Table 193.7.

193.1.10 A receptacle that is provided with a rotatable outlet or outlets and is not provided with a flush device cover plate or outlet box cover shall be marked where visible during installation with the following or equivalent, "For Use Only With ______ (Cat. No) (Series) Cover Plate, Manufactured by ____________".

**Table 193.7**
**Marking and instructions applicable to angle and shroud adapters for use with attachment plugs and cord connectors**

| Description | Reference | Marking | Location |
|---|---|---|---|
| All devices | 1 | a) Identification of the attachment plugs, cord connectors, or both, on which the angle or shroud adapter is intended to be installed, identified by manufacturer name, catalog, or series designation.<br>b) The intended flexible-cord types (such as type S, SJ, SJT, HPN, and SPT-1). A cord identification referring to the generic (trade) names for each family of cords (such as Hard Service Cord, Vacuum Cleaner Cord, and Parallel Cord) is not prohibited when all types of cords identified in the family can be utilized with the device.<br>c) The conductor size or sizes. | a) On the device,<br>b) On the smallest unit container, or<br>c) On a stuffer sheet provided with each device |

Table 193.7 Continued on Next Page

**Table 193.7 Continued**

| Description | Reference | Marking | Location |
|---|---|---|---|
| | | d) The total number of conductors.<br><br>e) The overall cord diameter range, if the device is intended to be utilized with a limited range of the cord diameters available for a cord type.<br><br>The information in b) through e) is not prohibited from being combined in an abbreviated format (such as wire sizes 18/3 SV to 14/3 SJ, 0.230 – 0.450 inch diameter). The conductor sizes, total number of conductors and overall diameters shall be included individually or as a range with the appropriate cord types. | |

## 193.2 Location of markings and instructions

193.2.1 A marking or instruction that is required to be provided on a device without any other restriction shall appear on any surface of the device that will be visible after the device is completely assembled but not installed in the intended manner.

193.2.2 A marking or instruction that is required to be provided on a device where visible during installation shall appear on any surface of the device that will be visible to the installer while wiring and assembling the device in the intended manner.

193.2.3 A marking or instruction that is required to be provided on a device where visible during use shall appear on any surface of the device that will be visible after the device is completely assembled and installed in the intended manner, but not on a face or other surface that will be obscured when the device is mated with another.

193.2.4 A marking or instruction that is required to be provided on a device where visible after installation shall appear on any surface of the device that will be visible after the device is completely assembled and installed in the intended manner. The marking is not to appear on plaster ears, whether the ears are separate pieces or are integral with the mounting means, unless the marking also appears elsewhere on the device. On a receptacle, such a marking shall appear in one of the following locations:

a) On the front of the body or mounting yoke of a receptacle intended for use with a separate flush plate;

b) On the outside of a receptacle mounted on a metal outlet-box cover;

c) On the inside of the insulating cover or on the exposed side of the base of a receptacle having an integral flush plate or outlet-box cover of insulating material; or

d) On a modular receptacle that is intended for installation in a separate mounting yoke, it may appear on the body of the receptacle.

193.2.5 The installation instructions for 5-15R, 5-20R, 6-15R and 6-20R flush receptacles as specified in Table 193.4 shall be located as follows:

a) Individually packaged devices intended for field installation – On the device, the unit container, or on an instruction sheet or card packaged within the unit container. The instructions may be provided on a separate single instruction sheet or card enclosed in a unit container containing more than two receptacles if the container is marked "Individual devices not marked for retail sale" or equivalent wording.

A display card which serves as the unit container and that is used to provide the required instructions for individually packaged receptacles shall be attached to the receptacle in such a fashion that it cannot be accidentally removed or torn free from the receptacle during shipment, distribution or normal handling. The use of a blister package or an equivalent means of securing the card to the receptacle is acceptable. Friction alone is not an acceptable method of attaching the card to the receptacle.

b) Bulk-shipped devices intended for field installation – On each device or provided in the bulk shipping container. One set of instructions shall be provided for each device. The instructions may be bundled in bulk, provided on a tear-off pad, or in other form that is packed in the bulk shipping container. The instructions need not be attached to each individual receptacle.

c) Bulk-shipped devices intended for factory installation as a component of other equipment – On the device, the unit container, or on a separate single instruction sheet or card enclosed in the shipping container. The shipping container shall be marked with a statement, "See enclosed installation instructions" or equivalent wording.

193.2.6 If any of the instructions described in 193.2.5 are placed on the unit container or display card or on an information sheet packed in the unit container, then all such information in its entirety shall be so placed. The information in a marking or instruction shall not be divided between a unit container and an information sheet. A portion of the information may be repeated in more than one location.

## 194 Identification and Marking of Terminals

### 194.1 Grounded and grounding

194.1.1 Device wiring terminals designated "W" (white) intended for connection to grounded circuit conductors or "G" (green) for grounding conductors shall be clearly and permanently identified on the device in accordance with Table 194.1 or Table 194.2. The colors or markings specified for this terminal identification shall not be applied to other than the designated terminals. The identifications shall be readily recognizable during wiring and relate directly to the appropriate terminals.

*Exception: A device that is intended only for factory assembly to a flexible cord and that is intended to be wired in accordance with Figure 194.1 is not required to comply with this requirement.*

**Table 194.1**
**Identification of wiring terminals**

| Identification by: | Grounded terminal | Grounding terminal | All other terminals |
|---|---|---|---|
| Wire-binding screw | White or silver-colored metal or plating on circular screw head | Hexagonal, green-colored nut[b] or slotted screw head[b] | Other than white, silver, grey, or green circular screw head |
| Pressure wire terminal-visible | White or silver-colored metal or plating on connector | Green-colored connector, screw or appendage[b] | Other than white, silver, grey, or green colored terminal |
| Pressure wire terminal-concealed | Distinct white-colored area adjacent to wire entrance hole, or the word "white", or the letter "W" distinctively marked adjacent to wire entrance hole[c] | Distinct green-colored area adjacent to wire entrance hole, or the word "green" or "ground", the letters "G" or "GR"[c], or the grounding | Other than white, silver, grey, or green area adjacent to wire entrance hole (does not preclude a white, grey, or green back cover) |

**Table 194.1 Continued on Next Page**

## Table 194.1 Continued

| Identification by: | Grounded terminal | Grounding terminal | All other terminals |
|---|---|---|---|
| | | symbol[d] distinctively marked adjacent to wire entrance hole | |
| Terminal plate[a] | White or silver-colored metal or plating | – | Other than white, silver, grey, or green metal or plating |
| Insulating enclosure or terminal | The word " white" or the letter "W", marked on or directly adjacent to terminal[c], or white or silver-colored metal or plating on terminal | The word "green", or "ground", the letters "G" or "GR"[c], or the grounding symbol[d] marked on or directly adjacent to terminal, or green colored terminal | Other than white, silver, grey, or green-colored terminal |

[a] Only when all line-terminal binding screws are of the same color.

[b] Not readily removable. See 194.3.1.

[c] In letters at least 1/16 inch (1.6 mm) high.

[d] The grounding symbol shown in Figure 194.2 permitted with or without the circle.

## Table 194.2
## Identification of leads

| Identification by: | Grounded conductor | Grounding conductor | All other conductors |
|---|---|---|---|
| Color of braid[b] | Solid white or gray (without tracer) | Not applicable | White or gray with tracer in braid or<br>Solid color other than white, gray, or green[a] (without tracer) |
| | Color other than white, gray or green, with tracer in braid | Not applicable | Solid color other than white, gray or green[a] (without tracer) |
| Color of insulation[b] | Solid white or gray; stripe, white or gray, on contrasting color other than green[a] | Green with or without one or more yellow stripes | Solid color other than white, gray, or green[a] |
| Color of separator[b] | Solid white or gray | Not applicable | Solid color other than white, gray or green[a] |
| Conductor tinning[c] | Tin or other acceptable metal on all strands of the conductor | Not applicable | No tin or other white metal on the strands of the conductor |

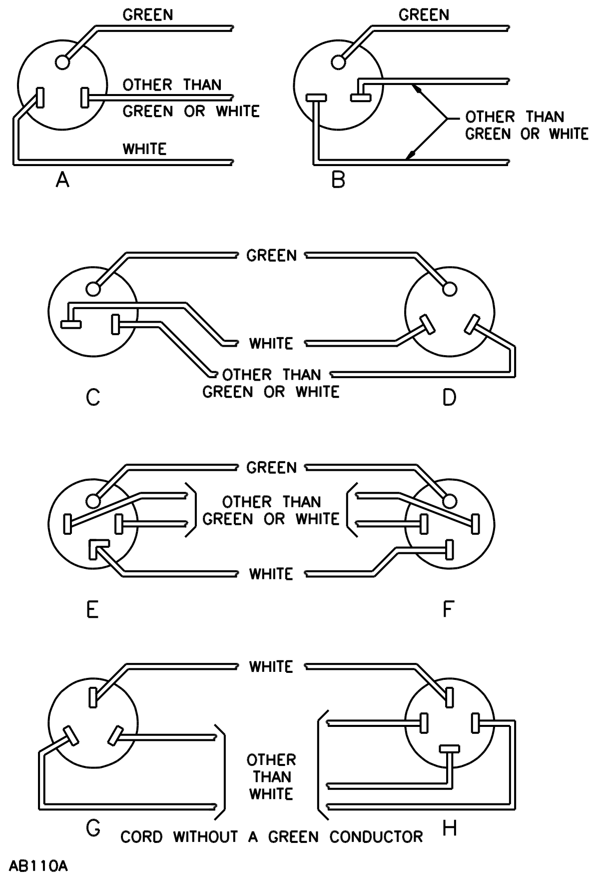
[a] A green wire, with or without one or more yellow stripes, is to be used only as an equipment grounding conductor.

[b] If color of braid, insulation, or separator is used for identification, all conductors are to be either tinned or not tinned.

[c] If conductor tinning is used for identification, all braids and/or insulation are to have the same color and shape.

## Figure 194.1

## Identifying cord or lead connections




NOTES

A, C, and D – Only caps are illustrated. The white and other than green or white connections are interchanged on an outlet.

B and E-H – Each illustration is representative of an outlet or a cap.

A-F – One conductor is green.

G and H – No conductor is green.

A-F – The cross section of the blade to which the green conductor is connected may be U-shaped instead of circular as illustrated.

G – The cross section of the radial blade may be L-shaped instead of rectangular as illustrated.

A, C-F, G and H – White signifies that the conductor is finished to show a white or gray color or is equivalently identified by:

1) A white or gray separator,

2) A stripe, ridge, or groove on the outside surface of the insulation, or

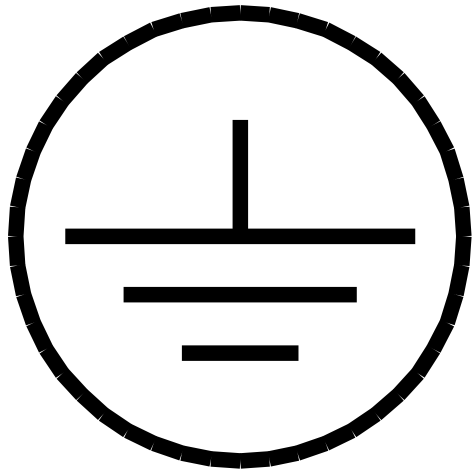
3) A tin or other white metallic coating on each strand.

A-F – Green signifies that the insulation on the conductor is green with or without one or more yellow stripes.

F – This arrangement also covers three-pole, four-wire, 60-ampere, 125/250-volt devices if the white terminal is rotated 90 degrees.

**Figure 194.2**

**Grounding symbol**



### 194.2 Other terminals

194.2.1 Device wiring terminals other than the grounded and grounding terminals described in 194.1.1 are not required to be identified, but if they are, the letters "X", "Y", and "Z" shall be used for identification according to the following convention:

a) Viewing the blade end of the plug and proceeding counter-clockwise starting from the grounding blade (G), or in the absence of a grounding blade, the grounded blade (W), the terminals shall be marked in sequence "X", "Y" and "Z."

b) Viewing the face end of the receptacle and proceeding clockwise, starting from the grounding contact slot (G), or in the absence of a grounding contact slot, the grounded contact slot (W), the terminals shall be marked in sequence "X", "Y" and "Z."

### 194.3 Removable parts

194.3.1 A part relied upon to provide the terminal identification required in 194.1.1 shall not be readily removable if it can be replaced with a similar part of another wiring terminal of the device. A suitably staked terminal screw is considered to be not readily removable for this purpose. A surface of a permanent appendage to a wiring terminal is not prohibited from being used to mark the terminal identification.

*Exception: A readily removable terminal intended for the equipment grounding conductor meets the intent of the requirement when the area adjacent to the terminal is also marked with one of the identifications specified in Table 194.1.*

194.3.2 Identification and marking of terminals in general-use devices other than those illustrated in Section C1 of the Standard for Wiring Device Configurations, UL 1681 and in Wiring Devices – Dimensional Specifications, ANSI/NEMA WD6, may be accepted on a basis equivalent to that outlined in 194.1.1 – 194.3.1. See 15.3.1.

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# SUPPLEMENT SA – ENCLOSURE TYPES FOR ENVIRONMENTAL PROTECTION

## INTRODUCTION

### SA1 Scope

SA1.1 The requirements of this supplement cover an enclosure rating system for attachment plugs, receptacles, inlets, and cord connectors provided with an enclosure intended for use in various environmental applications.

SA1.2 A device with an environmental enclosure shall comply with the applicable requirements of this Standard, UL 498, except as modified by the requirements in this supplement.

SA1.3 The requirements of this supplement do not cover enclosure type designations for wiring devices for use in hazardous locations as defined by the National Electrical Code, ANSI/NFPA 70.

### SA2 Glossary

SA2.1 For the purposes of this supplement, the following definitions apply.

SA2.2 ENCLOSURE, ENVIRONMENTAL – That portion or those portions of a device intended to provide a degree of protection to the contacts, blades, terminals, and other live parts of that device and of any adjoining devices or components comprising a complete protective system against specified environmental conditions, both when the device is unmated and when it is fully connected to its intended mating device. This may include covers, gaskets, boots, and similar protective means. That portion or portions of a device providing such protection may differ for the unmated and the fully connected conditions.

SA2.3 GASKET– A deformable material clamped between stationary faces to provide a degree of protection as specified in Table SA6.1. This may include surfaces or features formed integrally from parts of the environmental enclosure made of deformable material.

SA2.4 SEALING MATERIAL – A pourable or extrudable substance, capable of some degree of hardening and bonding to substrates after application and used as a formed-in-place seal of joints or openings to reduce the likelihood of the passage of gases, vapors, or liquids.

## CONSTRUCTION

### SA3 General

SA3.1 When a receptacle or inlet is provided with or integrates into its design an outlet box, cabinet, junction box, or other portion of the environmental enclosure which includes a means for connection to a conduit, raceway, or other wiring system, in addition to the requirements in this supplement, such an outlet box, cabinet, junction box, or the like, shall comply with the applicable construction and performance requirements in the Standard for Metallic Outlet Boxes, UL 514A, the Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers, UL 514C, or the Standard for Enclosures for Electrical Equipment, Environmental Considerations, UL 50E, as appropriate.

SA3.2 When a receptacle or inlet is provided with or integrates into its design an outlet box cover or cover plate for flush devices, in addition to the requirements in this supplement, such a cover or cover plate shall comply with the applicable construction and performance requirements in the Standard for Metallic Outlet Boxes, UL 514A, the Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers, UL 514C, or the Standard for Cover Plates for Flush-Mounted Wiring Devices, UL 514D, as appropriate.

SA3.3 When a 15- and 20-ampere, 125- and 250-volt nonlocking receptacle is provided with or integrates into its design an outlet box, cabinet, junction box, or other portion of an environmental enclosure that has an environmental rating suitable for use in either a damp or wet location, the receptacle shall comply with Supplement SD "Weather-Resistant Receptacles" contained in this Standard.

SA3.4 The enclosure of an attachment plug, receptacle, inlet, or cord connector marked with an enclosure type designation in accordance with SA7.1 shall comply with the construction requirements in the Standard for Enclosures for Electrical Equipment, Environmental Considerations, UL 50E, that correspond to the enclosure type. A device that complies with the requirements for more than one type of enclosure shall comply with the corresponding requirements for each enclosure type. The enclosure type designation for a device when unmated is not required to be the same as the enclosure type designation of that device when it is fully connected to its intended mating device.

SA3.5 All parts of an environmental enclosure shall be permanently secured to the wiring device such that they cannot be completely removed without the use of a tool after the device has been installed as intended.

*Exception: A part of an environmental enclosure can be completely removable without the use of a tool when the enclosure type designation required in SA7.1 is marked only on the removable part.*

SA3.6 A Type 2 or 3R enclosure shall have provisions for drainage.

*Exception No. 1: A device marked with a Type 2 or 3R enclosure rating that depends on an adjoining device or component comprising the complete environmental enclosure to provide drainage is not required to have provision for drainage on the device itself when the installation instructions or smallest unit container of a device identifies the intended adjoining device or component.*

*Exception No. 2: A Type 2 or 3R enclosure that is also marked as Type 12, 12K, or 13 shall be shipped with the provision for drainage blocked or closed. Instructions shall be provided with the device to indicate how to unblock or open the provision for drainage.*

SA3.7 For a receptacle or inlet marked with a Type 3, 3S, 4, 4X, 6, 6P, 12, 12K, or 13 enclosure rating, the mounting means shall be external to the cavity containing live parts.

SA3.8 A receptacle or inlet which is marked with a Type 12K enclosure rating and which includes conduit knockouts or reclosed openings for conductor entry shall have such knockouts or reclosed openings only in the top and bottom enclosure walls.

SA3.9 A Type 4, 4X, 6, or 6P environmental enclosure comprised of two mateable devices fully connected together shall have enclosure securement means other than blade-and-contact retention alone to resist unintended separation initiated solely by the force of hose-directed water.

SA3.10 To reduce the risk of unintentional separation while submerged, a Type 6 or 6P environmental enclosure comprised of two mateable devices fully connected together shall:

a) Employ an enclosure securement means such that the devices cannot be disconnected without the use of a tool after the devices have been installed as intended, fully connected, and submerged, or

b) Be marked on each device as indicated in SA7.7.

SA3.11 The Type 6 or 6P environmental enclosure designation shall be limited to grounding-type attachment plugs, receptacles, cord connectors, and inlets.

## SA4 Polymeric Enclosures

SA4.1 Polymeric materials used for Types 3, 3R, 3S, 4 and 4X enclosures, or polymeric materials used for fastenings or hinges for these enclosure types shall comply with the Ultraviolet Light Exposure Test in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

*Exception No. 1: Compliance of elastomeric materials shall be demonstrated by the absence of any permanent damage such as distortion of the boot or fitting, or cracking or splitting of the material, following the exposure to ultraviolet light as described in UL 746C, and the subsequent impact test described in Section SA6.*

*Exception No. 2: A part fully internal to the environmental enclosure is not required to comply with this requirement.*

SA4.2 Polymeric materials used for Types 6 and 6P enclosures, or polymeric materials used for fastenings or hinges for these enclosure types shall comply with the Ultraviolet Light Exposure Test and the Water Exposure and Immersion Test in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

*Exception No. 1: Compliance of elastomeric materials shall be demonstrated by the absence of any permanent damage such as distortion of the boot or fitting, or cracking or splitting of the material, following the exposure to ultraviolet light and water as described in UL 746C, and the subsequent impact test described in Section SA6.*

*Exception No. 2: A part fully internal to the environmental enclosure is not required to comply with this requirement.*

## SA5 Gaskets

SA5.1 The requirements in this section apply to gaskets that are required for an electrical enclosure to maintain a tight fit or to comply with the enclosure performance requirements when the wiring device is unmated or fully connected to its intended mating device.

SA5.2 A gasket shall be secured with adhesive or by mechanical means, including force-fit or the combination of the gasket's shape and elastomeric properties. The gasket and its securing means shall not be damaged when the cover is opened.

SA5.3 The gasket material shall comply with the Standard for Gaskets and Seals, UL 157.

## PERFORMANCE

## SA6 General

SA6.1 The enclosure of a device shall comply with the requirements and tests specified in Table SA6.1 for the particular environmental enclosure type appropriate for the intended use and description of the device. Requirements and test descriptions are contained in the Standard for Enclosures for Electrical Equipment, Environmental Considerations, UL 50E, except as modified in this section. All tests are to be conducted using:

a) One set of representative devices unmated, with shrouds and flap or screw covers in place, and

b) One set of representative devices fully connected to their intended mating devices with any enclosure securement means engaged or in place. This set of devices consists of connected combinations of either attachment plugs and receptacles, cord connectors and inlets, or attachment plugs and cord connectors.

SA6.2 An attachment plug or cord connector is to be wired with the appropriate size and type of flexible cord in accordance with the manufacturer's instructions. The free ends of flexible cord are to be sealed against moisture ingress. When assemblies consist of either an attachment plug or cord connector unmated or of an attachment plug and cord connector fully connected together, the assemblies are to be mounted to a horizontal board using clamps on the flexible cord within 4 – 10 inches (101 – 250 mm) of the strain relief of the device.

SA6.3 A receptacle or inlet is to be mounted to the appropriate representative outlet box, wall or panel surface and connected to a wiring system in accordance with the manufacturer's instructions. If the device is provided with a knockout or hub, a short length of the appropriate type of conduit or tubing with its free end sealed to reduce the likelihood of entrance of moisture is to be connected to the device. To equalize the pressure between the enclosure cavity interior and exterior during the Rain Test, the Hose and Hosedown Tests, and the Submersion Test in the Standard for Enclosures for Electrical Equipment, Environmental Considerations, UL 50E, the conduit or tubing is permitted to be vented to an area outside of where moisture may enter through the vent. Prior to subjecting the receptacle or inlet to the Rain Test or the Hose and Hosedown Tests, a self-closing cover that requires positioning or movement in normal use shall remain functional and comply with the requirements of the Rain Test after 1000 cycles of operation.

**Table SA6.1**
**Environmental enclosure types**

| Type | Intended use and description | Requirements or qualification tests from UL 50E |
|---|---|---|
| 2 | Indoor use primarily to provide a degree of protection against limited amounts of falling water and dirt. | Corrosion protection (5.3) or Rust Resistance Test,<br>Drip Test,<br>Gaskets,<br>Gasket Tests |
| 3 | Outdoor use primarily to provide a degree of protection against rain, sleet, wind blown dust and damage from external ice formation. | Rain Test,<br>Dust Test or the hose test described in the Hose and Hosedown Tests,<br>Icing Test,<br>Outdoor Enclosures,<br>Indoor Enclosures,<br>Corrosion Resistant Enclosures,<br>Gaskets,<br>Gasket Tests |
| 3R | Outdoor use primarily to provide a degree of protection against rain, sleet, and damage from external ice formation. | Rain Test,<br>Icing Test,<br>Outdoor Enclosures,<br>Indoor Enclosures,<br>Corrosion Resistant Enclosures,<br>Gaskets,<br>Gasket Tests |
| 3S | Outdoor use primarily to provide a degree of protection against rain, sleet, windblown dust and to provide for operation of external mechanisms when ice laden. | Rain Test,<br>Outdoor method of the Dust Test or the hose test described in the Hose and Hosedown Test,<br>Icing Tests,<br>Outdoor Enclosures,<br>Indoor Enclosures,<br>Corrosion Resistant Enclosures,<br>Gaskets,<br>Gasket Tests |
| 4 | Indoor or outdoor use primarily to provide a degree of protection against windblown dust and rain, splashing water, hose-directed water and damage from external ice formation. | Hosedown test described in the Hose and Hosedown Tests,<br>Outdoor Enclosures,<br>Indoor Enclosures,<br>Corrosion Resistant Enclosures, |

**Table SA6.1 Continued on Next Page**

## Table SA6.1 Continued

| Type | Intended use and description | Requirements or qualification tests from UL 50E |
|---|---|---|
| | | Icing Test,<br>Gaskets,<br>Gasket Tests |
| 4X | Indoor or outdoor use primarily to provide a degree of protection against corrosion, windblown dust and rain, splashing water, hose-directed water and damage from external ice formation. | Hosedown test described in the Hose and Hosedown Tests,<br>Outdoor Enclosures,<br>Indoor Enclosures,<br>Corrosion Resistant Enclosures,<br>Corrosion Resistance Test,<br>Icing Test,<br>Gaskets,<br>Gasket Test |
| 5 | Indoor use primarily to provide a degree of protection against settling airborne dust, falling dirt, and dripping noncorrosive liquids. | Corrosion protection (5.3) or Rust Resistance Test,<br>Drip Test,<br>Indoor settling airborne dust method of the Dust Test or the Atomized Water Test – method B of the Atomized Water Test,<br>Gaskets,<br>Gasket Tests |
| 6 | Indoor or outdoor use primarily to provide a degree of protection against hose-directed water, and the entry of water during occasional temporary submersion at a limited depth and damage from external ice formation. | Hosedown test described in the Hose and Hosedown Tests,<br>Icing Tests,<br>Submersion Tests,<br>Outdoor Enclosures,<br>Indoor Enclosures,<br>Corrosion Resistant Enclosures,<br>Gaskets,<br>Gasket Tests |
| 6P | Indoor or outdoor use primarily to provide a degree of protection against hose-directed water, the entry of water during prolonged submersion at a limited depth and damage from external ice formation. | Hosedown test described in the Hose and Hosedown Tests,<br>Icing Test,<br>Outdoor Enclosures,<br>Indoor Enclosures,<br>Corrosion Resistant Enclosures,<br>Air Pressure Test,<br>Gaskets,<br>Gasket Tests |
| 12, 12K | Indoor use primarily to provide a degree of protection against circulating dust, falling dirt, and dripping noncorrosive liquids. | Corrosion protection (5.3) or Rust Resistance Test,<br>Drip Test,<br>Indoor circulating airborne method of the Dust Test or the Atomized Water Test – method A of the Atomized Water Test,<br>Gaskets,<br>Gasket Tests |
| 13 | Indoor use primarily to provide a degree of protection against dust, spraying of water, oil, and noncorrosive coolant. | Corrosion protection (5.3) or Rust Resistance Test,<br>Oil Test,<br>Gaskets,<br>Gasket Test |

SA6.4 When conducting the Rain Test, the Drip Test, the Hose and Hosedown Tests, and the Submersion Test in the Standard for Enclosures for Electrical Equipment, Environmental Considerations, UL 50E, talcum powder, a moisture-indicating paste, or other similar moisture indicator is to be used. The moisture indicator is to be placed within the environmental enclosure in any area where moisture can come into contact with live parts, and between the faces of the mated devices. Moisture on exposed blades is acceptable only for an unmated attachment plug or inlet that is not provided with a means to maintain the integrity of the specified enclosure type in the blade area. Water is permitted on the face of the device as a result of the Rain Test, the Drip Test, the Hose and Hosedown Tests, and the Submersion Test.

SA6.5 The Rain Test and the Drip Test are not required to be conducted when the enclosure complies with the Hose and Hosedown Tests. Table SA6.2 lists other acceptable substitutes for specific qualification tests from the Standard for Enclosures for Electrical Equipment, Environmental Considerations, UL 50E.

**Table SA6.2**
**Acceptable test substitutes**

| Qualification test from UL 50E | Acceptable substitute for the qualification test | Special conditions |
|---|---|---|
| Rain Test | Hose or Hosedown Test | None |
| Drip Test | Hose or Hosedown Test | None |
| Dust Test (Outdoor method) | Hose test described in Hose or Hosedown Test | None |
| Dust Test (Indoor circulating airborne method | Atomized Water Test– Method A or the Hose or Hosedown Tests | None |
| Dust Test (Indoor circulating airborne method and indoor settling airborne method | Atomized Water Test– Method B or the Hose or Hosedown Tests | None |
| Dust Test | Submersion Test | Enclosure tested without pipe thread sealing compound |
| Dust Test | Oil Test | None |
| Drip Test | Oil Test | None |
| Air Pressure Test | Submersion Test | Enclosure does not have connections for pressurizing the interior and the duration of the submersion is increased from 30 minutes to 24 hours |

SA6.6 The Dust Test is not required to be conducted when the enclosure complies with the Submersion Test. For the devices covered by this supplement, the Submersion Test is not an acceptable substitute for the Hose and Hosedown Tests.

SA6.7 An attachment plug, receptacle, inlet, or cord connector shall also comply with the Crushing Resistance Test described in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. An inlet or receptacle shall also comply with the ball impact test described in the Resistance to Impact Test contained in UL 746C while an attachment plug or cord connector shall comply with the Impact Test (Plugs and Connectors) described in the Standard for Plugs, Receptacles, and Cable Connectors, of the Pin and Sleeve Type, UL 1682.

SA6.8 The ball impact test mentioned in SA6.7 is to be conducted:

a) At room temperature for all devices,

b) Immediately after being conditioned for three hours in a cold chamber at -35°C (-31°F) for devices intended for outdoor use, in lieu of conducting the test at room temperature, and

c) Immediately after being conditioned for three hours in a cold chamber at 0°C (32°F) for devices intended for indoor-use only in locations where the temperature is less than actual room conditions, such as in an unheated garage.

## MARKINGS

### SA7 General

SA7.1 A device with an environmental enclosure rating shall be marked "Enclosure Type(s) ________," "Enc. Type(s) ________," "Enc. ________ ," or the equivalent, where the blank is to be filled in with one or more of the enclosure type designations specified in Table SA6.1. An enclosure that complies with the performance requirements only when its cover or cap is closed and that has a cover or cap which is not self-closing shall be marked "Enclosure Type ________ When Cover Closed," or the equivalent, where the blank is to be filled in with the type designation. An enclosure that complies with the performance requirements only when the device is fully connected to its intended mating device shall be marked "Enclosure Type ________ When Connected," or the equivalent, where the blank is to be filled in with the type designation. The markings shall be visible after installation on the outer enclosure of the device or on the inner or outer surface of the cover or cap. When a part of an environmental enclosure is completely removable without the use of a tool, the enclosure type designation shall be marked only on the removable part. (See SA3.5). An enclosure that requires an additional locking, latching or detent action of a self-closing cover or cap to comply with the performance requirements shall be additionally marked to indicate that action where visible after installation on the outer surface of the cover or cap.

SA7.2 The required markings shall be:

a) Molded or die-stamped,

b) Paint-stenciled or ink-stamped,

c) Stamped or etched onto a metal plate that is permanently secured to the outer enclosure, or

d) Provided on a pressure-sensitive label or a label secured by cement or adhesive.

SA7.3 A required marking shall be capable of withstanding the stresses of ordinary usage, including exposure to weather and other ambient conditions, handling, storage, and similar conditions. An adhesive-backed label shall comply with the requirements in the Standard for Marking and Labeling Systems, UL 969, for the exposure conditions and surface temperatures indicated in Table SA7.1.

*Exception No. 1: The need for exposure tests on forms of marking other than labels shall be individually evaluated.*

*Exception No. 2: A rated surface temperature other than those specified in Table SA7.1 is able to be used when it is demonstrated that the temperature is not exceeded in service.*

SA7.4 For an attachment plug or cord connector with an environmental enclosure rating, the installation instructions or smallest unit container of the device shall be marked "Enclosure Type ________ When Mated With ________," or the equivalent, where the first blank is to be filled in with the type designation and the second blank is to be filled in with the identification of the line of mating devices intended to be used with the device in order for that device to comply with the environmental enclosure requirements corresponding to that type designation.

SA7.5 For a receptacle or inlet with an environmental enclosure rating, the installation instructions or smallest unit container of the device shall be marked "Enclosure Type ________ When Mated With ________ and Installed With ________," or the equivalent, where the first and second blanks are to be filled in as indicated in SA7.4, and the third blank is to be filled in with the identification of any necessary outlet box or cabinet, conduit, or cord fitting, sealing material, preparatory or finishing actions, and any similar information concerning the installation of the device into the overall enclosure, in order for that device to comply with the environmental enclosure requirements corresponding to that type designation.

SA7.6 A receptacle with an integral outlet box cover is able to be marked "Wet Location," "Damp Location," or "Wet Location Only When Cover Closed" when the cover complies with SA3.2.

SA7.7 A Type 6 or 6P disconnectable device that can be disconnected from its intended mating device without the use of a tool after the devices have been installed as intended, fully connected, and submerged shall be marked, "CAUTION" and the following or the equivalent: "Risk of Shock. Do not disconnect while connectors are submerged."

SA7.8 When the acceptability of the environmental enclosure rating of a receptacle or inlet is dependent upon a particular mounting orientation, the enclosure shall be marked to indicate the required orientation.

*Exception No. 1: The enclosure is not required to be marked when the installation instructions or smallest unit container of the receptacle or inlet indicates the required orientation.*

*Exception No. 2: The enclosure of a Type 2 or 3R receptacle or inlet dependent upon the particular mounting orientation of a specific Type 2 or 3R outlet box, or other portion of the environmental enclosure which includes a means for connection to a conduit, raceway, or other wiring system is not required to be marked when the outlet box, cabinet, junction box, or other portion of the environmental enclosure bears its own orientation marking and is specifically identified in the installation instructions or smallest unit container of the receptacle or inlet.*

*Exception No. 3: The enclosure of a Type 2 or 3R receptacle or inlet dependent upon the particular mounting orientation of an unspecified outlet box, cabinet, junction box, or other portion of the environmental enclosure which includes a means for connection to a conduit, raceway, or other wiring system, is not required to be marked when the installation instructions or smallest unit container of the receptacle or inlet indicate the required orientation of the outlet box, cabinet, junction box, or other portion of the environmental enclosure.*

**Table SA7.1**
**Label exposure conditions**

| Enclosure type number | Label exposure conditions | Maximum surface temperature °C (°F) | Minimum surface temperature °C (°F) |
|---|---|---|---|
| 2 | Indoor locations where exposed to high humidity or occasional exposure to water | 60 (140) | 0 (32) |
| 3, 3R, 3S, 4, 4X, 6, 6P | Indoor or outdoor locations where exposed to high humidity or occasional exposure to water | 80 (176) | −35 (−31) |
| 5, 12, 12K, 13 | Indoor locations where exposed to high humidity or occasional exposure to water; additional conditions depending upon the application | 60 (140) | 0 (32) |

# SUPPLEMENT SB – MARINE SHORE POWER INLETS

## INTRODUCTION

### SB1 Scope

SB1.1 The requirements of this supplement cover marine shore power inlets rated at not less than 20 A and not more than 50 A, 250 V maximum. These devices are intended for use with marine shore power cable sets to extend the shore power supply from a shore-installed power outlet to a boat, in accordance with the applicable requirements in the American Boat and Yacht Council (ABYC) Std. E-8-1985, National Fire Protection Association Standard for Pleasure and Commercial Motor Craft, NFPA No. 302-1987, and the United States Coast Guard (USCG) Regulations Title 33, Chapter 1, CFR, Part 183.

### SB2 Glossary

SB2.1 For the purpose of this supplement, the following definitions apply.

SB2.2 FACE COVER – A threaded or hinged cover intended to restrict water from coming in contact with the male blades of a shore power inlet when it is not connected to a shore power cable set.

SB2.3 SHORE POWER CABLE SET – A length of flexible cord or cable assembled with a locking-type grounding attachment plug as a line fitting and a locking-type grounding cord connector as a load fitting intended to be used to supply shore power to boats that are moored to a dock.

SB2.4 SHORE POWER INLET– A boat-mounted inlet (motor attachment plug) intended to provide connection for a shore power cable set.

### SB3 General

SB3.1 A marine shore power inlet shall comply with the requirements for inlets in this Standard and the requirements for wet-location cover plates in the Standard for Metallic Outlet Boxes, UL 514A, the Standard for Nonmetallic Outlet Boxes, Flush Device Boxes, and Covers, UL 514C, or the Standard for Cover Plates for Flush-Mounted Wiring Devices, UL 514D, as applicable, except as modified by the requirements in this supplement.

## CONSTRUCTION

### SB4 General

SB4.1 A shore power inlet shall employ a L5-20P, L5-30P, L6-20P, L6-30P, L14-20P, L14-30P, L15-20P, L15-30P, L21-20P, L21-30P, SS1-50P, or SS2-50P configuration.

SB4.2 A shore power inlet shall be provided with a threaded hub and a threaded or hinged face cover. The hub and the face cover, if threaded, shall have a 2-3/4 – 16, Class 2 thread having at least three full threads. A shore power inlet shall be dimensioned to couple with a shore power cable set load fitting of a corresponding configuration. The face cover shall be positively retained in place on the shore power inlet. See Table SB4.1 and Figure SB4.1 for the required dimensions.

**Table SB4.1**
**Dimensions for a shore power inlet as shown in Figure SB4.1**

| Rating | Shore power inlet inches (mm) | | NEMA WD6 designation |
|---|---|---|---|
| | A[a] | B | |
| 20A, 125 V, 1 Phase, 2 Pole, 3 Wire | 1.880 (47.75) | 0.921[b] (23.39) | L5-20P |
| 30 A, 125 V, 1 Phase, 2 Pole, 3 Wire | 1.880 (47.75) | 1.000[b] (25.40) | L5-30P |
| 20 A, 250 V, 1 Phase, 2 Pole, 3 Wire | 1.880 (47.75) | 0.921[b] (23.39) | L6-20P |
| 30 A, 250 V, 1 Phase, 2 Pole, 3 Wire | 1.880 (47.75) | 1.000[b] (25.40) | L6-30P |
| 20 A, 125/250 V, 1 Phase, 3 Pole, 4 Wire | 2.000 (50.80) | 0.921[b] (23.39) | L14-20P |
| 30 A, 125/250 V, 1 Phase, 3 Pole, 4 Wire | 2.000 (50.80) | 1.000[b] (25.40) | L14-30P |
| 20 A, 250 V, 3 Phase, 3 Pole, 4 Wire | 2.000 (50.80) | 0.921[b] (23.39) | L15-20P |
| 30 A, 250 V, 3 Phase, 3 Pole, 4 Wire | 2.000 (50.80) | 1.000[b] (25.40) | L15-30P |
| 20 A, 208Y/120 V, 3 Phase, 4 Pole, 5 Wire | 2.000 (50.80) | 0.921[b] (23.39) | L21-20P |
| 30 A, 208Y/120 V, 3 Phase, 4 Pole, 5 Wire | 2.000 (50.80) | 1.000[b] (25.40) | L21-30P |
| 50 A, 125 V, 1 Phase, 2 Pole, 3 Wire | 2.015 (51.18) | 1.163[c] (29.54) | SS1-50P |
| 50 A, 125/250 V, 1 Phase, 3 Pole, 4 Wire | 2.015 (51.18) | 1.163[c] (29.54) | SS2-50P |

[a] Minimum dimension.

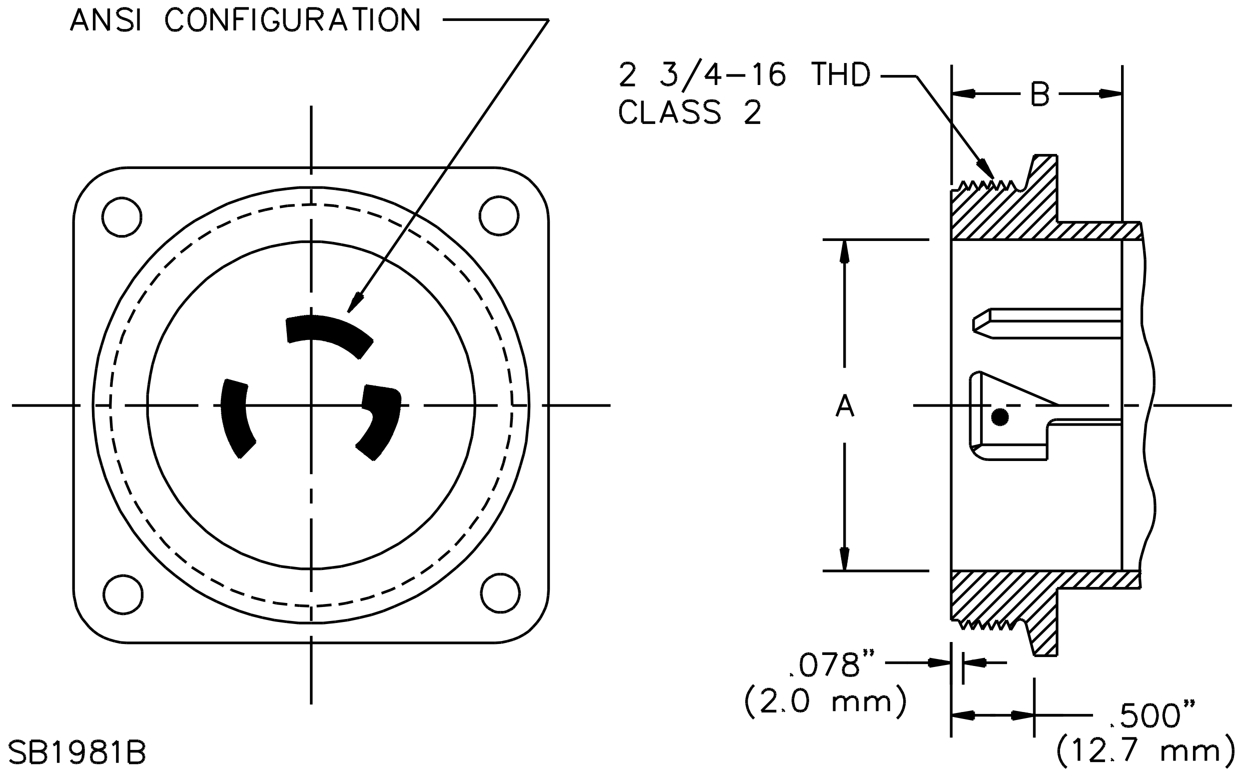
[b] Tolerance of minus 0, plus 0.031 (plus 0.79 mm).

[c] Maximum dimension.

SB4.3 With the face cover in the closed position, the construction of a shore power inlet shall not permit water to enter the inlet and contact the blades or face of the device as determined by the Water-Spray Test, Section SB11.

**Figure SB4.1**

**Dimensions of a shore power inlet**



## SB5 Insulating Materials

SB5.1 An insulating material employed in a shore power inlet shall comply with the Ultraviolet Light Exposure Test and the Water Exposure and Immersion Test in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

*Exception: A material used only on the blade face or rear housing of the shore power inlet is not required to be subjected to the Ultraviolet Light Exposure Test.*

## SB6 Corrosion Resistance

SB6.1 All current-carrying parts shall be copper alloy. The blades of the shore power inlet shall be provided with a corrosion-resistant plating.

SB6.2 Noncurrent-carrying metal parts, such as metal strain-relief clamps or hinges that are depended upon to meet the requirements of the standard, shall be galvanically compatible with other metal parts of the shore power inlet, and shall provide corrosion resistance equivalent to that of:

a) Stainless steel alloys 302, 304, 410, or 430, or

b) Bronze alloys with less than 15 percent zinc content.

SB6.3 If there is any question as to whether the parts are corrosion resistant, the Salt-Spray Test, Section SB8, shall be performed.

# PERFORMANCE

## SB7 General

SB7.1 A shore power inlet shall be subjected to the Mechanical Strength Test, Section SB10, the Water-Spray Test, Section SB11, and the Shock Test, Section SB12. If necessary to determine compliance with the corrosion resistance requirements in SB6.2, a shore power inlet shall also be subjected to the Salt-Spray Test, Section SB8, and the Dielectric Voltage-Withstand Test, Section SB9.

## SB8 Salt-Spray Test

SB8.1 If necessary to determine compliance with the corrosion resistance requirement in SB6.2, a shore power inlet shall be exposed to salt spray (fog) as described in SB8.2. Following the exposure, the shore power inlet shall comply with the Dielectric Voltage-Withstand Test, Section SB9, the Mechanical Strength Test, Section SB10, and the Water-Spray Test, Section SB11.

SB8.2 The salt spray exposure is to be conducted for a period of 750 hours in accordance with the Standard Practice for Operating Salt Spray (Fog) Apparatus, ASTM B117.

## SB9 Dielectric Voltage-Withstand Test

SB9.1 After being subjected to the Salt-Spray Test, Section SB8, a shore power inlet shall withstand without breakdown the application of a 60 Hz essentially sinusoidal potential of 1250 V applied for 1 minute between live parts of opposite polarity and between live parts and accessible dead metal parts.

SB9.2 The test potential is to be supplied from a 500 VA or larger capacity testing transformer whose output is essentially sinusoidal and can be varied. The applied potential is to be increased from zero until the required test voltage is reached, and is to be held at that voltage for a period of 1 minute. The increase in the applied potential is to be at a uniform rate that is as rapid as is consistent with its value being correctly indicated by the voltmeter.

## SB10 Mechanical Strength Test

SB10.1 As a result of the test described in SB10.2 – SB10.4, there shall not be any cracking, breaking, or other physical deterioration of the shore power inlet.

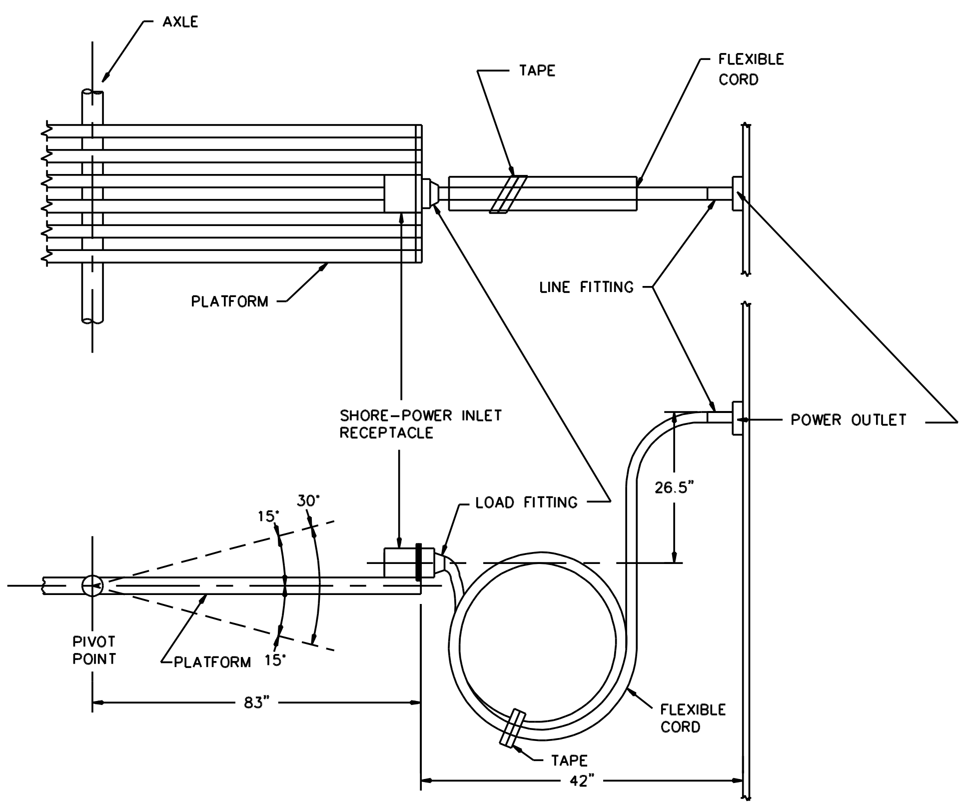
SB10.2 One shore power inlet is to be installed on a platform as shown in Figure SB10.1. A 50 ft (15.2 m) shore power cable set is to be connected between the shore power inlet and a fixed end (to simulate its connection to a power inlet) as shown in the figure. The excess cord of the shore power cable set is to be coiled between the shore power inlet and the fixed point and taped at the base of the coil. During the test, the shore power cable set is to be free to move without striking any surface.

SB10.3 The platform is to be rotated to cause the mounted power inlet to move back and forth in a vertical direction through an angle of 30 degrees (15 degrees above and below the horizontal) for a total of 1000 cycles at a rate of 15 cycles per minute.

SB10.4 After completion of the 1000 cycles, the shore power inlet is to be visually examined for damage including cracking of the insulation materials, boots, and covers.

**Figure SB10.1**

**Mechanical strength test apparatus**




SB1968

| inch | 26.5 | 42 | 83 |
|---|---|---|---|
| mm | 673 | 1067 | 2108 |

## SB11 Water-Spray Test

SB11.1 As a result of the test described in SB11.2 – SB11.4, water shall not contact the current-carrying parts of a shore power inlet.

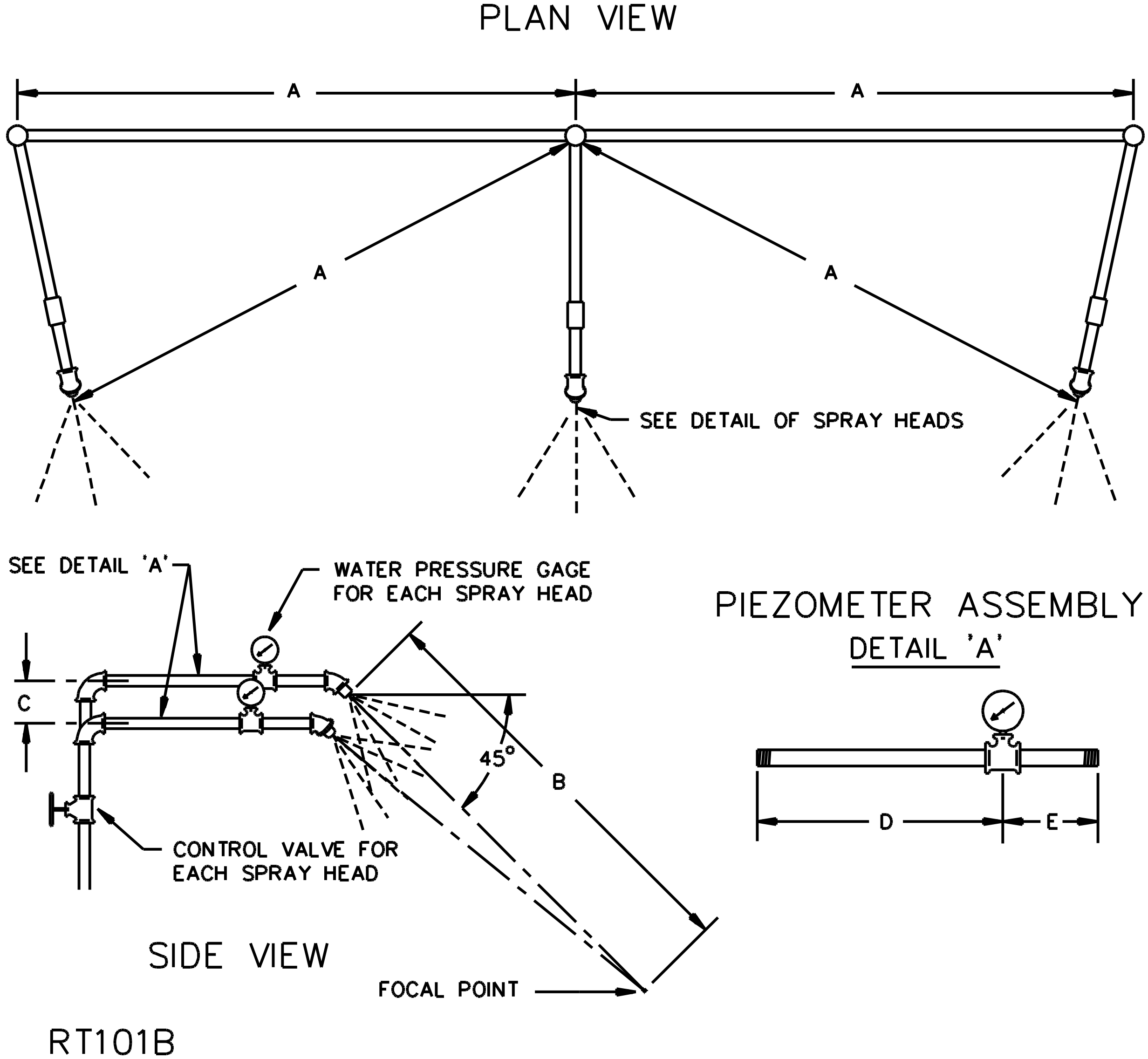
SB11.2 One shore power inlet is to be mounted to a vertical wall section with its face cover in the closed position.

SB11.3 The shore power inlet is then to be sprayed with water for one hour. The water-spray apparatus is to consist of three spray heads mounted in a water-supply pipe rack as illustrated in Figure SB11.1. The spray heads are to be constructed in accordance with Figure SB11.2. The water-supply pipe rack with spray heads is to be located so that the focal point of the spray is at the face cover of the shore power inlet. The water pressure is to be maintained at 5 lbs/in$^2$ (34 kPa) at each spray head.

SB11.4 After being subjected to the water spray described in SB11.3, the outside surface of the shore power inlet is to be wiped dry. The face cover is then to be opened and inspected for any water entry.

**Figure SB11.1**

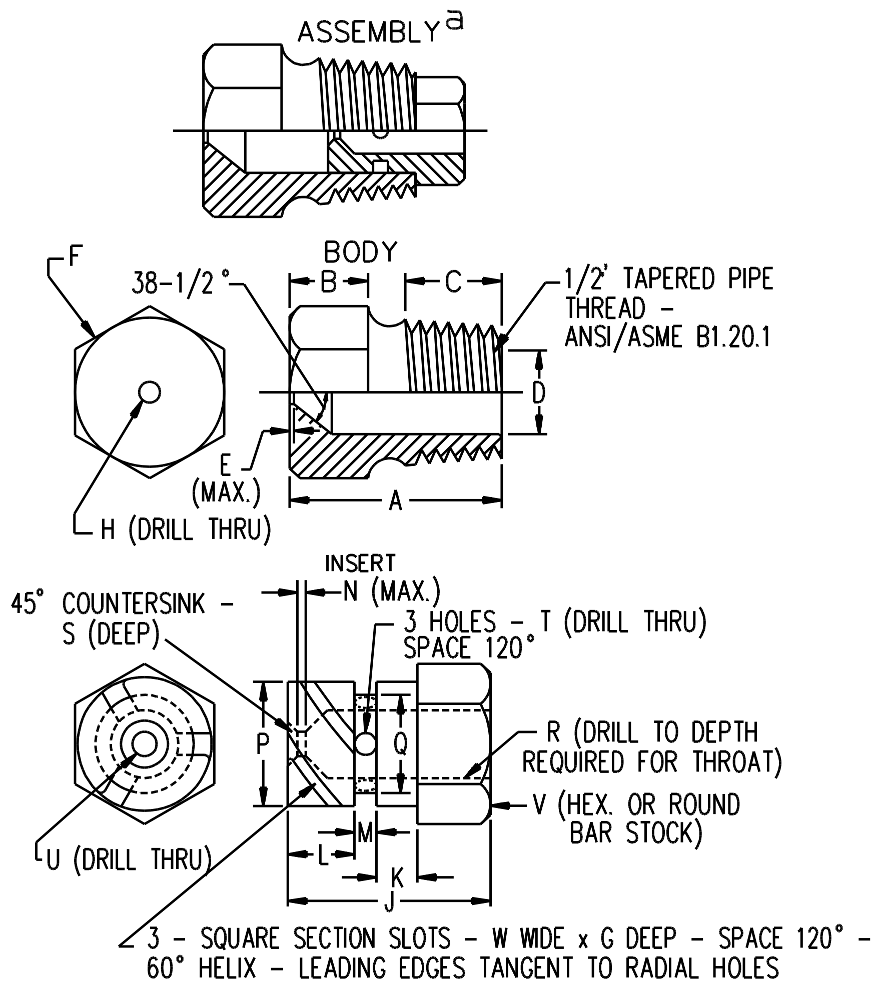
**Water-spray-head piping**




| Item | Inch | mm |
|---|---|---|
| A | 28 | 710 |
| B | 55 | 1400 |
| C | 2-1/4 | 55 |
| D | 9 | 230 |
| E | 3 | 75 |

**Figure SB11.2**

**Water-spray head**




| Item | inch | mm | Item | inch | mm |
|---|---|---|---|---|---|
| A | 1-7/32 | 31.0 | N | 1/32 | 0.80 |
| B | 7/16 | 11.0 | P | .575 | 14.61 |
| C | 9/16 | 14.0 | | .576 | 14.63 |
| D | .578 | 14.68 | Q | .453 | 11.51 |
| | .580 | 14.73 | | .454 | 11.53 |
| E | 1/64 | 0.40 | R | 1/4 | 6.35 |
| F | c | c | S | 1/32 | 0.80 |
| G | .06 | 1.52 | T | (No. 35)[b] | 2.80 |
| H | (No.9)[b] | 5.0 | U | (No. 40)[b] | 2.50 |
| J | 23/32 | 18.3 | V | 5/8 | 16.0 |
| K | 5/32 | 3.97 | W | 0.06 | 1.52 |
| L | 1/4 | 6.35 | | | |
| M | 3/32 | 2.38 | | | |

[a] Nylon Rain-Test Spray Heads are available from Underwriters Laboratories

[b] ANSI B94.11M Drill Size

[c] Optional – To serve as a wrench grip.

RT100E

## SB12 Shock Test

SB12.1 As a result of the test described in SB12.2 – SB12.4:

a) There shall not be any cracking, breaking, or physical deterioration of the shore power inlet, and

b) No portion of the flexible cord attached to the wiring terminals of the shore power inlet shall pull out of the device.

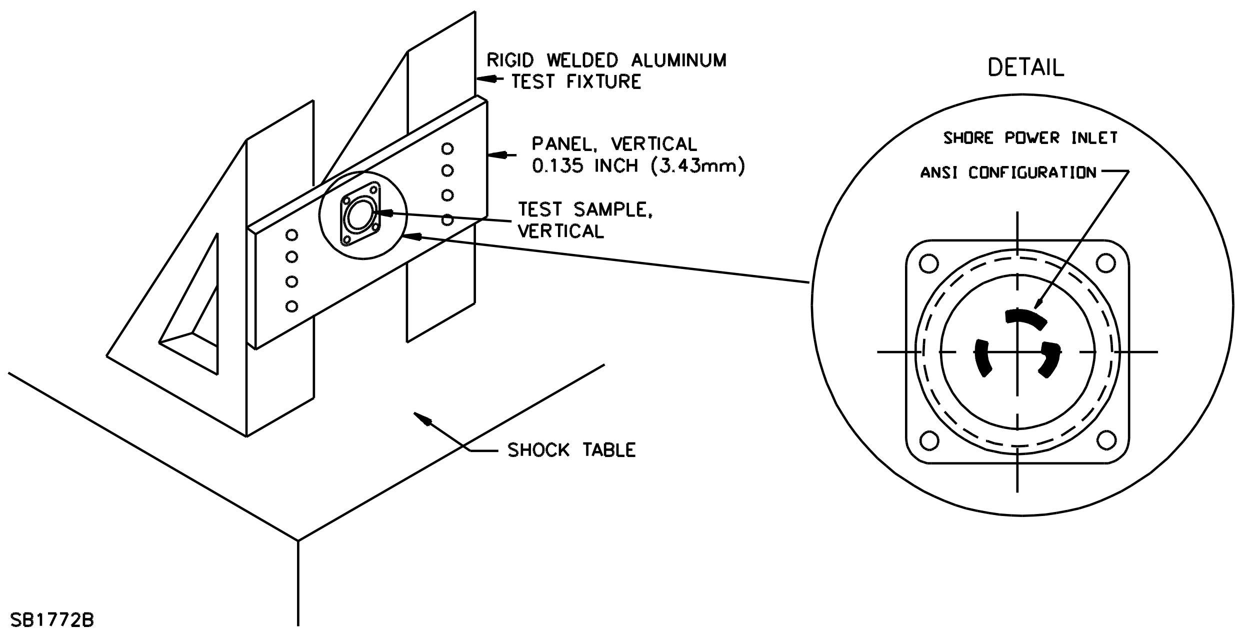
SB12.2 One device is to be mounted on a 0.135 inch (3.43 mm) steel or aluminum panel that is in turn to be secured in a vertical plane to a rigid test fixture. The assembly (inlet, panel, and fixture) is then to be secured to a shock table. See Figure SB12.1.

SB12.3 The device is to be wired with flexible cord of the appropriate size for the device rating and torqued to simulate a normal installation. The opposite end of the cord is to be secured to a point located off the shock table platform at a point within 18 inches (457 mm) of the terminals.

SB12.4 The assembly (device, fixture, and cord) is to be subjected to 1000 shock impacts of 10 g [322 ft/s$^2$ (98 m/s$^2$)] peak acceleration and 20 – 25 milliseconds duration as measured at the base of the half-sine shock wave envelope. The test is to be conducted at room temperature.

**Figure SB12.1**

**Shock test**



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# SUPPLEMENT SC – HOSPITAL GRADE DEVICES

## INTRODUCTION

### SC1 Scope

SC1.1 The requirements of this supplement cover Hospital Grade attachment plugs, cord connectors, and receptacles, intended for hospital use in other than hazardous locations in accordance with Article 517 of the National Electrical Code, ANSI/NFPA 70. They are applicable only to nonlocking-type devices of the 5-15, 6-15, 5-20, and 6-20 configurations. Receptacles shall be intended only for flush installation, and plugs and connectors shall be either of the straight type (flexible cord exits at the rear of the device) or angled type (cord exits at an angle to the major plug axis) intended for field assembly on flexible cord.

SC1.2 A Hospital Grade device shall comply with the applicable requirements of this Standard, UL 498, except as modified by the requirements in this supplement.

SC1.3 Other types such as factory assembled plugs and connectors, devices having locking-type configurations, or devices for hazardous locations may be investigated based on the requirements in this supplement along with any modifications needed to adequately represent the expected use of the device.

SC1.4 These requirements do not cover Hospital Grade molded-on attachment plugs of power-supply cords.

## CONSTRUCTION

### SC2 General

SC2.1 To provide strain relief for an attachment plug or cord connector, the clamp shall be capable of being easily tightened on the specified flexible cords to grip both the jacket and individually insulated conductors so that forces exerted on the cord (pushing or pulling) are not transmitted to the wiring terminal. See also Strain Relief Tests, Sections SC5 and SC19.

SC2.2 The wiring terminals of an attachment plug or cord connector shall be located in individual insulating compartments (wiring terminal enclosures) with no joints or seams through which stray strands of the conductor can pass during wiring. The wiring terminal compartment insulating walls or barriers are to either:

a) Extend not less than 1/32 inch (0.79 mm) above metal parts of wired terminals and provide a spacing between metal parts of adjacent wire terminals of not less than 3/32 inch (2.38 mm) through air and over surface,

b) Extend not less than to be flush with metal parts of wired terminals and provide a spacing between metal parts of adjacent wired terminals of not less than 1/4 inch (6.35 mm) through air and over surface, or

c) Extend over the top of the terminal compartments with a wire clearance hole in the insulating wall or cover sized to:

1) Accept the individual wire insulation, or

2) Be spaced not less than 1/4 inch (6.35 mm) apart as measured from the periphery of each hole.

SC2.3 The housing of an attachment plug or cord connector that is grasped in handling the device shall be an insulating material with no accessible metal parts on the outside that extend into wiring or cord compartments that may contain unclamped or stray flexible cord conductor strands. Metal strain relief clamps are not prohibited by this requirement.

SC2.4 The size of an attachment plug shall provide for the full insertion of two attachment plugs simultaneously into a duplex receptacle. Angle plugs may have their assemblies rotated to determine compliance.

SC2.5 The blades of an attachment plug shall be formed of solid brass material in conformance with Wiring Devices – Dimensional Specifications, ANSI/NEMA WD6. The grounding pin shall not be capable of being easily bent or removed without the use of tools.

SC2.6 The grounding contact of a cord connector or receptacle shall enable free insertion of a U-shaped grounding pin at any possible angle permitted by the clearance opening for the grounding pin.

## PERFORMANCE

## GENERAL

### SC3 Representative Devices

SC3.1 A Hospital Grade attachment plug is to be subjected to the tests outlined in Table SC3.1 in addition to those outlined in Table 59.1.

**Table SC3.1**
**Summary of tests[a]**
**Hospital grade attachment plugs**

| Section | Test sequences | No. of devices[b] | Details |
|---|---|---|---|
| SC5 | Strain Relief – static pull | 6 | |
| SC5 | Strain Relief – rotary pull | 3 | |
| SC5 | Strain Relief – abrupt removal | | |
| | Straight plugs | 8 | |
| | Angle plugs | 16 | |
| SC6 | Crushing | 6 | |
| SC7 | Impact Resistance | 6 | |
| SC8 | Mechanical Drop | 6 | |
| SC9 | Mold Stress Relief | 6 | May be combined with Mold Stress Relief Test in Section 63. See Table 59.1. |

[a] To be conducted in addition to any applicable tests specified in Table 59.1.

[b] A set of representative devices may be used for more than one test sequence if agreeable to all concerned.

SC3.2 A Hospital Grade cord connector is to be subjected to the tests outlined in Table SC3.2 in addition to those outlined in Table 59.3.

**Table SC3.2**
**Summary of tests[a]**
**Hospital grade cord connectors**

| Section | Test sequences | No. of devices[b] | Details |
|---|---|---|---|
| SC11<br>SC12 | Grounding Contact Temperature<br>Resistance | 8 | |
| SC13 | Grounding Contact Overstress | 6 | |

Table SC3.2 Continued on Next Page

**Table SC3.2 Continued**

| Section | Test sequences | No. of devices[b] | Details |
|---|---|---|---|
| SC14 | Plug Connection and Separation | | |
| SC15 | Crushing | 6 | |
| SC16 | Impact Resistance | 6 | |
| SC17 | Mechanical Drop | 6 | |
| SC18 | Mold Stress Relief | 6 | May be combined with Mold Stress Relief Test in Section 63. See Table 59.3. |
| SC19 | Strain Relief – static pull | 6 | |
| SC19 | Strain Relief– rotary pull | 3 | |
| SC19 | Strain Relief – abrupt removal | 8 | |

[a] To be conducted in addition to any applicable tests specified in Table 59.3.

[b] A set of representative devices may be used for more that one test sequence if agreeable to all concerned.

SC3.3 A Hospital Grade receptacle is to be subjected to the tests outlined in Table SC3.3 in addition to those outlined in Table 59.4.

**Table SC3.3**
**Summary of tests[a]**
**Hospital grade receptacles**

| Section | Test sequences | No. of devices[b] | Details |
|---|---|---|---|
| SC21<br>SC22<br>SC23<br>SC24 | Abrupt Plug Removal<br>Grounding Contact Temperature<br>Resistance<br>Fault Current | 8 | Represents the Fault Current Test required by Section 122 |
| SC25 | Grounding Contact Overstress | 6 | |
| SC26 | Terminal Strength | 3 | |
| SC27 | Assembly Security | 3 | |
| SC28 | Impact | 6 | |
| SC29 | Mold Stress Relief | 6 | May be combined with the Mold Stress Relief Test in Section 63. See Table 59.4. |

[a] To be conducted in addition to any applicable tests specified in Table 59.4.

[b] A set of representative devices may be used for more than one test sequence if agreeable to all concerned.

## HOSPITAL GRADE ATTACHMENT PLUGS

### SC4 General

SC4.1 Unless otherwise stated, previously untested plugs are to be used for each test.

### SC5 Strain Relief Tests

#### SC5.1 General

SC5.1.1 After being subjected to the strain relief tests described in this section, there shall not be any displacement of the conductors, conductor insulation, or outer jacket of the flexible cord exceeding 1/32 inch (0.79 mm). There shall not be any cuts, rips, or tears in the cord insulation nor any breakage of the attachment plug that could adversely affect the enclosure of live parts, strain relief, or grounding path integrity.

SC5.1.2 Attachment plugs are to be assembled onto 12 inch (305 mm) lengths of flexible cord 24 hours before testing. The flexible cord is to be cut at right angles to its major axis (but not stripped) and placed in the plug with its conductors positioned as if they were to be connected to the terminals. A 20 A attachment plug is to be assembled onto 16 AWG (1.3 $mm^2$), Type SJT cord. A 15 A plug is to be assembled onto 18 AWG (0.83 $mm^2$), Type SVT cord except where the device is marked on or in the carton to specifically exclude the use of cords having a diameter of less than 0.300 inch (7.62 mm) in which case Type SJT cord having 18 AWG (0.83 $mm^2$) conductors is to be used. Except for a device that is individually packaged with instructions for cord clamp installation indicating the torsional force to be applied, the clamp is to be tightened with a torque of 8 in-lbf (0.9 N·m). Straight-plug testing requires 17 assemblies; angle-plug testing requires 25.

### SC5.2 Method A – static pull

SC5.2.1 Each of six devices previously assembled onto flexible cord is to be subjected to a gradually applied pull of 30 lbf (133 N) to the free end of the cord while supporting the attachment plug. The force is to be applied for 1 minute in a direction perpendicular to the plane of cord entry.

### SC5.3 Method B – rotary pull

SC5.3.1 Each of three devices previously assembled onto flexible cord is to be subjected to a rotary cord motion while a 10 lbf (44.5 N) is applied for 2 hours. The cord is to be rotated at a rate of approximately 9 rpm in a 3 inch diameter (0.76 mm) circle at a point of 6 inches (152 mm) below the cord exit with the attachment plug rigidly mounted. (Note – This test is conveniently done with the UL secureness test apparatus described in the Standard for Wire Connectors, UL 486A-486B.)

### SC5.4 Method C – abrupt removal

SC5.4.1 Each attachment plug previously assembled onto flexible cord as described in SC5.1.2 is to be subjected to one abrupt removal from a Hospital Grade duplex receptacle in accordance with the procedure described in this section. One half of the devices is to be tested using a receptacle that has the grounding contact integral with the strap. The remaining devices are to be tested with a receptacle having separate grounding contacts riveted to the strap. A new plug is to be used for each abrupt removal.

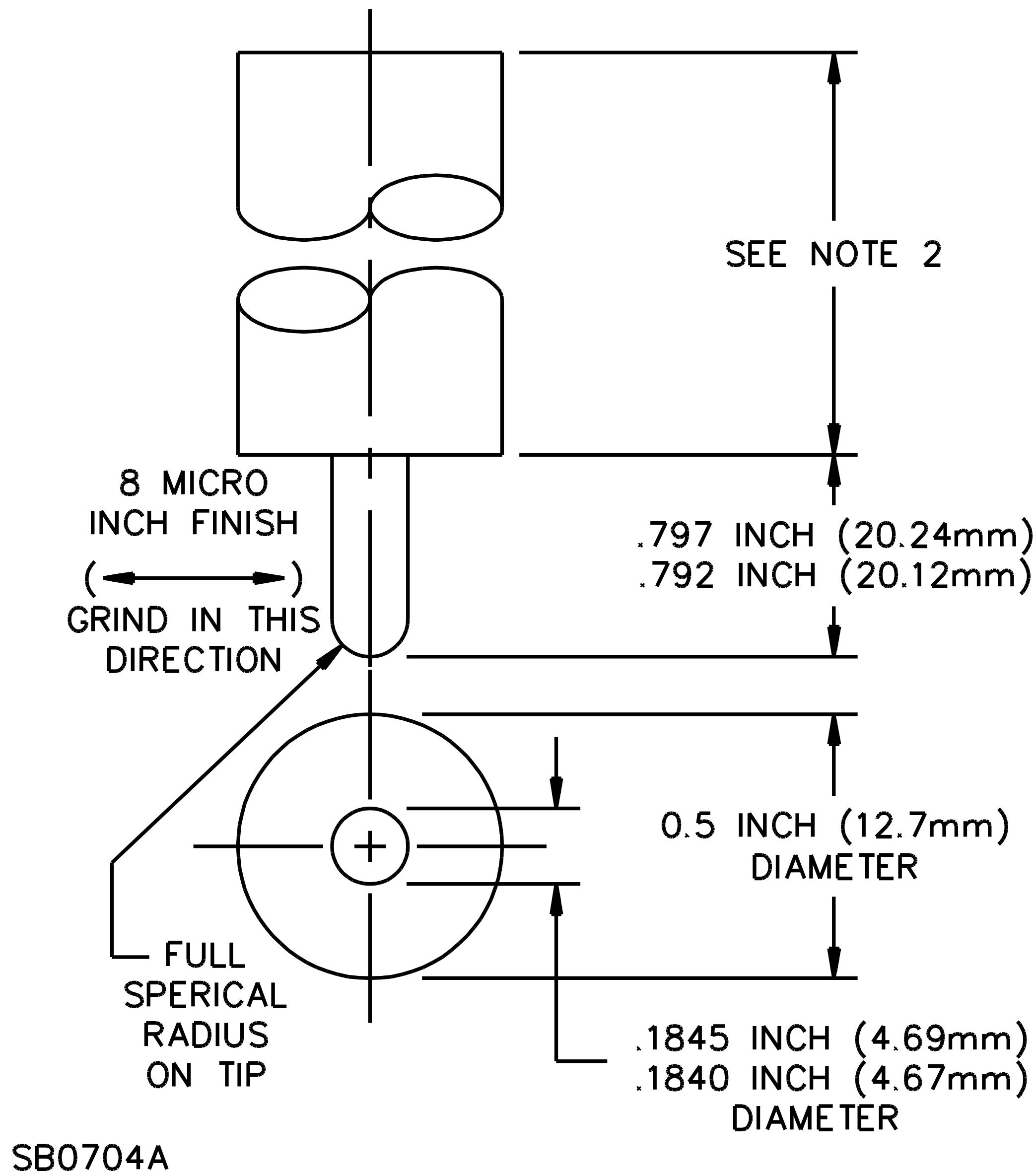
SC5.4.2 Each receptacle outlet to be used for conducting this test is first to be conditioned by ten cycles of full insertion and complete withdrawal of an attachment plug of the matching configuration having solid line blades and a U-shaped ground pin rigidly supported by the attachment plug body. Each conditioned outlet is then to retain the fully inserted test pin illustrated in Figure SC5.1 for not less than 1 minute with the receptacle face horizontal and the weight applied perpendicular to the face plane, tending to remove the pin. The displacement of the test pin shall not be greater than 0.079 inch (2 mm). Any receptacle that is unable to retain the test pin after the conditioning cycles is not to be used for conducting the abrupt removal test.

SC5.4.3 Each receptacle is then to be mounted to represent a typical installation and a 0.030 plus 0.003 minus 0.0 inch (0.76 plus 0.08 minus 0.0 mm) thick steel faceplate rigidly mounted as intended, being supported around its perimeter. The receptacle face is to be in a vertical plane in a manner that will facilitate the test orientations described in SC5.5.1 and SC5.6.1. See Figure SC5.2.

SC5.4.4 The flexible cord of each attachment plug assembly is to be fastened to the clamping mechanism shown in Figure SC5.3 or an equivalent mechanism that provides for the connection to the test set up shown in Figure SC5.2.

**Figure SC5.1**

**Standard grounding pin**




NOTES

1) All dimensions in inches.

2) Length not specified

3) Total tool weight of 4 oz (113 g).

4) Hardened steel pin.

| microinch | 8 |
| --- | --- |
| nanometer | 200 |

**Figure SC5.2**

**Test set-up for abrupt removals test**

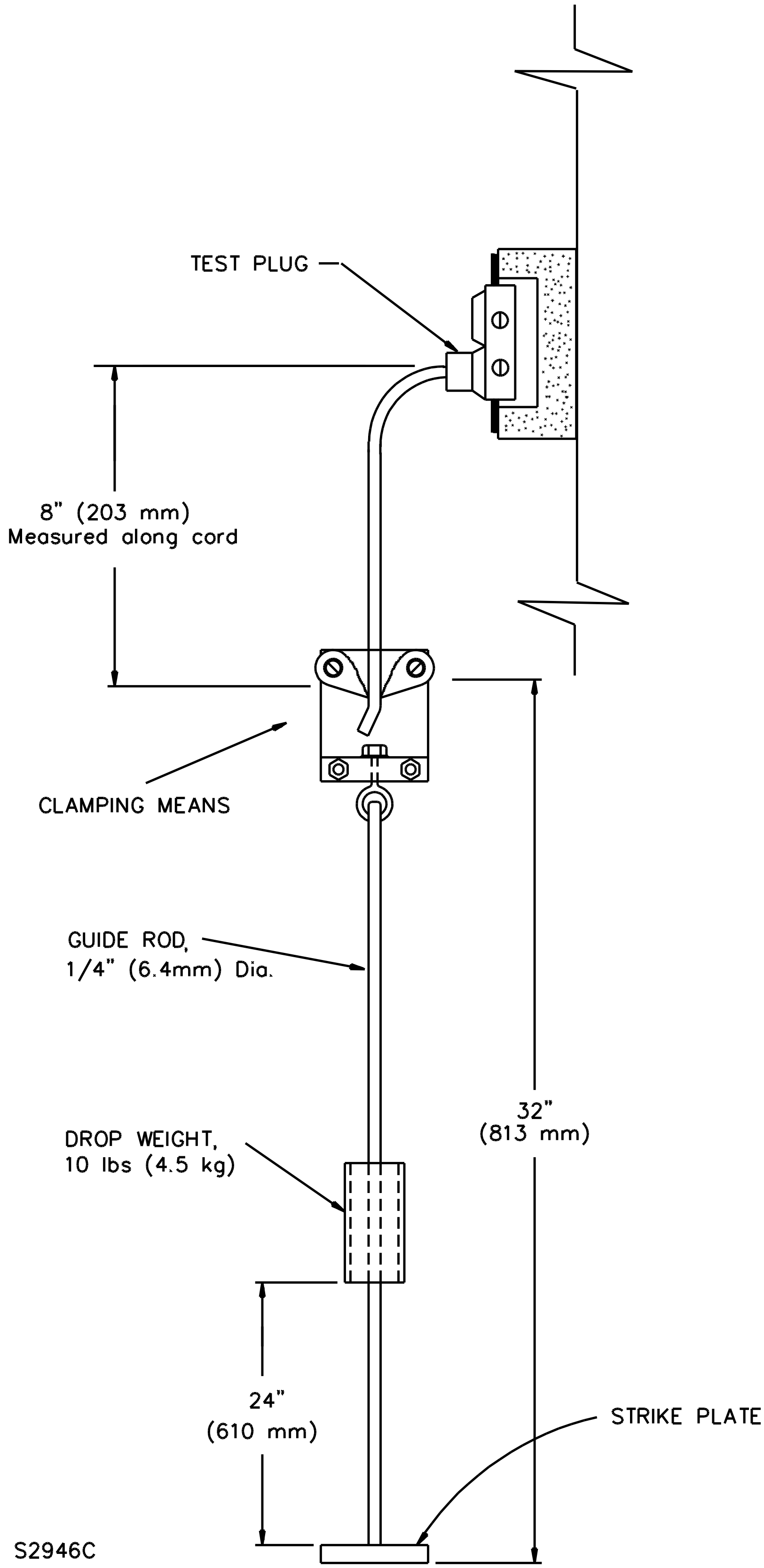
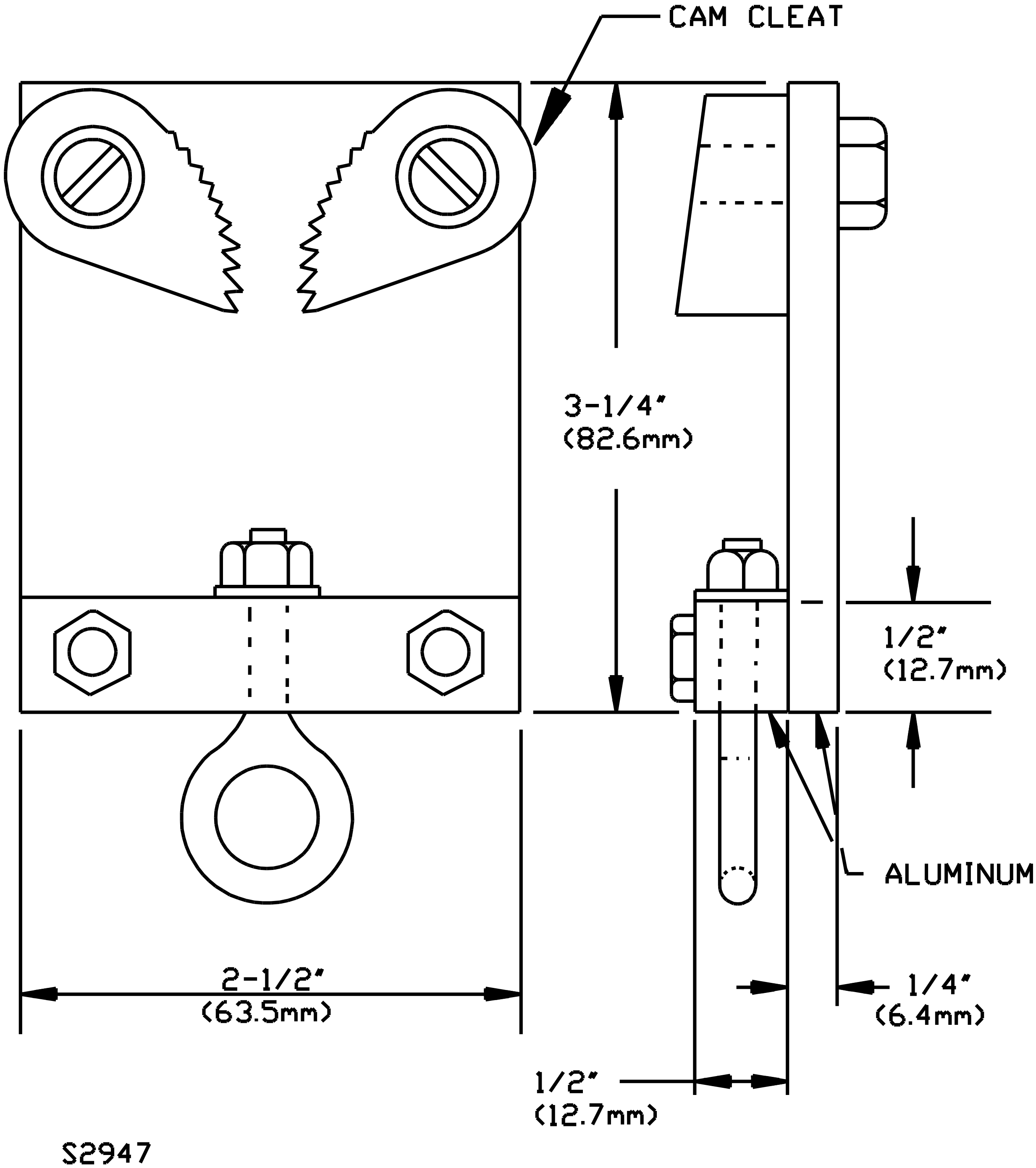


**Figure SC5.3**

**Typical clamping mechanism**



SC5.4.5 The receptacle outlets conditioned as described in SC5.4.2 and subsequently mounted as described in SC5.4.3 are then to be used to subject the attachment plug to the abrupt removals specified in SC5.5.1 or SC5.6.1, as applicable. Each abrupt removal is to consist of the full insertion of the attachment plug followed by the complete withdrawal by means of a 10 lb (4.4 kg) weight dropped from a height of 24 inches (0.61 m) – measured from the bottom of the weight – onto a striker plate attached to the plug by a 1/4 inch (6.4 mm) diameter guide rod and a flexible coupling. The guide rod shall be located as shown in Figure SC5.2. The applied force shall cause the removal of the test plug in one continuous motion.

### SC5.5 Straight attachment plugs

SC5.5.1 The abrupt removal procedure for straight plugs is as follows: one removal with the grounding pin opening to the top of the vertically-oriented receptacle slots, then three additional removals rotating the receptacle 90 degrees clockwise before each additional plug removal. A total of eight devices is therefore required (four to be tested with each of the two receptacle types mentioned in SC5.4.1).

### SC5.6 Angle attachment plugs

SC5.6.1 The abrupt removal procedure for angle plugs is as follows: four separate removals are required in each of two receptacle positions. First, the receptacle is to be positioned with the grounding pin opening to the top of the vertically-oriented slots. The first plug removal is to be with the direction of cord exit from the attachment plug to the top, then three additional removals are to be performed using devices whose cover has been rotated 90, 180, and 270 degrees from the original position. Four similar removals are then to be done with the receptacle positioned so that the grounding pin hole is to the right of the horizontally-oriented slots (first plug tested with cord exit to the top to be followed by plug removals with the cord exit at 90, 180, and 270 degrees from the original position). A total of 16 devices is therefore required (8 to be tested with each of the two receptacle types mentioned in SC5.4.1).

## SC6 Crushing Test

SC6.1 An attachment plug shall be capable of withstanding the crushing test without resulting in breakage, deformation, or other adverse effects that may interfere with the intended function of the device.

SC6.2 Each of six devices wired onto flexible cord is to be placed between rigid horizontal steel plates. A crushing force is to be applied, increased gradually to a value of 500 lbf (2224 N). The force is then gradually removed. Each assembly is to be oriented in a natural resting position before applying the force. In no case is the force to be applied to the projecting blades.

SC6.3 The flexible cord used to wire the attachment plugs is to be the minimum size and type of flexible cord specified for use by the manufacturer in accordance with Reference No. 4 of Table 193.1.

## SC7 Impact Resistance Test

SC7.1 As a result of the impact resistance test there shall not be any breakage of the body or other damage that may adversely affect the function of an attachment plug.

SC7.2 Each of the devices wired onto flexible cord is to be subjected to an impact caused by dropping a cylindrical 10 lb (4.5 kg) weight, having a flat face that is 2 inches (50.8 mm) in diameter, from a height of 18 inches (457 mm). Each assembly is to be placed on a hardwood surface in any natural resting position. A cylindrical attachment plug is to have its major axis parallel to the surface. The hardwood surface is to be a maple block approximately 1-5/8 inches (42 mm) thick by 4-1/2 inches (114 mm) square and is to rest on a fixed surface such as a concrete floor.

SC7.3 The flexible cord used to wire the attachment plugs is to be the minimum size and type of flexible cord specified for use by the manufacturer in accordance with Reference No. 4 of Table 193.1.

## SC8 Mechanical Drop Test

SC8.1 Following the mechanical drop test:

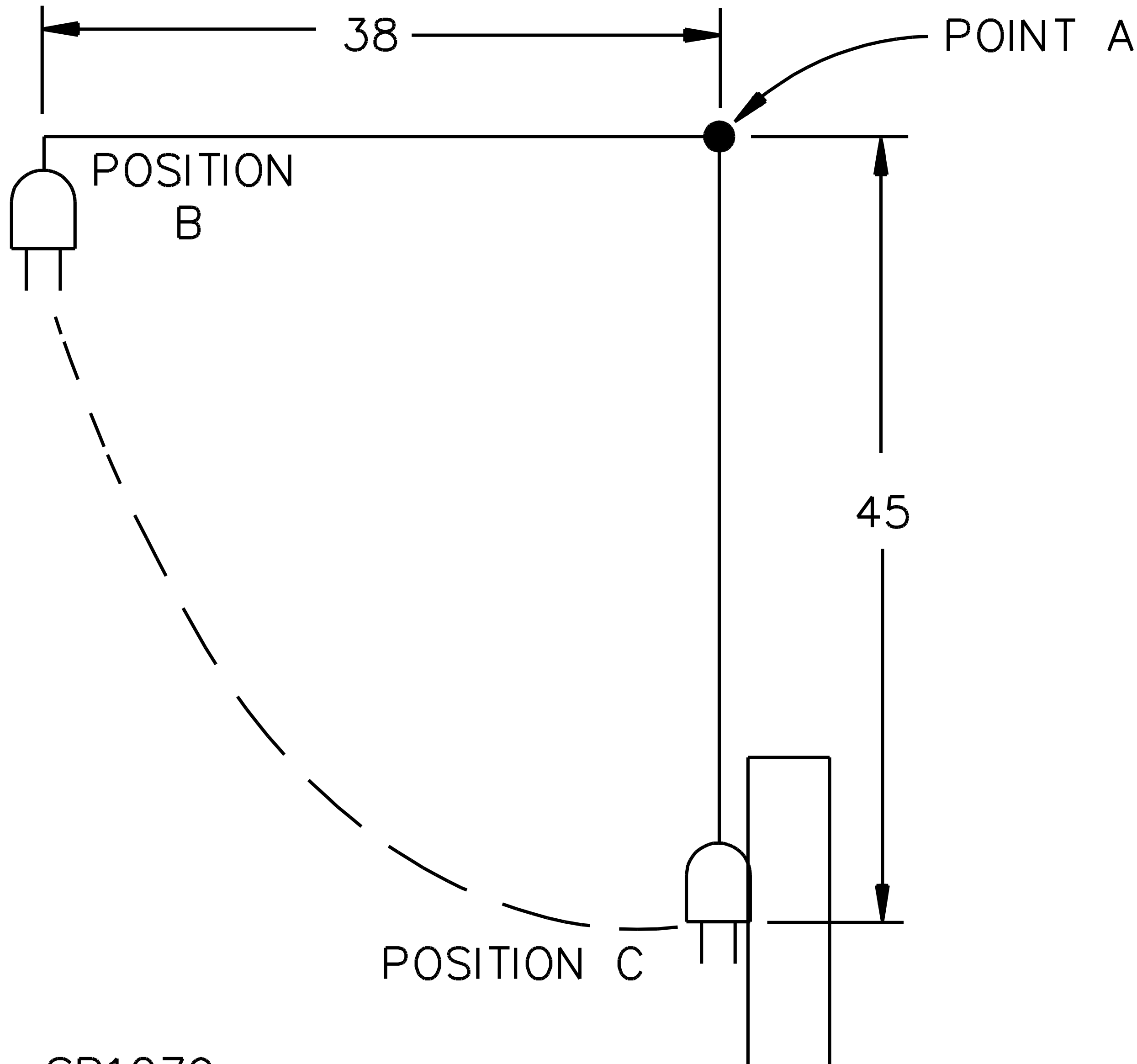
a) There shall not be any chipping, breaking, or loosening of parts that could adversely affect the functioning of the device, and

b) The attachment plug shall be capable of withstanding the dielectric voltage-withstand test in SC8.4.

**Figure SC8.1**

**Mechanical drop test apparatus**

**(All dimensions in inches)**




| inch | 38 | 45 |
|---|---|---|
| m | 0.96 | 1.14 |

SC8.2 Each of the devices is to be assembled onto 18 AWG (0.8 $mm^2$) flexible cord of a length sufficient for mounting on the test apparatus shown in Figure SC8.1. A 0.250 inch diameter (6.35 mm) braided nylon rope or its equivalent may be used to facilitate handling by the apparatus. The cord and attachment plug assembly is to be supported at point A so that when hanging freely the attachment plug rests against the vertical maple block 45 inches (1.14 m) below point A. A moving member of the test apparatus is to lift the test assembly to the test position B shown in Figure SC8.1 and then release it causing the plug to fall freely and strike the impact block at point C.

SC8.3 Each device is to be tested for not more than 1300 cycles. Each device is to complete not less than 500 cycles, and the average of the number of cycles completed by all devices is to be not less than 1000 cycles. Devices are to be inspected every 50 cycles beginning with the completion of 450 cycles. Assembly screws may be tightened throughout the test every 200 cycles.

SC8.4 The mechanical drop testing in SC8.2 and SC8.3 is to be followed by a dielectric voltage-withstand test of two times the plug rating plus 1000 V, applied between live parts of opposite polarity and between live parts and grounded metal parts for a period of 1 minute.

### SC9 Mold Stress Relief Test

SC9.1 As a result of temperature conditioning, there shall not be a change in any dimension greater than 10 percent nor any warpage creating an opening greater than 1/32 inch (0.79 mm) in any butt joint forming the enclosure of each attachment plug. Each attachment plug shall remain capable of functioning as intended.

SC9.2 The unwired attachment plugs are to be placed in a circulating air oven for 7 hours at 70°C (158°F). The devices are to be removed from the oven and allowed to cool to room temperature before determining compliance.

## HOSPITAL GRADE CORD CONNECTORS

### SC10 General

SC10.1 Unless otherwise stated, previously untested cord connectors are to be used for each test.

### SC11 Grounding Contact Temperature Test

SC11.1 The acceptability of the grounding path in a cord connector shall be demonstrated by a temperature rise not exceeding 30°C (54°F) when subjected to the test described in this section.

SC11.2 For the grounding contact temperature test, the previously untested cord connectors are first to be conditioned by 10 cycles of insertion and withdrawal from a solid-blade, 2-pole, 3-wire attachment plug having rigidly mounted blades and a U-shaped grounding pin. The abrupt removal test is not required on cord connectors.

SC11.3 The devices are to be wired in a series circuit through the grounding conductor path of the tested outlet of each device and a mating Hospital Grade plug. The test current is to be 25 A (125 percent of the maximum branch-circuit rating to which a 15 or 20 A receptacle could be connected). The cord connectors are to be wired using 12 AWG (3.3 $mm^2$) flexible cord. Temperatures are to be measured after 1 hour on the grounding pin close to the face of the inserted plug. The current is then to be reduced to 22 A (110 percent of the maximum branch circuit rating) and the test continued until thermal equilibrium is reached. The temperature rise over room ambient shall not exceed 30°C (54°F) at any time.

### SC12 Resistance Test

SC12.1 The total resistance between the mated attachment plug grounding terminal and cord connector grounding terminal shall not exceed 0.01 ohms when tested as follows.

SC12.2 The devices previously subjected to the Grounding Contact Temperature Test, Section SC11, are to be used for this test.

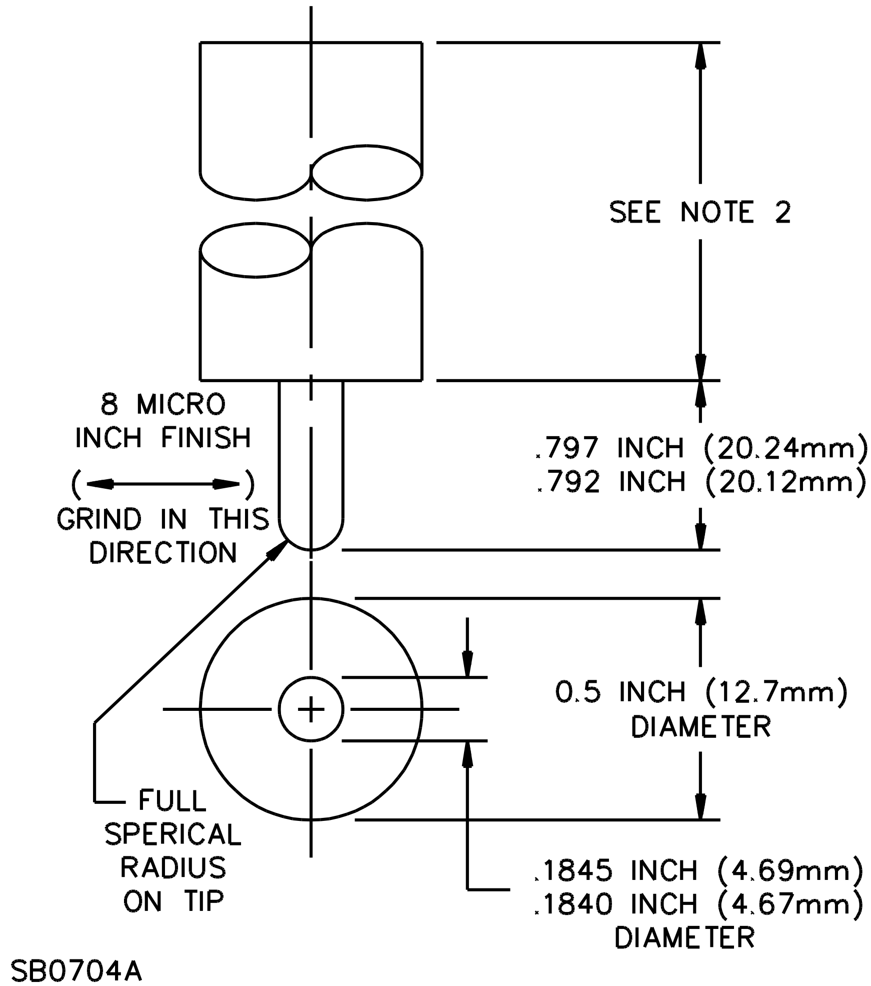
SC12.3 Compliance with SC12.1 is to be determined by passing an alternating current of 22 A from a power supply of 12 V or less from the attachment plug grounding terminal to the cord connector grounding terminal. The resulting drop in potential is to be measured between these two points. The resistance in ohms is to be determined by dividing the drop in potential in volts by the current in amperes passing between the two points.

## SC13 Grounding Contact Overstress Test

SC13.1 A cord connector shall be capable of retaining the standard test pin shown in Figure SC13.1 for at least 1 minute following the conditioning described in SC13.2. The displacement of the test pin shall not be greater than 0.079 inch (2 mm). There shall not be any breakage that adversely affects the integrity of the enclosure of live parts.

**Figure SC13.1**

**Standard grounding pin**




NOTES

1) All dimensions in inches.

2) Length not specified.

3) Total tool weight of 4 oz (113 g).

4) Hardened steel pin.

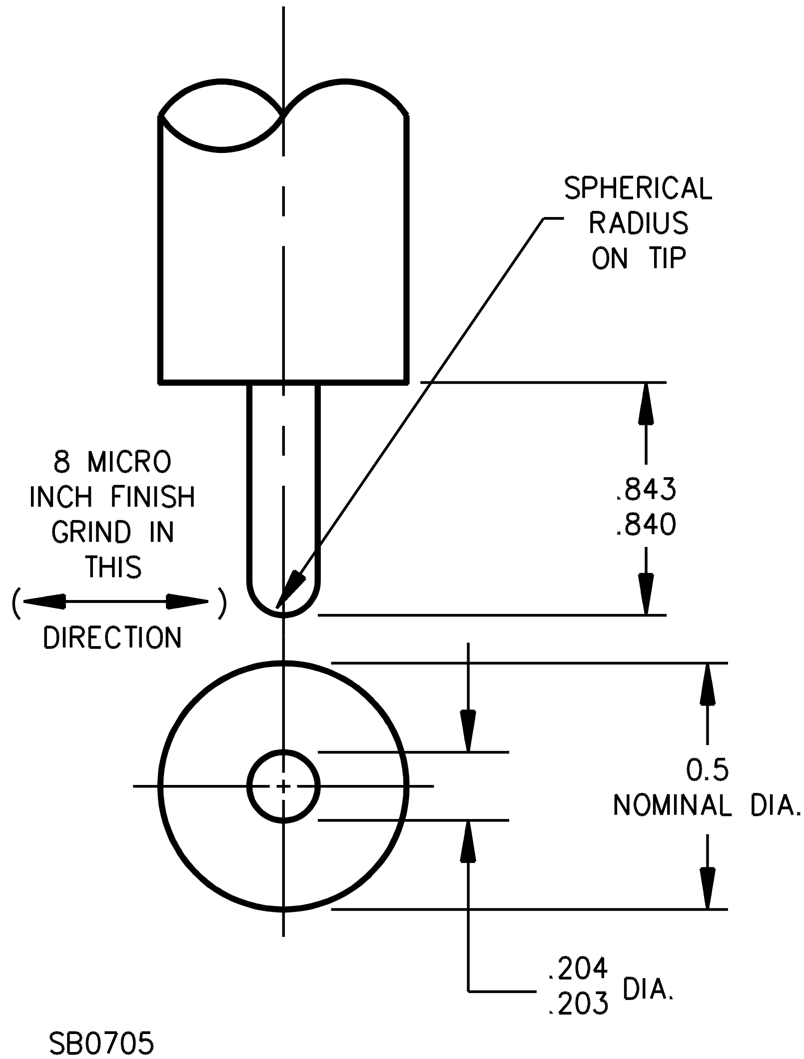
| | | | |
|---|---|---|---|
| | 0.1845 | | 0.797 |
| inch | 0.1840 | 0.5 | 0.792 |
| mm | 4.686 | 13 | 20.24 |
| | 4.674 | | 20.12 |

| | |
|---|---|
| microinch | 8 |
| nanometer | 200 |

SC13.2 Each outlet of six untested devices is to be conditioned then tested. The grounding contact of each outlet is to be conditioned by 20 insertions and withdrawals of the test pin illustrated in Figure SC13.2. For testing, the test pin illustrated in Figure SC13.1 is to be fully inserted in the receptacle which has its face horizontal so that the weight, applied perpendicular to the face, tends to withdraw the pin.

**Figure SC13.2**

**Oversize grounding pin**




NOTES

1) All dimensions in inches.

2) Length not specified for tool handle.

3) Hardened steel pin.

| | | | |
|---|---|---|---|
| inch | 0.204 / 0.203 | 0.5 | 0.843 / 0.840 |
| mm | 5.18 / 5.16 | 13 | 21.41 / 21.34 |

| | |
|---|---|
| microinch | 8 |
| nanometer | 200 |

## SC14 Plug Connection and Separation Test

SC14.1 Following the program of severe manual forces applied during the connection and separation of these devices described in this section, a cord connector shall:

a) Maintain the grounding path integrity through the cord connector and the integrity of the cord connector insulating enclosure, and

b) Have each outlet capable of retaining the test pin illustrated in Figure SC13.1. The displacement of the test pin shall not be greater than 0.079 inch (2 mm).

SC14.2 Each of six devices previously subjected to the grounding contact overstress test is to be tested by the insertion of a Hospital Grade attachment plug from the maximum angle permitted by the slots so as to maximize the grounding contact stress. The fully inserted plug is then to be firmly grasped in one hand and the cord connector in the other in preparation for the separations described below. Each device is to be subjected to a total of nine connections and separations as follows:

a) The first three separations are to be subjected to a severe wiggling from side to side and twisting in such a manner that the cord connector is rotated in a direction opposite to the rotation of the attachment plug during the withdrawal,

b) The next three separations are to be subjected to a severe breaking action in one direction in such a manner that the grounding pin of the mated attachment plug applies a force tending to deform the grounding contact construction in the cord connector, and

c) The final three separations are to be subjected to a severe breaking action in the opposite direction.

SC14.3 After the separation conditioning, the test pin shown in Figure SC13.1 is to be inserted in the grounding contact with the force of the weight applied in a direction perpendicular to the face of the cord connector and tending to withdraw the pin from the device.

## SC15 Crushing Test

SC15.1 A cord connector shall be capable of withstanding the crushing test without resulting in breakage, deformation, or other adverse effects that may interfere with the intended function of the device.

SC15.2 Each of six devices wired onto flexible cord is to be placed between rigid horizontal steel plates. A crushing force is to be applied, increased gradually to a value of 500 lbf (2224 N). The force is then gradually removed. Each assembly is to be oriented in a natural resting position before applying the force. In no case is the force to be applied to the projecting blades.

SC15.3 The flexible cord used to wire the cord connector is to be the minimum size and type of flexible cord specified for use by the manufacturer in accordance with Reference No. 13 of Table 193.3.

## SC16 Impact Resistance Test

SC16.1 As a result of the impact resistance test there shall not be any breakage of the body or other damage that may adversely affect the function of a cord connector.

SC16.2 Each of the devices wired onto flexible cord is to be subjected to an impact caused by dropping a cylindrical 10 lb (4.5 kg) weight, having a flat face that is 2 inches (50.8 mm) in diameter, from a height of 18 inches (457 mm). Each assembly is to be placed on a hardwood surface in any natural resting position. A cylindrical cord connector is to have its major axis parallel to the surface. The hardwood surface is to be a maple block approximately 1-5/8 inches (42 mm) thick by 4-1/2 inches (114 mm) square and is to rest on a fixed surface such as a concrete floor.

SC16.3 The flexible cord used to wire the cord connector is to be the minimum size and type of flexible cord specified for use by the manufacturer in accordance with Reference No. 5 of Table 193.3.

## SC17 Mechanical Drop Test

SC17.1 Following the mechanical drop test:

a) There shall not be any chipping, breaking, or loosening of parts that could adversely affect the functioning of the device, and

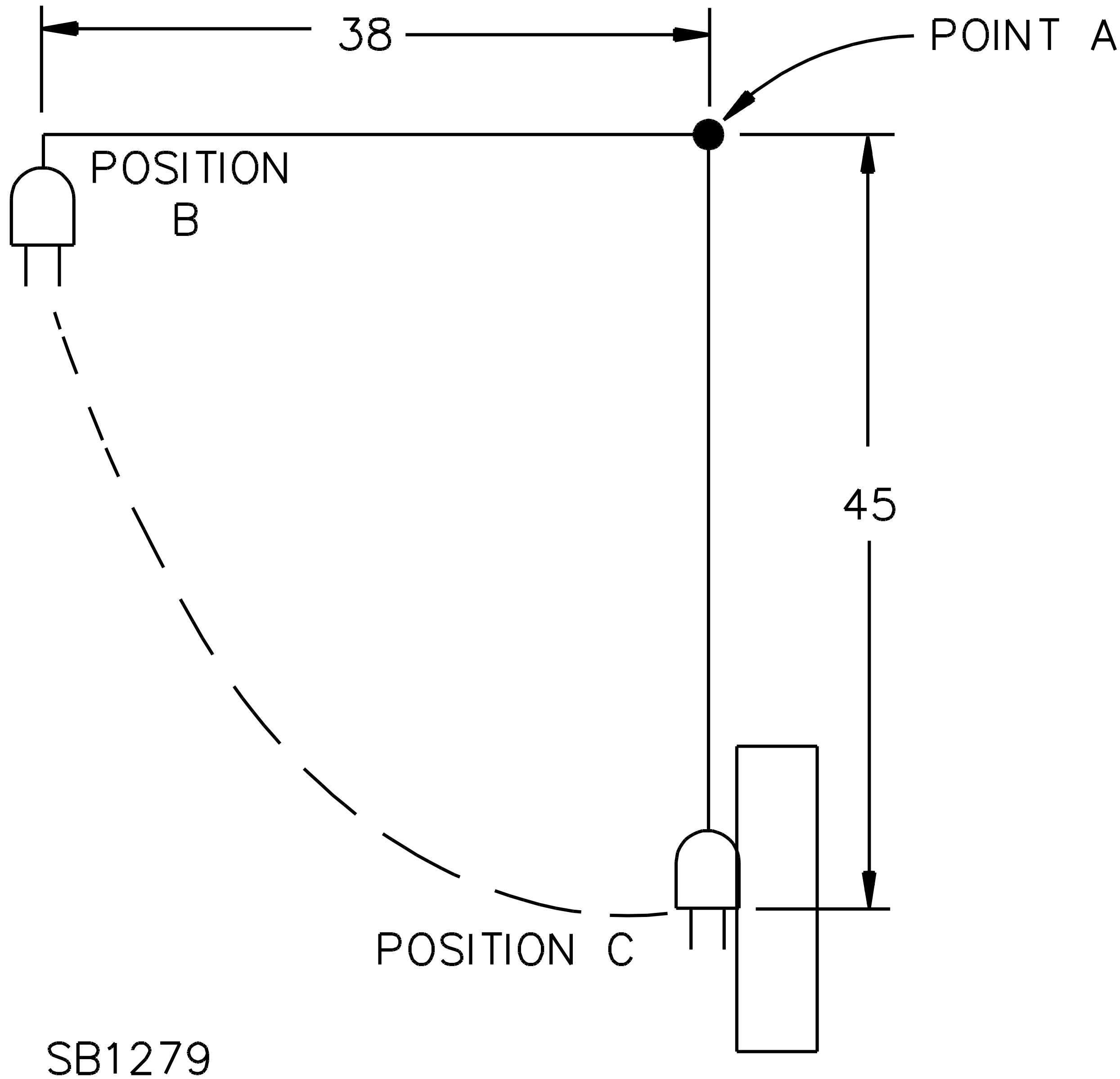
b) The cord connector shall be capable of withstanding the dielectric voltage-withstand test in SC17.4.

SC17.2 Each of the devices is to be assembled onto 18 AWG (0.82 $mm^2$) flexible cord of a length sufficient for mounting on the test apparatus shown in Figure SC17.1. A 0.250 inch diameter (6.35 mm) braided nylon rope or its equivalent may be used to facilitate handling by the apparatus. The cord and attachment plug assembly is to be supported at point A so that when hanging freely the attachment plug rests against the vertical maple block 45 inches (1.14 m) below point A. A moving member of the test apparatus is to lift the test assembly to the test position B shown in Figure SC17.1 and then release it causing the plug to fall freely and strike the impact block at point C.

**Figure SC17.1**

**Mechanical drop test apparatus**

**(All dimensions in inches)**




| inch | 38 | 45 |
| --- | --- | --- |
| m | 0.96 | 1.14 |

SC17.3 Each device is to be tested for not more than 1300 cycles. Each device is to complete not less than 500 cycles, and the average of the number of cycles completed by all devices is to be not less than 1000 cycles. Devices are to be inspected every 50 cycles beginning with the completion of 450 cycles. Assembly screws may be tightened throughout the test every 200 cycles.

SC17.4 The mechanical drop testing in SC17.2 and SC17.3 is to be followed by a dielectric voltage-withstand test of two times the connector rating plus 1000 V, applied between live parts of opposite polarity and between live parts and grounded metal parts for a period of 1 minute.

## SC18 Mold Stress Relief Test

SC18.1 As a result of temperature conditioning, there shall not be a change in any dimension greater than 10 percent nor any warpage creating an opening greater than 1/32 inch (0.79 mm) in any butt joint forming the enclosure of each cord connector. Each cord connector shall remain capable of functioning as intended.

SC18.2 The unwired cord connectors are to be placed in a circulating air oven for 7 hours at 70°C (158°F). The devices are to be removed from the oven and allowed to cool to room temperature before determining compliance.

## SC19 Strain Relief Tests

### SC19.1 General

SC19.1.1 A cord connector shall withstand the strain relief tests described in this Section. Fifteen devices are necessary to accomplish strain-relief testing.

*Exception: A cord connector that employs the same construction as a Hospital Grade attachment plug is not required to be subjected to strain relief testing.*

SC19.1.2 After being subjected to the strain relief tests described in this section, there shall not be any displacement of the conductors, conductor insulation, or outer jacket of the flexible cord exceeding 1/32 inch (0.79 mm). There shall not be any cuts, rips, or tears in the cord insulation nor any breakage of the cord connector that could adversely affect the enclosure of live parts, strain relief, or grounding path integrity.

SC19.1.3 Cord connectors are to be assembled onto 12 inch (305 mm) lengths of flexible cord 24 hours before testing. The flexible cord is to be cut at right angles to its major axis (but not stripped) and placed in the plug with its conductors positioned as if they were to be connected to the terminals. A 20 A cord connector is to be assembled onto 16 AWG (1.3 $mm^2$), Type SJT cord. A 15 A connector is to be assembled onto 18 AWG (0.82 $mm^2$), Type SVT cord except where the device is marked on or in the carton to specifically exclude the use of cords having a diameter of less than 0.300 inch (7.62 mm) in which case Type SJT cord having 18 AWG (0.82 $mm^2$) conductors is to be used. Except for a device that is individually packaged with instructions for cord clamp installation indicating the torsional force to be applied, the clamp is to be tightened with a torque of 8 in-lbf (0.9 N·m).

### SC19.2 Method A – static pull

SC19.2.1 Each of six devices previously assembled onto flexible cord is to be subjected to a gradually applied pull of 30 lbf (133 N) to the free end of the cord while supporting the cord connector. The force is to be applied for 1 minute in a direction perpendicular to the plane of cord entry.

### SC19.3 Method B – rotary pull

SC19.3.1 Each of three devices previously assembled onto flexible cord is to be subjected to a rotary cord motion while a 10 lbf (44.5 N) is applied for 2 hours. The cord is to be rotated at a rate of approximately 9 rpm in a 3 inch diameter (0.76 mm) circle at a point of 6 inches (152 mm) below the cord exit with the attachment plug rigidly mounted. (Note – This test is conveniently done with the UL secureness test apparatus described in the Standard for Wire Connectors, UL 486A-486B.)

### SC19.4 Method C – abrupt removal

SC19.4.1 Each of eight previously untested cord connectors assembled onto flexible cord as described in SC19.1.3 is to be subjected to one abrupt removal from a Hospital Grade attachment plug as described in this section.

SC19.4.2 Each Hospital Grade attachment plug is to be rigidly mounted to a fixed support with its face at a 60 degree angle from the vertical as shown in Figure SC19.1.

SC19.4.3 The flexible cord of each cord connector assembly is to be fastened to the clamping mechanism shown in Figure SC19.2 or an equivalent mechanism that provides for the connection to the test set up described in Figure SC19.1.

**Figure SC19.1**

**Test set-up for abrupt removals test**

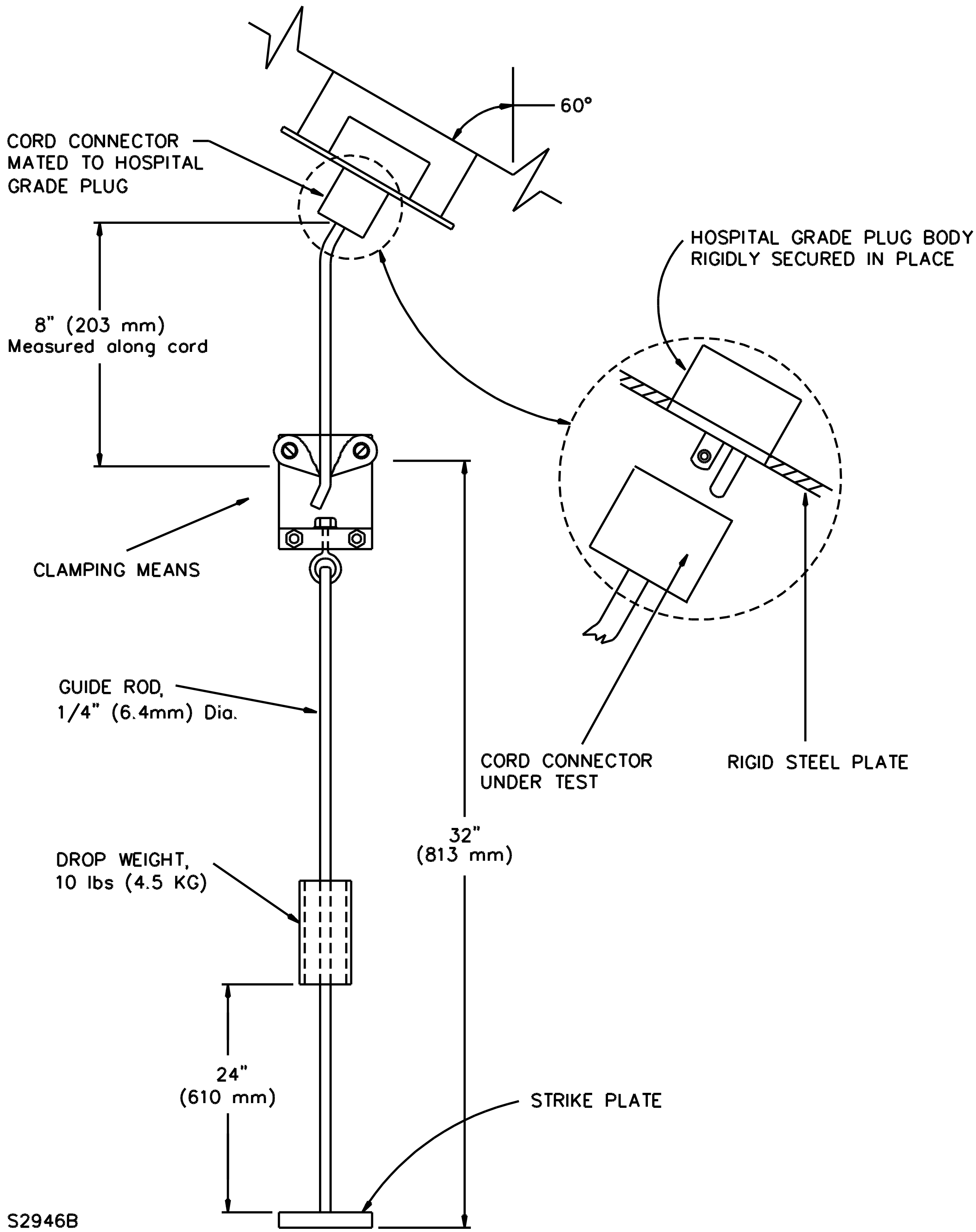
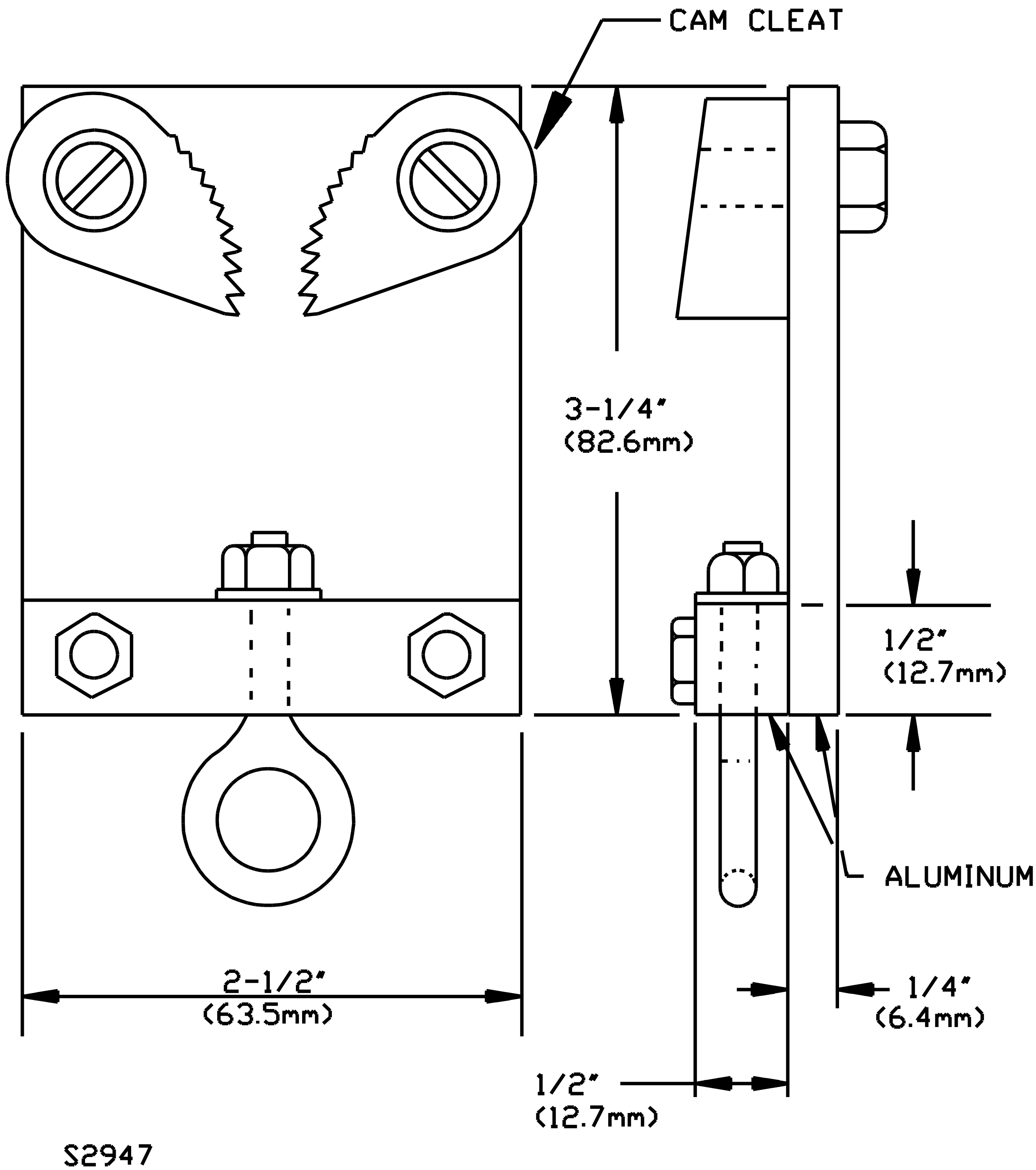


**Figure SC19.2**

**Typical clamping mechanism**



SC19.4.4 The Hospital Grade attachment plug mounted as described in SC19.4.2 is then to be used to subject the cord connectors to the abrupt removals specified in SC19.4.5. Each abrupt removal is to consist of the full insertion of the cord connector onto the test plug followed by the complete withdrawal by means of a 10 lb (4.4 kg) weight dropped from a height of 24 inches (0.61 m) – measured from the bottom of the weight – onto a striker plate attached to the plug by a 1/4 inch (6.4 mm) diameter guide rod and a flexible coupling. The guide rod shall be located as shown in Figure SC19.1. The applied force shall cause the removal from the test plug in one continuous motion. A new test plug is to be used for each abrupt removal.

SC19.4.5 The abrupt removal procedure for cord connectors is as follows: one removal with the grounding pin opening to the top of the vertically-oriented line blades, then three additional removals rotating the plug 90 degrees clockwise before each additional cord connector removal.

HOSPITAL GRADE RECEPTACLES

## SC20 General

SC20.1 Unless otherwise stated, previously untested devices are to be used for each test.

SC20.2 The Hospital Grade attachment plugs required to perform the tests in Grounding Contact Temperature Test, Section SC22, Resistance Test, Section SC23, and Fault Current Test, Section SC24, shall have a U-shaped grounding pin.

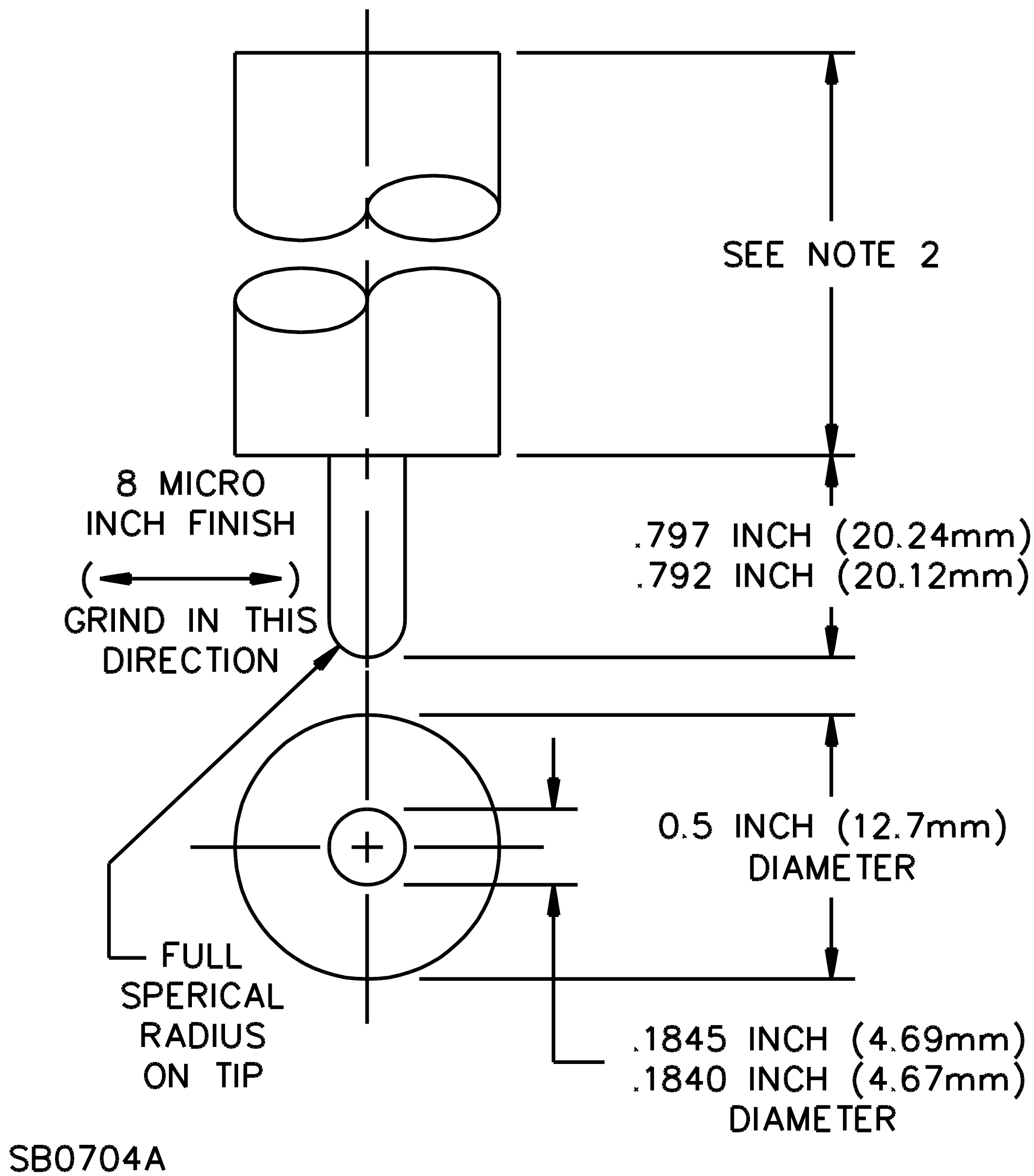
## SC21 Abrupt Plug Removal Test

SC21.1 A receptacle shall retain the test pin illustrated in Figure SC21.1 without breakage or other damage such that full insertion of an attachment plug in the intended manner cannot be accomplished or the integrity of the enclosure of live parts is adversely affected when tested as described in this section.

SC21.2 Each receptacle outlet is to be first conditioned by ten cycles of full insertion and complete withdrawal of an attachment plug of the matching configuration having solid line blades and a U-shaped ground pin rigidly supported by the attachment plug body. Each conditioned outlet is then to retain the fully inserted test pin illustrated in Figure SC21.1 for not less than 1 minute with the receptacle face horizontal and the weight applied perpendicular to the face plane, tending to remove the pin. The displacement of the test pin shall not be greater than 0.079 inch (2 mm).

**Figure SC21.1**

**Standard grounding pin**




NOTES

1) All dimensions in inches.

2) Length not specified

3) Total tool weight of 4 oz (113 g).

4) Hardened steel pin.

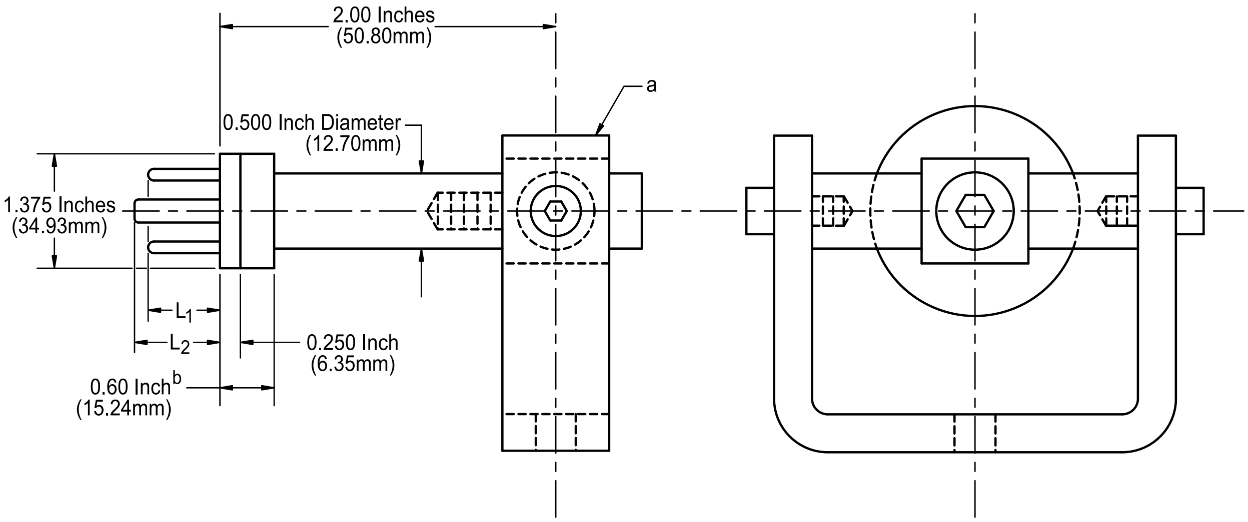
| microinch | 8 |
|---|---|
| nanometer | 200 |

SC21.3 Each receptacle is then to be mounted to represent a typical installation and a 0.030 plus 0.003 minus 0.0 inch (0.76 plus 0.08 minus 0.0 mm) steel faceplate rigidly mounted as intended, being supported around its perimeter. The receptacle face is to be in a vertical plane in a manner that will facilitate the test orientations described in SC21.5 and SC21.6.

SC21.4 The outlets tested as described in SC21.2 and subsequently mounted as described in SC21.3 are to then each be subjected to a series of abrupt removals of the test plug illustrated in Figure SC21.2 as follows. The test plug shall use solid line blades made of brass and a U-shaped ground pin made of brass. Each abrupt removal is to consist of the full insertion of the test plug followed by the complete withdrawal by means of a 10 lb (4.4 kg) weight dropped from a height of 24 inches (0.61 m) – measured from the bottom of the weight – onto a striker plate attached to the plug by a 1/4 inch (6.4 mm) diameter guide rod and a flexible coupling. The guide rod shall be located vertically below the outlet being tested, and 2 inches (50.8 mm) in front of the plane of the receptacle face (see Figure SC21.3). The applied force shall cause the removal of the test plug in one continuous motion. New brass line blades and ground pin are to be used in the test plug for each abrupt removal.

**Figure SC21.2**

**Typical test plug for abrupt plug removals**

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NOTES

Material: Tool Steel

Line Blades and Ground Pin Material: Brass

a – Universal coupling, details not specified, typical application shown.

b – Dimensions are for typical construction and can be varied, provided that the necessary support of the test blades is maintained.

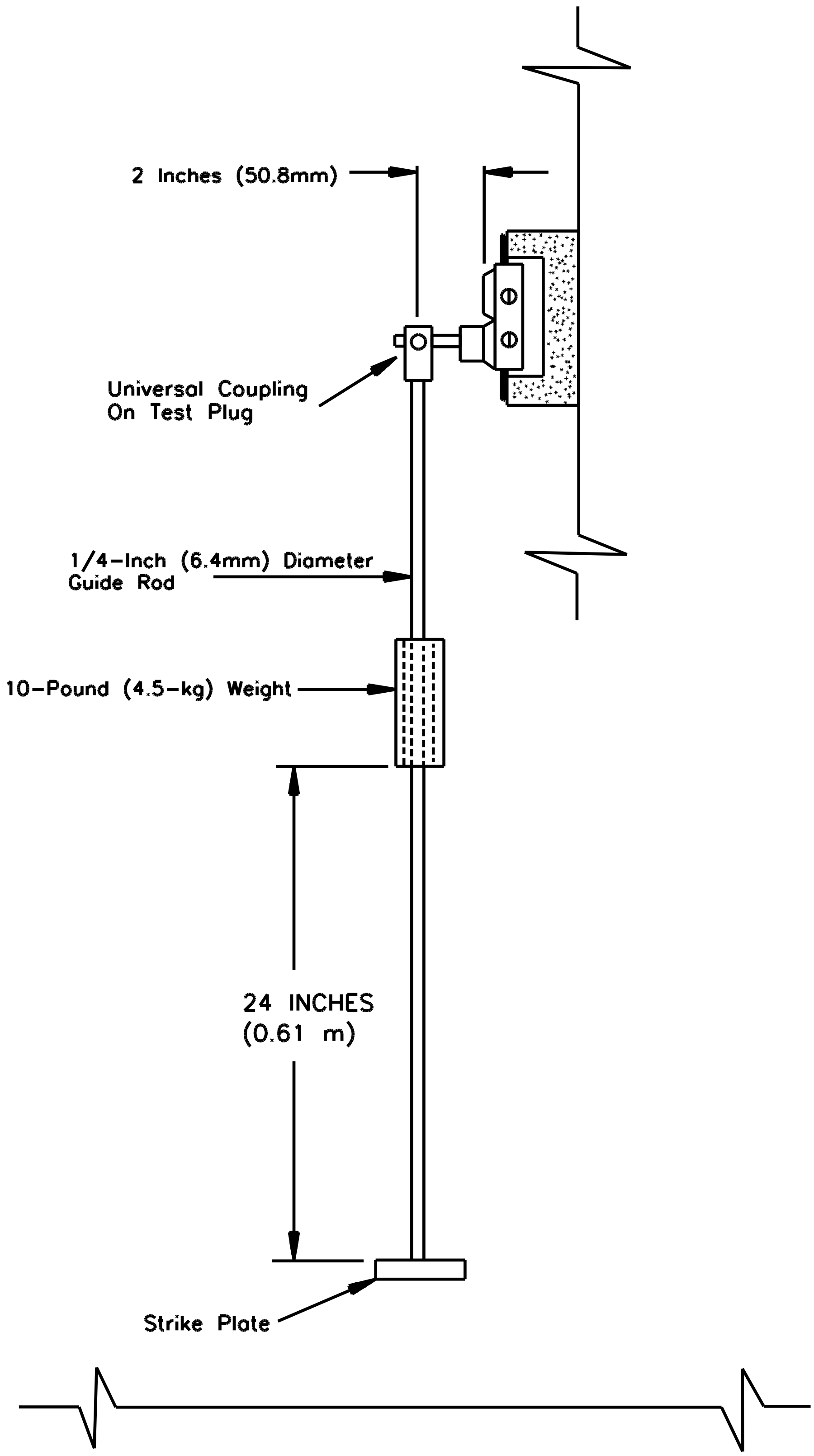
$L_1$ = 0.625 inch (15.88 mm) Max.

$L_2$ = 0.843 inch (21.41 mm) Max.

$L_2 - L_1$ = 0.125 inch (3.18 mm) Min.

## Figure SC21.3

## Test set-up for abrupt removals test

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SC21.5 Four devices are to be tested as follows: two removals with the grounding pin opening to the top of the vertically-oriented slots, then four removals with the receptacle rotated 180 degrees, then two more removals in the initial position.

SC21.6 The remaining four devices are to be tested as follows: two removals with the grounding pin opening to the right of the horizontally oriented slots, then four removals with the receptacle rotated 180 degrees, then two more removals in the initial position.

SC21.7 Duplex receptacles are to be tested by using one of the two outlets for one half of the devices and the other outlet for the remaining devices.

SC21.8 Receptacles rated 20 A that accept 15 A attachment plugs are to be tested using one half of the devices for testing with the 20 A plug configuration and the remaining devices with the 15 A plug configuration.

SC21.9 After the conditioning described in SC21.2 and the abrupt plug removals described in SC21.4 – SC21.6, each outlet shall retain the fully inserted test pin illustrated in Figure SC21.1 for at least 1 minute. For this test, each receptacle is to be placed with its face horizontal so that the downward force exerted by the pin is perpendicular to the plane of the receptacle face and tends to withdraw the pin. The displacement of the test pin shall not be greater than 0.079 inch (2 mm).

SC21.10 In addition to retaining the fully inserted test pin as described in SC21.9, each receptacle outlet subjected to the tests described in this section shall:

a) Be capable of receiving a fully inserted attachment plug (3-wire, solid blades with U-shaped grounding pin) of the intended configuration,

b) Not experience any breakage or other damage that exposes live parts to contact with a probe consisting of a 1/32 inch (0.79 mm) diameter cylindrical rod, and

c) Retain a fully inserted 2-wire attachment plug having a rigid body and solid blades without displacement of more than 0.079 inch (2 mm) resulting from the application of a 3 lbf (13.3 N) in a direction perpendicular to the receptacle outlet and tending to withdraw the plug, following which, there shall be electrical continuity through each blade/contact connection.

## SC22 Grounding Contact Temperature Test

SC22.1 The acceptability of the grounding path in a receptacle shall be demonstrated by a temperature rise not exceeding 30°C (54°F) when subjected to the test described in this section.

SC22.2 The devices previously subjected to the Abrupt Plug Removal Test in Section SC21 are to be wired in a series circuit through the grounding conductor path of the tested outlet of each device and a mating Hospital Grade plug. The test current is to be 25 A (125 percent of the maximum branch-circuit rating to which a 15 or 20 A receptacle could be connected). Each receptacle is to be wired using 12 AWG (3.3 $mm^2$) solid copper wire. Attachment plugs are to be wired using 12 AWG (3.3 $mm^2$) flexible cord. Temperatures are to be measured after 1 hour on the grounding pin close to the face of the inserted plug. The current is then to be reduced to 22 A (110 percent of the maximum branch circuit rating) and the test continued until thermal equilibrium is reached. The temperature rise over room ambient shall not exceed 30°C (54°F) at any time.

## SC23 Resistance Test

SC23.1 The total resistance between the mated attachment plug grounding terminal and receptacle grounding terminal shall not exceed 0.01 ohms when tested as follows.

SC23.2 The devices previously subjected to the Grounding Contact Temperature Test, Section SC22 are to be used for this test.

SC23.3 Compliance with SC23.1 is to be determined by passing an alternating current of 22 A from a power supply of 12 V or less from the attachment plug grounding terminal to the receptacle grounding terminal. The resulting drop in potential is to be measured between these two points. The resistance in ohms is to be determined by dividing the drop in potential in volts by the current in amperes passing between the two points.

## SC24 Fault Current Test

SC24.1 When subjected to the Fault Current Test, the circuit breaker shall operate when the test circuit is closed. The grounding path shall retain its integrity as demonstrated by a continuity check after removing and reinserting the attachment plug.

SC24.2 The devices previously used for the Resistance Test, Section SC23, are to be subjected to the Fault Current Test described in Section 122.

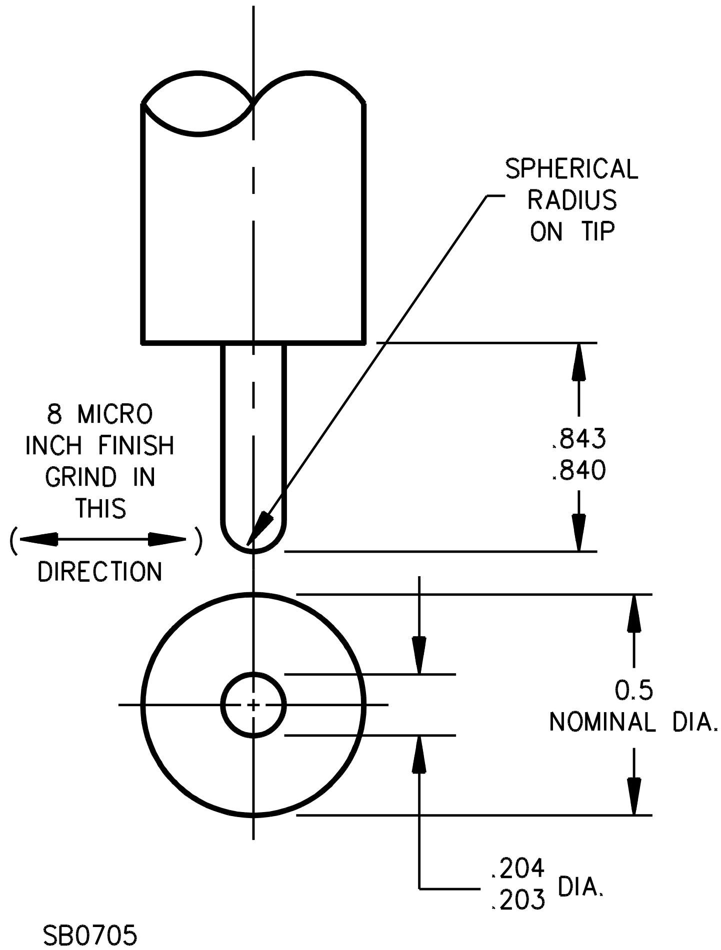
## SC25 Grounding Contact Overstress Test

SC25.1 A receptacle is to be capable of retaining the standard test pin shown in Figure SC21.1 for at least 1 minute following the conditioning described in SC25.2. The displacement of the test pin shall not be greater than 0.079 inch (2 mm). There shall not be any breakage that adversely affects the integrity of the enclosure of live parts.

SC25.2 Each outlet of six untested devices is to be conditioned, then tested. The grounding contact of each outlet is to be conditioned by 20 insertions and withdrawals of the test pin illustrated in Figure SC25.1. For testing, the test pin is to be fully inserted in the receptacle which has its face horizontal so that the weight, applied perpendicular to the face, tends to withdraw the pin.

## Figure SC25.1

## Oversize grounding pin




NOTES

1) All dimensions in inches.

2) Length not specified for tool handle.

3) Hardened steel pin.

4) If the test pin is unable to be fully seated in the grounding contact, a similar test pin is to be used. All dimensions other than the 0.203 – 0.204 inch (5.16 – 5.18 mm) pin diameter are to be identical to the dimensions of the pin shown above. The pin diameter is to be the largest diameter that is able to be fully seated in the grounding contact with a minimum diameter of 0.190 inch (4.83 mm).

| | | | |
|---|---|---|---|
| | 0.204 | | 0.843 |
| inch | 0.203 | 0.5 | 0.840 |
| mm | 5.18 | 13 | 21.41 |
| | 5.16 | | 21.34 |

| | |
|---|---|
| microinch | 8 |
| nanometer | 200 |

## SC26 Terminal Strength Test

SC26.1 The terminals of three untested receptacles are to be subjected to the Terminal Strength Test described in Section 123 with the modifications described in SC26.2.

SC26.2 The terminals are to be disassembled, assembled, and torqued three additional times following the method described in 123.5 except that the maximum tightening torque is to be 14 lbf-in (1.6 N·m).

## SC27 Assembly Security Test

SC27.1 A Hospital Grade receptacle is to be subjected to the Assembly Security Test described in Section 124 except that the force exerted by the pushout tool inserted into the slots of the receptacle is to be 100 lbf (445 N).

## SC28 Impact Test

SC28.1 A receptacle shall withstand the following impact test without experiencing breakage that impairs the function of the receptacle in enclosing and supporting contacting members for the connection of an attachment plug.

SC28.2 Six receptacles are to be mounted to a cast metal (malleable iron) outlet box and a metal faceplate installed as intended to provide peripheral support against the box edge. The receptacle, faceplate, and box are to be placed on a steel plate at least 1/2 inch (12.7 mm) thick with the outlet facing upward. A 5 lb (2.3 kg) cylindrical weight, 1-1/4 inch (31.8 mm) in diameter and having a flat end, is to be dropped from a height of 18 inches (0.46 m) to impact the center of each receptacle outlet. For duplex receptacles, three devices are to be tested using one outlet, and three using the other.

## SC29 Mold Stress Relief Test

SC29.1 As a result of temperature conditioning, there shall not be a change in any dimension greater than 10 percent nor any warpage creating an opening greater than 1/32 inch (0.79 mm) in any butt joint forming the enclosure of each receptacle. Each device shall remain capable of functioning as intended.

SC29.2 The unwired receptacles are to be placed in a circulating air oven for 7 hours at 90°C (194°F). The devices are to be removed from the oven and allowed to cool to room temperature before determining compliance.

# MARKINGS

## SC30 General

SC30.1 An attachment plug or cord connector shall be marked with the phrase "Hospital Grade", "Hosp. Grade" or "HG" and with a green dot. The markings shall be located on any external surface including the face of the device so that it is visible after installation on flexible cord. The green dot shall not be located on an external (removable) strain relief clamp.

SC30.2 A receptacle shall be marked with the phrase "Hospital Grade" "Hosp. Grade or "HG"" where visible during installation and with a green dot that is visible after installation with the cover plate secured as intended.

SC30.3 The green dot shall be a contrasting shade of green if on a green-bodied device and shall be 3/16 inch (4.8 mm) minimum, 1/4 inch (6.4 mm) maximum in diameter.

SC30.4 The green dot shall be ink stamped, painted, or otherwise applied in a manner determined to be indelible. A label or sticker marked with the green dot and attached by an adhesive or other means to the device shall not be readily removable without destroying its significance if reapplied.

# SUPPLEMENT SD – WEATHER-RESISTANT RECEPTACLES

## INTRODUCTION

### SD1 Scope

SD1.1 The requirements of this supplement cover weather-resistant flush-type receptacles, intended for wet and damp locations in accordance with Article 406 of the National Electrical Code, ANSI/NFPA 70.

SD1.2 These requirements are applicable to flush-type, non-locking configuration devices of the ANSI/NEMA 5-15R, 6-15R, 5-20R, 6-20R, 6-30R, TT-30R, 14-30R and 14-50R configurations only.

SD1.3 Weather-resistant receptacles are intended only for flush installation in an appropriate enclosure suitable for the application.

SD1.4 A weather-resistant receptacle shall comply with the applicable requirements of this Standard, UL 498, except as modified by the requirements in this supplement.

SD1.5 This supplement is intended to evaluate only the flush receptacle covered by this Standard, UL 498.

SD1.6 This supplement does not apply to the enclosure or any component which forms the enclosure, including the outlet box or flush-device cover plate, or both.

SD1.7 This supplement does not apply to other end-product equipment that incorporate a weather-resistant receptacle.

## CONSTRUCTION

### SD2 General

SD2.1 In addition to the general performance and construction requirements for receptacles, weather-resistant receptacles shall also comply with requirements for corrosion resistance, cold impact, accelerated aging, and resistance to ultraviolet light and water exposure, as specified in this supplement.

### SD3 Insulating Materials

SD3.1 An insulating material used in the construction of the face of a weather-resistant receptacle shall comply with the Ultraviolet Light and Water Exposure Test in Section SD8.

*Exception: Insulating materials used in the construction of components other than the face of a weather-resistant receptacle, such as the body, shutters, and indicator lights, are not required to comply with this requirement. This exception does not apply to external shutters located on the outer face of the device.*

### SD4 Corrosion Resistance

SD4.1 Except as noted in SD4.2, all current-carrying parts shall be copper alloy.

SD4.2 All wire-binding screws and terminal pressure plates shall be copper alloy or stainless steel having a minimum of 16 percent chromium content. An internal backwire nut may be steel protected with nickel as described in SD4.4(a)(3) or (4). Protection is required on all sheared or cut edges but not required for punched holes with screw threads.

SD4.3 Metals used in combinations shall be galvanically compatible.

SD4.4 Noncurrent-carrying metal parts, such as metal mounting yoke, and mounting screws shall be:

a) Steel protected by one of the following coatings:

1) Hot-dipped mill-galvanized sheet steel conforming with the coating Designation A60, G60 or G90 in the Weight (Mass) of Coating Requirements table in the Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process, ASTM A653, with not less than 40 percent of the zinc on any side, based on the minimum single-spot test requirement in this ASTM designation. The weight of the zinc coating may be determined by any acceptable method; however, in case of question the weight of coating shall be established in accordance with the Standard Test Method for Weight (Mass) of Coating on Iron or Steel Articles With Zinc or Zinc-Alloy Coatings, ASTM A90. Sheared, cut edges, punched holes and screw threads are not required to be additionally protected;

2) A zinc coating, other than that provided on hot-dipped mill-galvanized steel, having an average thickness not less than 0.0005 in (0.013 mm) and a minimum thickness of not less than 0.0004 in (0.0102 mm). Sheared, cut edges punched holes, and screw threads are not required to be additionally protected;

3) A nickel coating having a thickness not less than 0.00015 in (0.0038 mm); or

4) A tin over nickel coating having an overall thickness of not less than 0.00015 in (0.0038 mm).

b) Stainless steel having a minimum of 16 percent chromium content; or

c) Copper, bronze or brass alloys.

d) Aluminum or aluminum alloys.

## PERFORMANCE

### SD5 General

SD5.1 A weather-resistant receptacle shall be subjected to the Cold Impact Test, Section SD6, the Accelerated Aging Test, Section SD7, and the Ultraviolet Light and Water Exposure Test, Section SD8.

### SD6 Cold Impact Test

SD6.1 When subjected to the Cold Impact Test described in SD6.2, six representative weather-resistant receptacles shall withstand the impact without breakage of the receptacle face or any other damage that could increase the risk of fire or electric shock. Upon completion of the test, each device shall be:

a) Capable of completely mating with the intended attachment plugs both grounding and non-grounding types;

b) Shall not crack to the extent such that a 1/32 in (0.8 mm) diameter rod can be inserted through the crack and contact live parts; and

c) Subjected to the Dielectric Voltage-Withstand Test described in Section 65. The devices are not required to be subjected to the humidity conditioning described in 65.1.2.

SD6.2 Six representative weather-resistant receptacles shall be conditioned for 5 h in circulating air at a temperature of minus 20 ±1°C (minus 4 ±2°F). Immediately following removal from the conditioning chamber, each device shall be subjected to the Impact Test described in SD6.3.

SD6.3 Six receptacles are to be mounted to a cast metal (malleable iron) outlet box and a metallic flush-device cover plate is to be installed on the receptacle in the intended manner. The receptacle, faceplate, and box are to be placed on a steel plate at least 1/2-inch (12.7-mm) thick with the outlet facing upward.A

3 lb (1.36 kg) cylindrical weight, 1-1/4 inch (31.8 mm) in diameter and having a flat end without any sharp edges, is to be dropped from a height of 11 in (279 mm) to impact the center of each receptacle outlet. For duplex receptacles, three devices are to be tested using one outlet, and three using the other.

## SD7 Accelerated Aging Test

SD7.1 A weather-resistant receptacle shall not crack or distort to the extent such that upon completion of the test each device shall be:

a) Capable of completely mating with the intended attachment plugs both grounding and non-grounding types;

b) Shall not crack to the extent such that a 1/32 in (0.8 mm) diameter rod can be inserted through the crack and contact live parts; and

c) Subjected to the Dielectric Voltage-Withstand Test described in Section 65. The devices are not required to be subjected to the humidity conditioning described in 65.1.2.

SD7.2 The device is to be placed in a full-draft air-circulating oven for 7 days at a temperature of 70°C (158°F). The device is to be allowed to rest at room temperature for at least one hour after removal from the oven.

## SD8 Ultraviolet Light and Water Exposure Test

SD8.1 When subjected to the Ultraviolet Light and Water Exposure Test described in SD8.2, the insulating material employed in the face of a weather-resistant receptacle, shall not exhibit deterioration such as cracking, crazing, or warping, after exposure.

*Exception: Insulating material employed in the face of a weather-resistant receptacle that has been investigated in accordance with the requirements for the Ultraviolet Light Exposure Test in the Standard for Polymeric Material – Use in Electrical Equipment Evaluations, UL 746C, and so identified, is not required to comply with this requirement.*

SD8.2 The receptacle is to be mounted such that the receptacle face is exposed to ultraviolet light and water by using either of the following methods:

a) Twin enclosed carbon-arc, Type D, in accordance with ASTM G151 and ASTM G153. Method 1, continuous exposure to light and intermittent exposure to water spray, with a programmed cycle of 120 min consisting of a 102 min light exposure and an 18 min exposure to water spray with light, shall be used. The apparatus shall operate with a black-panel temperature of 63 ±3°C (145 ±5°F); or

b) Xenon-arc, Type B, in accordance with ASTM G155. Test Method A, continuous exposure to light and intermittent exposure to water spray, with a programmed cycle of 120 min consisting of a 102 min light exposure and an 18 min exposure to water spray with light, shall be used.

SD8.3 The xenon-arc lamp apparatus shall employ borosilicate glass inner and outer optical filters capable of producing a spectral irradiance of 0.35 $W/m^2/nm$ at 340 nm and a blackpanel temperature of 63 ±3°C (145 ±5°F).

SD8.4 Three representative devices in each color shall be mounted on the inside of the cylinder in the ultraviolet-light apparatus in such a way that they do not touch each other.

SD8.5 For twin enclosed carbon-arc, the representative devices shall be exposed for a total of 720 h. For xenon-arc, the representative devices shall be exposed for a total of 1000 h.

SD8.6 For a material that is to be evaluated in a range of colors, representative devices in the natural (when used in this color) and in the most heavily pigmented light and dark colors shall be provided to represent the color range.

## MARKINGS

### SD9 General

SD9.1 A weather-resistant receptacle shall be marked with the phrase "Weather Resistant" or the abbreviation “WR” that is visible after installation with the cover plate secured as intended.

SD9.2 The letters shall be a minimum of 4.8 mm (3/16 inch) in height and visible after installation.

# SUPPLEMENT SE – RECEPTACLES WITH INTEGRAL POWER SUPPLY WITH CLASS 2 OUTPUT CONNECTORS

## INTRODUCTION

### SE1 Scope

SE1.1 The requirements of this supplement cover receptacles with integral power supply with one or more Class 2 output low-voltage connectors, a Class 2 separable conductor lead assembly, or both, intended to be installed in an outlet box.

SE1.2 These requirements are applicable to flush-type, non-locking configuration devices of the ANSI/NEMA 5-15R, 6-15R, 5-20R and 6-20R configurations only.

SE1.3 A receptacle with integral power supply with one or more Class 2 output low-voltage connectors, a Class 2 separable conductor lead assembly, or both, is intended only for flush installation in an appropriate enclosure suitable for the application.

SE1.4 A receptacle with integral power supply with one or more Class 2 output low-voltage connectors, a Class 2 separable conductor lead assembly, or both, shall comply with the applicable requirements of this Standard, UL 498, except as modified by the requirements of this supplement.

SE1.5 This supplement does not apply to the enclosure or any part which forms the enclosure, including the outlet box, flush device cover plate, or both.

SE1.6 This supplement only applies to a receptacle with integral power supply with Class 2 output. It does not apply to a receptacle and separable Class 2 power supply or where the Class 2 power supply is either located or derived outside the outlet box.

SE1.7 This supplement does not apply to a receptacle that is solely provided with low-voltage connectors such as combination receptacle and voice, data, multi-media, or coaxial cable type connectors.

### SE2 Glossary

SE2.1 For the purpose of this supplement, the following definitions apply.

SE2.1.1 CLASS 2 SEPARABLE LEAD ASSEMBLY – Consists of a factory-made, power-limited cable assembly provided with a connector for connection to a power supply output.

SE2.1.2 RECEPTACLE WITH INTEGRAL POWER SUPPLY WITH A CLASS 2 SEPARABLE LEAD ASSEMBLY – A receptacle with an integral power supply and associated Class 2 output low voltage connections not accessible when the cover plate is installed. The receptacle is intended for flush mounting in or on an outlet box for fixed installation on a branch circuit.

SE2.2 RECEPTACLE WITH INTEGRAL POWER SUPPLY WITH ONE OR MORE CLASS 2 OUTPUT LOW-VOLTAGE CONNECTORS – A receptacle with integral power supply and associated Class 2 output low-voltage connectors accessible when cover plate is installed. The receptacle is intended for flush mounting in or on an outlet box for fixed installation on a branch circuit.

SE2.3 REPLACEMENT PART – An individual replacement part identified by the manufacturer, for use in the same manufacturer's complete device.

Note: The replacement part is packaged as a “kit” containing the individual part and installation instructions [See Section SE14, User Instructions (Separable Face Assembly as a Replacement Part), of this Supplement].

SE2.4 SEPARABLE FACE ASSEMBLY – A receptacle with integral power supply and associated Class 2 output low-voltage connectors employing a modular face consisting of either:

a) ANSI/NEMA slot configuration and Class 2 output connectors,

b) Class 2 output connectors, or any

c) Other Class 2 component.

## CONSTRUCTION

### SE3 General

SE3.1 In addition to the construction, performance and marking requirements contained in this Standard, a receptacle with integral power supply with one or more Class 2 outputs shall also comply with the applicable requirements of the Standard for Class 2 Power Units, UL 1310.

SE3.2 A receptacle with integral power supply with one or more Class 2 output low-voltage connectors shall be provided with a suitable flush device cover plate or outlet box cover that complies with the applicable requirements of the Standard for Cover Plates for Flush-Mounted Wiring Devices, UL 514D.

*Exception: A receptacle with integral power supply with one or more Class 2 output low-voltage connectors need not be provided with a cover plate or box cover if all the following conditions are met:*

*a) The unit is intended for use with a cover plate having dimensions that comply with Wiring Devices – Dimensional Specifications, ANSI/NEMA WD6, for features intended to accommodate a flush-mounted wiring device of the dimensions specified in ANSI/NEMA WD6; and*

*b) Markings specified in SE15.1 are visible after installation using a cover plate having dimensions specified in (a); and*

*c) No cover plate modifications are needed in order to comply with this Standard.*

SE3.3 The Class 2 low-voltage output connectors of a receptacle with integral power supply shall be insulated and extend beyond the plane of the receptacle mounting yoke and be accessible when a cover plate is installed.

*Exception: A receptacle provided with a Class 2 separable conductor lead assembly shall comply with SE3.5.*

SE3.4 The Class 2 low-voltage power supply shall be configured for supply from a single branch circuit. The device shall be configured to prevent split-wiring of the receptacle outlets.

SE3.5 A receptacle provided with a Class 2 separable conductor lead assembly shall only be of the conductor leads-type construction as identified in Leads, 30.5, or provide a suitable barrier or protection to prevent the separable lead assembly from contacting live terminations. The connector for the separable lead shall be located behind the plane of the receptacle mounting yoke and not be accessible when a cover plate is installed. This connector shall be an integral part of the receptacle housing or attached with a short Class 2 lead assembly. This lead assembly shall meet all of the applicable requirements of SE8.1 – SE8.5 except it shall not be longer than 6 inches (152 mm).

### SE4 Separable Face Assembly

SE4.1 A receptacle with integral power supply with one or more Class 2 outputs that employ a separable face assembly shall be formed and assembled so that it may be installed, in accordance with the installation instructions, into its specified receptacle, without risk of fire or electric shock. Risk of fire or electric shock is determined by compliance with the construction and performance requirements herein and the applicable requirements of the Standard for Attachment Plugs and Receptacles, UL 498.

SE4.2 A separable face assembly shall not require the installer to remove, defeat, or replace any factory installed securement means (such as a rivet).

SE4.3 A separable face assembly shall be constructed such that when separated from the receptacle, there shall not be any exposed contact to live parts as determined by the articulate probe with web stop shown in UL 498 Figure 9.1.

*Exception: With the separable face assembly removed from the receptacle (device), exposed output of the Class 2 power supply may be accessible to contact by the articulate probe with web stop.*

SE4.4 A separable face assembly shall be configured in such a manner (i.e. keyed) to prevent incorrect arrangement or positioning.

SE4.5 A separable face assembly shall be mechanically secured to the receptacle (device) by a latch or the like to prevent unintentional separation from the receptacle during normal use. The securement means may additionally rely on the flush device cover plate for mechanical support, but not as the sole means of securement to the receptacle (device).

SE4.6 A separable face assembly that also covers the ANSI/NEMA slot configuration shall be investigated to the applicable UL 498 requirements with and without the separable face assembly secured to the receptacle.

SE4.7 The Class 2 power supply shall be contained within the receptacle (device) assembly only.

SE4.8 A separable face assembly may be provided as a replacement part. See Section SE14, User Instructions (Separable Face Assembly as a Replacement Part), for details.

### SE5 Polymeric Enclosures

SE5.1 In addition to the insulating material requirements of Section 8, a polymeric material used to enclose the Class 2 power supply circuitry shall have a flame rating not less than 5V, or comply with the 127 mm Flame Test specified in the Standard for Polymeric Material – Use in Electrical Equipment Evaluations, UL 746C.

### SE6 Spacings

SE6.1 In addition to the spacings requirements of Section 14, a receptacle with integral power supply with one or more Class 2 output low-voltage connectors, shall also comply with the spacings requirements for the power supply circuitry of the Standard for Class 2 Power Units, UL 1310.

SE6.2 A receptacle with integral power supply with one or more Class 2 output low-voltage connectors shall maintain a minimum of a 1/4 inch (6.35 mm) separation of branch circuit wiring and Class 2 connections after installation. Compliance is checked by measurement and if necessary, by conducting the Assembly Test as identified in Section SE11.

SE6.3 A receptacle with integral power supply with one or more Class 2 output low-voltage connectors shall provide adequate spacings clearance of 3/64 inch (1.2 mm) between each terminal and the metal of a standard outlet box of the minimum size in which it is intended to be installed. Compliance is checked by conducting the Assembly Test as identified in Section SE11.

SE6.4 Class 2 output low-voltage connectors shall be located as to prevent a line blade of an attachment plug from being improperly inserted into the Class 2 output low-voltage connector (i.e. USB) slot and the line contacts of the receptacle. Compliance is checked by inspection and if necessary, the test described in Section SE11, Assembly Test.

*Exception: A receptacle with an integral power supply with one or more Class 2 output low-voltage connectors, that complies with the requirements in this Standard for Tamper-Resistance Receptacles, complies with this requirement.*

## SE7 Class 2 Disconnect Switch

SE7.1 A receptacle with an integral Class 2 power supply which employs a separable lead assembly shall be provided with an integral switch to disconnect all power to the separable lead.

SE7.2 The switch identified in SE7.1 shall be accessible to the user after installation into an outlet box with a cover plate installed. A visible means shall also be provided to denote power status, such as an on/off marking or an indicator light. See SE15.2 for further details.

## SE8 Class 2 Separable Lead Assembly

SE8.1 A Class 2 separable lead assembly shall consist of type CL3, CL3P, or CL3R cable surrounded by tubing, with one end terminating in a molded-on or permanently attached separable connector, as described in SE8.2 – SE8.5.

SE8.2 A separable lead assembly shall be provided with type CL3, CL3P, or CL3R cable which complies with the Standard for Power-Limited Circuit Cables, UL 13. The CL3, CL3P, or CL3R cable shall have a minimum 300 V rating and shall be not less than 18 inches (457 mm) in length.

*Exception: Leads may be less than 18 inches if part of a complete system that includes Class 2 equipment intended and investigated for mounting in or on the device box.*

SE8.3 Tubing surrounding the type CL3, CL3P, or CL3R cable shall comply with the Standard for Extruded Insulating Tubing, UL 224, have a minimum 300 V rating, and be provided over the entire length of the CL3 conductors. The tubing shall be continuous and firmly fixed to the Class 2 separable lead assembly.

SE8.4 One end of a Class 2 separable lead assembly shall be provided with a molded-on or permanently attached separable connector to be inserted into mating connector located on the body of the receptacle. Permanently attached can be achieved by crimping, welding, riveting, or equivalent to render the connector non-rewireable.

SE8.5 The connectors of separable lead devices located on the lead and on the body of the receptacle shall have contacts that are not likely to be contacted by branch circuit wiring when mated or unmated. Openings less than 0.062 in. (1.6 mm) in diameter are deemed to comply with this requirement.

## PERFORMANCE

## SE9 General

SE9.1 It shall be permissible for the electronic circuitry in an receptacle with integral power supply with one or more Class 2 output low-voltage connectors to be removed or de-energized to facilitate Overload, Temperature, and Resistance to Arcing testing.

SE9.2 A receptacle with integral power supply with one or more Class 2 output low-voltage connectors that employs a separable face assembly shall comply with the applicable requirements of this Standard, with and without separable face assembly installed in place.

## SE10 Class 2 Output Power Supply

SE10.1 For all testing to the Standard for Class 2 Power Units, UL 1310, where the device is to be energized from a source of supply, the assembly is to be assembled as intended into a nonmetallic outlet box with a depth as specified by the manufacturer. The outlet box shall be mounted in a vertical wall section as follows:

a) With a depth of minimum 125 percent of the box depth;

b) With plywood or gypsum wallboard surfaces; and

c) Loosely filled with fiberglass or equivalent thermal insulation.

SE10.2 Under any condition of low voltage output loading, individually or collectively, tests shall be conducted to represent the worst case of:

a) No load on the branch circuit outlets; and

b) Full load from either one of the branch circuit outlets.

SE10.3 All low voltage output connectors shall comply with the Class 2 performance requirements of the Standard for Class 2 Power Units, UL 1310.

## SE11 Assembly Test

SE11.1 A receptacle with integral power supply with one or more Class 2 output low-voltage connectors shall comply with all of the following:

a) Maintain a minimum of a 1/4 inch (6.35 mm) separation of branch circuit wiring and Class 2 connections;

b) Maintain adequate spacings clearance between each terminal and the metal of a standard outlet box of the minimum size in which it is intended to be installed;

c) Not permit contact to be made between the probe shown in Figure 139.1 and any live part through the Class 2 output connectors or through any flush device cover plate or outlet box cover opening or joint surrounding the installed device; and

d) Not permit contact to be made between the Class 2 output connector and receptacle line contacts with an ANSI/NEMA 1-15P attachment plug.

SE11.2 A receptacle with integral power supply with one or more Class 2 output low-voltage connectors shall be wired with the largest conductor (AWG) size when installed into the minimum size metallic outlet box, as indicated in the manufacturer's instructions. The conductor length shall be 6 inches (152 mm).

SE11.3 Following assembly, the device shall be checked for compliance with SE11.1(a) and SE11.1(b). Additionally, with the flush-device cover plate or outlet box cover installed, the probe is to be applied to any opening or joint surrounding the Class 2 output and through the Class 2 output connector slot openings with a force of 8 ounces (2.2 N) in attempt to contact live parts. A suitable indicating device (such as an ohmmeter, battery-and-buzzer combination, or similar device) is to be connected between the probe and the wiring terminal of the receptacle to determine whether contact is made. The rod is to be inserted in the Class 2 output connector slot opening successively in three directions in any orientation that may permit access to contact live parts. The probe is applied for approximately 5 seconds in each of the three directions. During each application the gauge shall not be moved or rotated and shall be withdrawn when moving from one direction to the next.

SE11.4 The same representative assembly as described in SE11.3 shall be checked for compliance with SE11.1(d), using an ANSI/NEMA 1-15P polarized attachment plug. One blade shall be inserted into the slot openings of the Class 2 output connector and the other blade into the slot openings of the receptacle contacts with a force of 10 pounds (45 N) in an attempt to contact live parts. A suitable indicating device (such as an ohmmeter, battery-and-buzzer combination, or similar device) is to be connected between the Class 2 output connector and the contacts of the receptacle to determine whether contact is made. The attachment plug is to be manipulated in any direction or orientation that may permit access to contact live parts. The attachment plug is applied for approximately 5 seconds in each direction.

## MARKINGS AND INSTRUCTIONS

### SE12 Installation Instructions

SE12.1 A receptacle with integral power supply with one or more Class 2 output low-voltage connectors shall be provided with installation instructions. These instructions shall be provided with each individual device and contain the following information:

a) The dimensions of the intended outlet box necessary to mount and secure the device; and

b) The largest branch circuit conductor size in AWG the device will accommodate.

SE12.2 Instructions shall include information to alert the user that a single branch circuit shall supply the device. The instructions shall include a pictorial or photograph illustrating proper installation and wiring method of conductors.

SE12.3 A receptacle with integral Class 2 power supply with a separable conductor lead assembly shall have a label marker located 18 inches from the separable molded-on connector to assure that Class 2 conductors do not terminate in the outlet box. The marker label shall be marked with the following or equivalent, “This marker must be located entirely outside of wall box. No portion may reside in the wall box clamp or inside the box”.

*Exception: Leads less than 18 inches if part of a complete system shall be marked with the following or equivalent, "These leads must be terminated to a specific Class 2 device, cat no. XXXXX, investigated for mounting in or on the device box".*

### SE13 User Instructions (General)

SE13.1 Each smallest unit packaging shall include user instructions as specified in SE13.2 – SE13.4.

SE13.2 The instructions for a receptacle with integral power supply with one or more Class 2 output low-voltage connectors shall address:

a) The use of appropriate Class 2 connectors with interconnecting cables;

b) That Class 2 output connections are not intended for supporting products or appliances;

c) That any output cable connected to the Class 2 outputs is to be routed away from the receptacle outlet slots or an inserted attachment plug blades into receptacle outlet; and

d) Charging Devices with Batteries – Reducing the risk of overheating, fire, or explosion of batteries during recharging by checking the compatibility with appliance manufacturer’s charging instructions.

SE13.3 A receptacle with integral power supply with one or more Class 2 separable conductor lead assembly shall be provided with a separate label marked with the following or equivalent, “Class 2 utilization equipment power is provided from receptacle”. The instructions shall advise the installer to apply this label in the wiring compartment of the Class 2 utilization equipment connected to the separable lead.

SE13.4 A receptacle with integral power supply with one or more Class 2 separable conductor lead assembly shall be provided with instructions explaining the operation of the disconnect switch for the lead connected Class 2 equipment.

### SE14 User Instructions (Separable Face Assembly as a Replacement Part)

SE14.1 A separable face assembly intended as a replacement part shall be provided with instructions pertaining to its installation.

SE14.2 An illustration may be used to clarify the intent of a required instruction but shall not replace the written instruction.

SE14.3 Instructions shall include the following statements or their equivalent:

IMPORTANT SAFETY INSTRUCTIONS

"WARNING – Use only replacement part (Catalog Number) with Receptacle (+) Only", where (+) is to be substituted with the specific manufacturer name and model / catalog number of the intended device(s)."

"WARNING – Risk of Fire or Electric Shock. Do not use this replacement part with any receptacle, other than the one specified on the replacement mark packaging and in these instructions."

SAVE THESE INSTRUCTIONS

SE14.4 The opening and closing statements of the instructions specified in SE14.3 – "IMPORTANT SAFETY INSTRUCTIONS," and "SAVE THESE INSTRUCTIONS," or the equivalent shall be entirely in upper case letters or shall be emphasized to distinguish them from the rest of the text.

## SE15 Markings (General)

SE15.1 The output "Class 2" connectors shall be marked with one of the following as identified in (a) through (c). The markings identified in (a) through (c) shall be permanently marked and visible after installation of the flush device cover plate or outlet box cover. The output electrical rating may be expressed in amperes and voltage, or wattage or in volt-ampere.

a) "Class 2" and electrical rating, or

b) "Class 2", or

c) Electrical rating

*Exception: For a receptacle provided with either a Class 2 connector located other than on the face of a receptacle when installed or a Class 2 separable conductor lead assembly, the output "Class 2" connectors shall be identified as being "Class 2". The "Class 2" designation and the output electrical rating, for a Class 2 connector located other than on the face of a receptacle when installed or for the separable lead need only be visible during installation.*

SE15.2 When provided, the actuator of the Class 2 Disconnect Switch shall be marked, "On/Off" or equivalent. The marking shall be visible after installation of the flush device cover plate or outlet box cover. An indicator light denoting whether power is on or off is considered equivalent.

SE15.3 A receptacle provided with a Class 2 separable conductor lead assembly shall be marked with the following or equivalent, "Separable Lead For Use with______ Products requiring __ V Only". The blank is to be filled in with the manufacturer's name and specified AC or DC voltage of the intended equipment.

SE15.4 A separable Class 2 wire lead assembly shall be provided with a flag label indicating, "Class 2" and the electrical rating. The label shall also be marked with correlation markings stating "For Use Only with Listed Model ________ Receptacle" or equivalent.

## SE16 Markings (Separable Face Assembly as a Replacement Part)

SE16.1 A separable face assembly intended as a replacement part shall be provided in the form of a kit, including marking as detailed in Section SE15, Markings (General).

SE16.2 A required marking shall be molded, die-stamped, paint-stenciled, stamped or etched metal that is permanently secured, or indelibly stamped lettering on a pressure-sensitive label secured by adhesive that, upon investigation, meets the intent of the requirement for the application.

SE16.3 The replacement part shall be provided with the following identification markings:

a) Manufacturer's name;

b) Specific catalog or series number; and

c) The date or other dating period of manufacture not exceeding any three consecutive months.

*Exception: Abbreviation of the date of manufacture, or provision in a nationally accepted conventional code or in a code affirmed by the manufacturer, meets the intent of the requirement.*

SE16.4 The replacement part packaging shall be marked with the following marking or equivalent:

"WARNING – Use only replacement part (Catalog Number) with (+) Receptacle Only".

Where “(+)” is to be substituted with the specific manufacturer name and model / catalog number of the intended device(s).

# SUPPLEMENT SF – RECESSED OUTLET KIT ASSEMBLY

## INTRODUCTION

### SF1 Scope

SF1.1 The requirements of this supplement cover a kit intended to facilitate the extension of a branch circuit for use with a flat-screen television or other electrical utilization equipment intended for wall or ceiling mounting in accordance with the National Electrical Code, NFPA 70. The kit is only intended for use with copper conductors and installation in dry locations. The kit consists of a recessed inlet, a detachable power supply cord, a length of non-metallic sheathed or armored cable with cable bushing, and a recessed outlet.

SF1.2 A kit may also include provisions for the connection or routing of audio, video and/or communication circuit cables.

SF1.3 A kit is only intended for use on 15- or 20-Ampere, 125 V branch circuits.

### SF2 Glossary

SF2.1 For the purpose of this supplement, the following definitions apply.

SF2.2 DETACHABLE POWER SUPPLY CORD – An assembly consisting of a length of flexible cord that is either assembled to or molded-on with both a line fitting (attachment plug) and load fitting (cord connector). The load fitting is intended to mate with a recessed inlet.

SF2.3 RECESSED OUTLET – A recessed mounted, single receptacle outlet with not more than three contact devices of the ANSI/NEMA configuration, intended for mounting in or on an outlet box, an outlet-box cover, or a flush device plate for fixed installation on a branch circuit and intended to be installed in a wall or ceiling and other vertical or horizontal surfaces.

SF2.4 RECESSED INLET – A recessed male blade device of the ANSI/NEMA configuration, either integrally formed or assembled to an outlet box, outlet box cover or enclosure, intended for the connection to a mating cord connector.

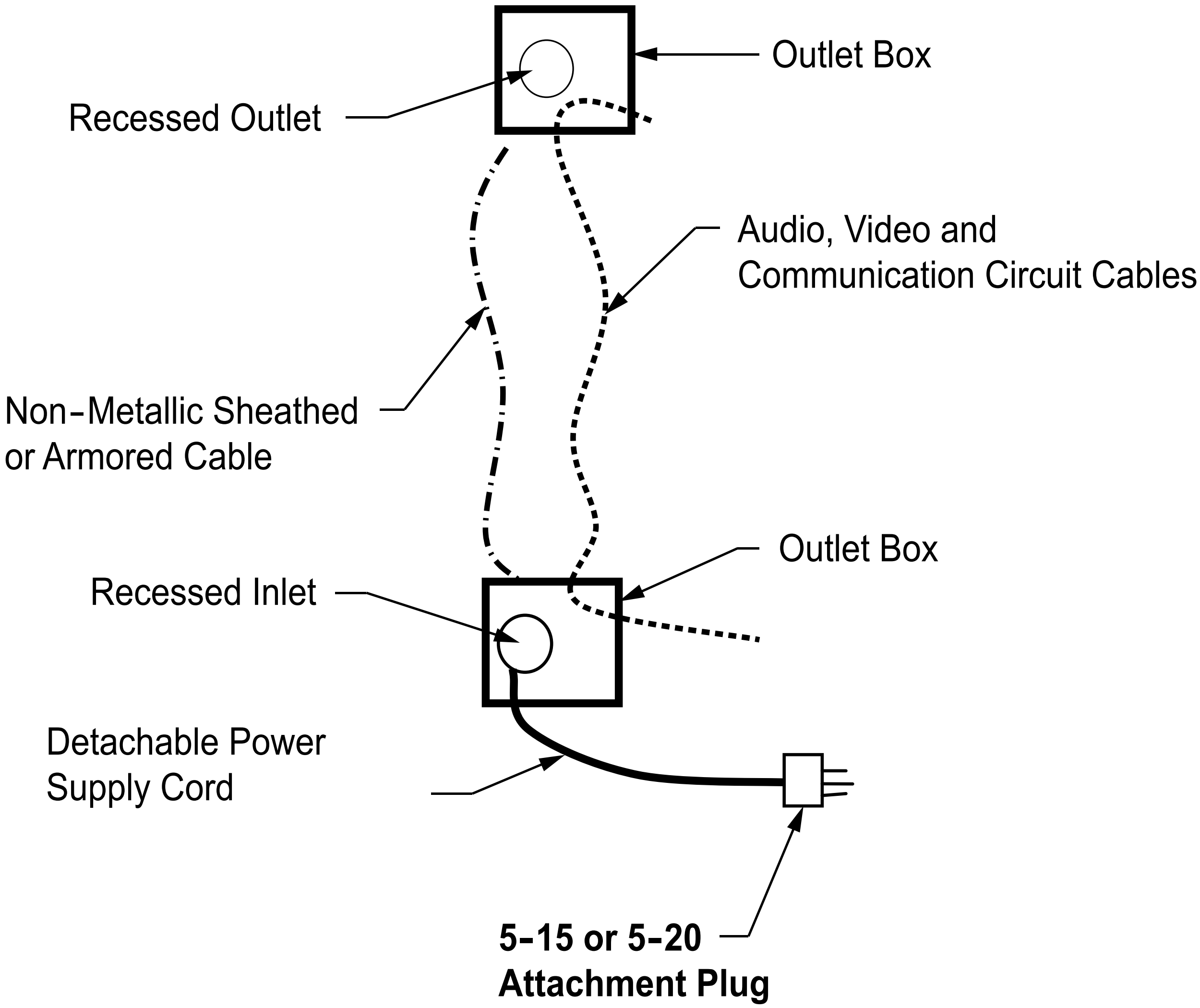
## CONSTRUCTION

### SF3 General

SF3.1 In addition to the construction, performance and marking requirements contained in this Standard, a kit shall also comply with the applicable requirements for its individual parts as described in Sections SF4 – SF13. See Figure SF3.1 for an example of a kit assembly.

**Figure SF3.1**

**Example of a recessed outlet kit assembly**

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SF3.2 The system shall be provided so that voltage, amperage, device configurations and polarity are consistent throughout the complete kit when assembled.

SF3.3 A three- to two-wire, grounding-type adapter shall not be provided with the kit.

## SF4 Outlet Box

SF4.1 An outlet box provided with, or integrated into, the design of a recessed outlet or inlet, shall comply with the Standard for Metallic Outlet Boxes, UL 514A, the Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers, UL 514C, as appropriate.

SF4.2 An outlet box provided with, or integrated into, the design of a recessed outlet or inlet shall not permit insulated power conductors and audio, video and/or communication circuit cables being contained in the same box.

SF4.3 All power conductor splices and connections of conductors shall be contained within an outlet box or enclosure and shall be accessible after installation. Cable interconnects per Outline for Nonmetallic Sheathed Cable Interconnects, UL 2256, are not permitted outside the outlet box or enclosure.

SF4.4 An outlet box provided with openings or knockouts for more than one cable or wiring method shall be marked as shown in SF15.6.

## SF5 Outlet Box Cover or Cover Plate

SF5.1 An outlet box cover or cover plate provided with or integrated into the design of a recessed outlet or inlet, shall comply with the Standard for Metallic Outlet Boxes, UL 514A, the Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers, UL 514C, or the Standard for Cover Plates for Flush-Mounted Wiring Devices,UL 514D, as appropriate.

*Exception: A flush-device cover plate that is intended for decorative purposes only, need not comply.*

## SF6 Recessed Outlet

SF6.1 A recessed single outlet device shall comply with all applicable requirements for a flush receptacle contained in this Standard.

## SF7 Recessed Inlet

SF7.1 A recessed inlet shall comply with all applicable requirements for an inlet contained in this Standard.

SF7.2 A recessed inlet employing configurations shown in the Standard for Appliance Couplers for Household and Similar General Purposes – Part 1: General Requirements, UL 60320-1, are not permitted.

## SF8 Non-Metallic Sheathed Cable

SF8.1 Non-metallic sheathed cable provided with the kit shall comply with all of the following:

a) Non-metallic sheathed cable shall comply with the applicable requirements in the Standard for Nonmetallic Sheathed Cables, UL 719;

b) The length of non-metallic sheathed cable shall be a minimum 6 ft. (1.83 m) to a maximum of 25 ft. (7.62 m) in length and be a minimum of either:

1) 14 AWG for a kit intended for use on a 15 A branch circuit; or

2) 12 AWG for a kit intended for use on a 20 A branch circuit. See SF15.4 for marking details; and

c) The non-metallic sheathed cable shall have a voltage rating not less than the rated voltage of the recessed outlet.

## SF9 Armored Cable

SF9.1 Armored cable provided with the kit shall comply with all of the following:

a) Armored cable shall comply with the applicable requirements in the Standard for Armored Cable, UL 4;

b) The length of armored cable shall be a minimum 6 ft. (1.83 m) to a maximum of 25 ft. (7.62 m) in length and be a minimum of either:

1) 14 AWG for a kit intended for use on a 15 A branch circuit, or

2) 12 AWG for a kit intended for use on a 20 A branch circuit. See SF15.4 for marking details;

c) Armored cable shall have a voltage rating not less than the rated voltage of the recessed outlet; and

d) Each end of the armored cable shall be provided with a cable bushing.

## SF10 Armored Cable Connectors

SF10.1 An armored cable connector used to secure armored cable to an outlet box shall comply with the Standard for Conduit, Tubing and Cable Fittings, UL 514B.

## SF11 Splices and Connections

SF11.1 Wire connectors used to splice conductors shall comply with the Standard for Splicing Wire Connectors, UL 486C.

SF11.2 Wire connectors shall be rated for the conductor size, type of conductor and the number of wires to be connected. See SF15.2 for marking details.

SF11.3 A terminal block used to splice conductors shall comply with the Standard for Terminal Blocks, UL 1059, and be suitable for field wiring.

SF11.4 A terminal block shall be suitable for both solid and stranded copper conductors. See SF15.3 for marking details.

SF11.5 All splices shall be enclosed within an outlet box or enclosure and be accessible. Cable interconnects per Outline for Nonmetallic Sheathed Cable Interconnects, UL 2256, are not permitted outside the outlet box or enclosure.

## SF12 Detachable Power Supply Cords

SF12.1 A detachable power supply cord shall comply with the applicable requirements in the Standard for Cord Sets and Power Supply Cords, UL 817.

SF12.2 The attachment plug of a detachable power supply cord shall be of the ANSI/NEMA 5-15 or 5-20 configuration only.

SF12.3 The cord connector of a detachable power supply cord shall be of the ANSI/NEMA 5-15 or 5-20 configuration only.

SF12.4 Configurations shown in the Standard for Appliance Couplers for Household and Similar General Purposes – Part 1: General Requirements, UL 60320-1, are not permitted.

SF12.5 The flexible cord of a detachable or non-detachable power supply cord shall be of the Type SJ, SJE, SJO, SJOO, SJT, SJTO, or SJTOO only.

SF12.6 The flexible cord of a detachable power supply cord shall be rated 300 volts and be a minimum of either:

a) 16 AWG for a kit intended for use with a 15 A circuit and rated devices, or

b) 14 AWG for a kit intended for use with a 20 A circuit and rated devices. See SF15.4 for marking details.

SF12.7 A detachable power supply cord shall be 6 ft. (1.83 m) – 12 ft. (3.65 m) in length measured from the face of the attachment plug to either the face of the cord connector.

## SF13 Accessibility of Live Parts

SF13.1 All live parts shall be protected against exposure to contact by persons when fully assembled using all essential parts and installed according to the manufacturer's instructions. Compliance is checked if necessary, by conducting the Assembly Test as identified in Section SF14.

*Exception: Male blades which are energized only when mated with the corresponding outlet are not required to comply with this requirement.*

SF13.2 Accessible dead-metal parts of a grounding device shall be conductively connected to the grounding-conductor path through the device.

*Exception: Accessible dead-metal parts electrically insulated from current-carrying parts are not required to comply with this requirement.*

## PERFORMANCE

## SF14 Assembly Test

SF14.1 A kit, when fully assembled using all essential parts and installed according to the manufacturer's instructions, shall maintain separation of branch circuit wiring and audio, video and/or communication circuit cables or connections.

SF14.2 A kit shall be assembled and installed in a simulated wall according to the manufacturer's instructions.

SF14.3 Following assembly, the kit shall be checked for compliance with SF13.1.

## MARKINGS AND INSTRUCTIONS

## SF15 Markings

SF15.1 In addition to the marking requirements for an inlet and a recessed outlet (receptacle) contained in this Standard, the markings described in SF15.2 – SF15.7 shall also be provided based upon the splice connection device provided.

SF15.2 For a kit provided with wire connectors, the following instructions shall be either marked on the device, on the smallest unit packaging, or on a separate instruction sheet, shall include the following:

a) The insulation strip length;

b) The wire sizes, combinations of wire sizes, and number of wires intended to be connected; and

c) The phrase “Copper wire only.”

SF15.3 For a kit provided with a terminal block, the following instructions shall be either marked on the device, on the smallest unit packaging, or on a separate instruction sheet:

a) The insulation strip length;

b) The tightening torque for a wire-binding-screw or a stud-and-nut type terminal; and

c) The phrase “Copper wire only.”

SF15.4 A kit provided with 14 AWG non-metallic sheath or armored cable shall be marked, "CAUTION – Risk of Fire and Shock – Only intended for use on 15 ampere branch circuits", or an equivalent wording following the word "CAUTION".

SF15.5 A marking intended to inform the user of a risk of electric shock, fire, or injury to persons shall be prefixed by a signal word "CAUTION," "WARNING," or "DANGER." The marking shall be in letters not less than 3/32 in (2.4 mm) high. The signal word shall be more prominent than any other required marking.

SF15.6 An outlet box with more than one opening or knockout for a cable as described in SF4.4 shall be marked “WARNING – Risk of Fire and Shock. Do not connect this box to any other circuits or outlets” or an equivalent statement. The Warning shall be on a safety orange background in accordance with Safety Colors, ANSI Z535.1, and Product Safety Signs and Labels, ANSI Z535.4.

SF15.7 A marking may appear on pressure-sensitive labels secured by adhesive. Pressure-sensitive labels secured by adhesive shall comply with the requirements in the Standard for Marking and Labeling Systems, UL 969. Pressure-sensitive labels shall be rated for the maximum temperature and type of surface to which the label is applied.

## SF16 Installation Instructions

SF16.1 Kits shall be provided with installation instructions which contain the following information both in writing and pictorially:

a) The wall cut-out dimensions of the outlet box provided with or integrated into the design of a recessed outlet or inlet;

b) Mounting and securement instructions of each outlet box; and

c) Method and materials to be used to make any connections or splices.

SF16.2 Instructions for kits provided with 14 AWG non-metallic sheathed or armored cable shall include the statement, "CAUTION – Risk of Fire and Shock – Only intended for use on 15 ampere branch circuits" or an equivalent wording following the word "CAUTION".

SF16.3 Instructions shall also include the statement, “CAUTION – Risk of Fire – Do Not Install Power Supply Cord Within the Wall Cavity”, or the equivalent.

SF16.4 Instructions shall also include the statement, “WARNING – Risk of Fire and Shock. Do not connect this box to any other circuits or outlets” or the equivalent.

## SF17 User Instructions

SF17.1 Each smallest unit packaging shall include user instructions to route away any audio, video and/or communication circuit cables and connectors from the receptacle or inlet slots.

SF17.2 Each smallest unit packaging shall include user instructions including the statement, "CAUTION – Risk of Fire – Only Use Cord Set Provided With This Kit", or the equivalent.

# APPENDIX A

## Standards for Components

Standards under which components of the products covered by this standard are evaluated include the following:

Title of Standard − UL Standard Designation

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Cover Plates for Flush-Mounted Wiring Devices – UL 514D
Enclosed and Dead-Front Switches – UL 98
Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors – UL 486E
Fuseholders – Part 1: General Requirements – UL 4248-1
Fuseholders – Part 4: Class CC – UL 4248-4
Fuseholders – Part 5: Class G – UL 4248-5
Fuseholders – Part 6: Class H – UL 4248-6
Fuseholders – Part 8: Class J – UL 4248-8
Fuseholders – Part 9: Class K – UL 4248-9
Fuseholders – Part 11: Type C (Edison Base) and Type S Plug Fuse – UL 4248-11
Fuseholders – Part 12: Class R – UL 4248-12
Fuseholders – Part 15: Class T – UL 4248-15
General-Use Snap Switches – UL 20
Marking and Labeling Systems – UL 969
Metallic Outlet Boxes – UL 514A
Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers – UL 514C
Polymeric Materials – Long Term Property Evaluations – UL 746B
Polymeric Materials – Short Term Property Evaluations – UL 746A
Receptacles and Switches Intended for Use with Aluminum Wire – UL 1567
Tests for Flammability of Plastic Materials for Parts in Devices and Appliances – UL 94
Wire Connectors – UL 486A-486B
Wiring Device Configurations – UL 1681

# APPENDIX B

## Wiring Device Configurations

The wiring device configuration charts illustrated in Figure 1 – Figure 3 are reproduced from the National Electrical Manufacturers Association (NEMA) publication ANSI/NEMA WD 6 – 2002 (R2008), Wiring Devices – Dimensional Specifications, Copyright 2008, by NEMA, copies of which may be purchased from NEMA, 1300 North 17th Street, Rosslyn, VA 22209.

**Figure 1**

**NEMA configurations for specific purpose plugs and receptacles**

| DESCRIPTION | | NEMA NUMBER | 15 AMPERE | | 30 AMPERE | | 50 AMPERE | |
|---|---|---|---|---|---|---|---|---|
| | | | RECEPTACLE | PLUG | RECEPTACLE | PLUG | RECEPTACLE | PLUG |
| MIDGET LOCKING | 125V, 2 POLE, 2 WIRE | ML1 | ML1-15R | ML1-15P | | | | |
| MIDGET LOCKING | 125V, 2 POLE, 3 WIRE GROUNDING | ML2 | ML2-15R | ML2-15P | | | | |
| MIDGET LOCKING | 125/250V, 3 POLE, 3 WIRE | ML3 | ML3-15R | ML3-15P | | | | |
| FSL CONFIGURATIONS | 28V DC, 2 POLE, 3 WIRE GROUNDING | FSL1 | | | FSL1-30R | FSL1-30P | | |
| FSL CONFIGURATIONS | 120V, 400HZ, 2 POLE, 3 WIRE GROUNDING | FSL2 | | | FSL2-30R | FSL2-30P | | |
| FSL CONFIGURATIONS | 120V, 400 HZ, 3-PHASE 3 POLE, 4 WIRE GROUNDING | FSL3 | | | FSL3-30R | FSL3-30P | | |
| FSL CONFIGURATIONS | 120/208V, 3Ø Y, 400 HZ 4 POLE, 5 WIRE GROUNDING | FSL4 | | | FSL4-30R | FSL4-30P | | |
| MARINE SHIP-TO-SHORE | 125V, 2 POLE, 3 WIRE GROUNDING | SS1 | | | | | SS1-50R | SS1-50P |
| MARINE SHIP-TO-SHORE | 125/250V, 3 POLE, 4 WIRE GROUNDING | SS2 | | | | | SS2-50R | SS2-50P |
| TRAVEL TRAILER | 120V AC, 2 POLE, 3 WIRE GROUNDING | TT | | | TT-30R | TT-30P | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

NOTE: BLANK SPACES RESERVED FOR FUTURE CONFIGURATIONS

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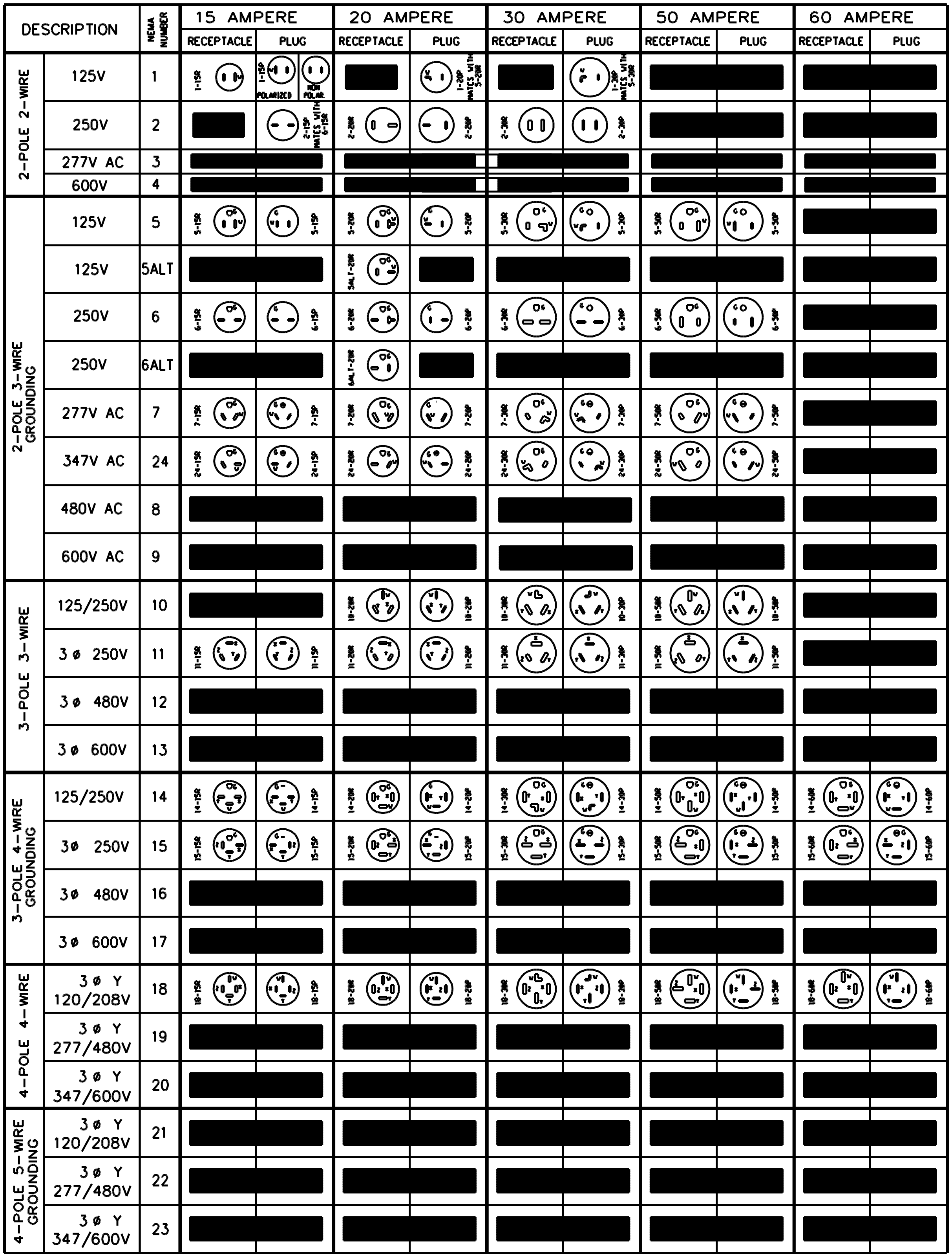
**Figure 2**

**NEMA configurations for straight blade plugs and receptacles**




NOTE: BLANK SPACES RESERVED FOR FUTURE CONFIGURATIONS

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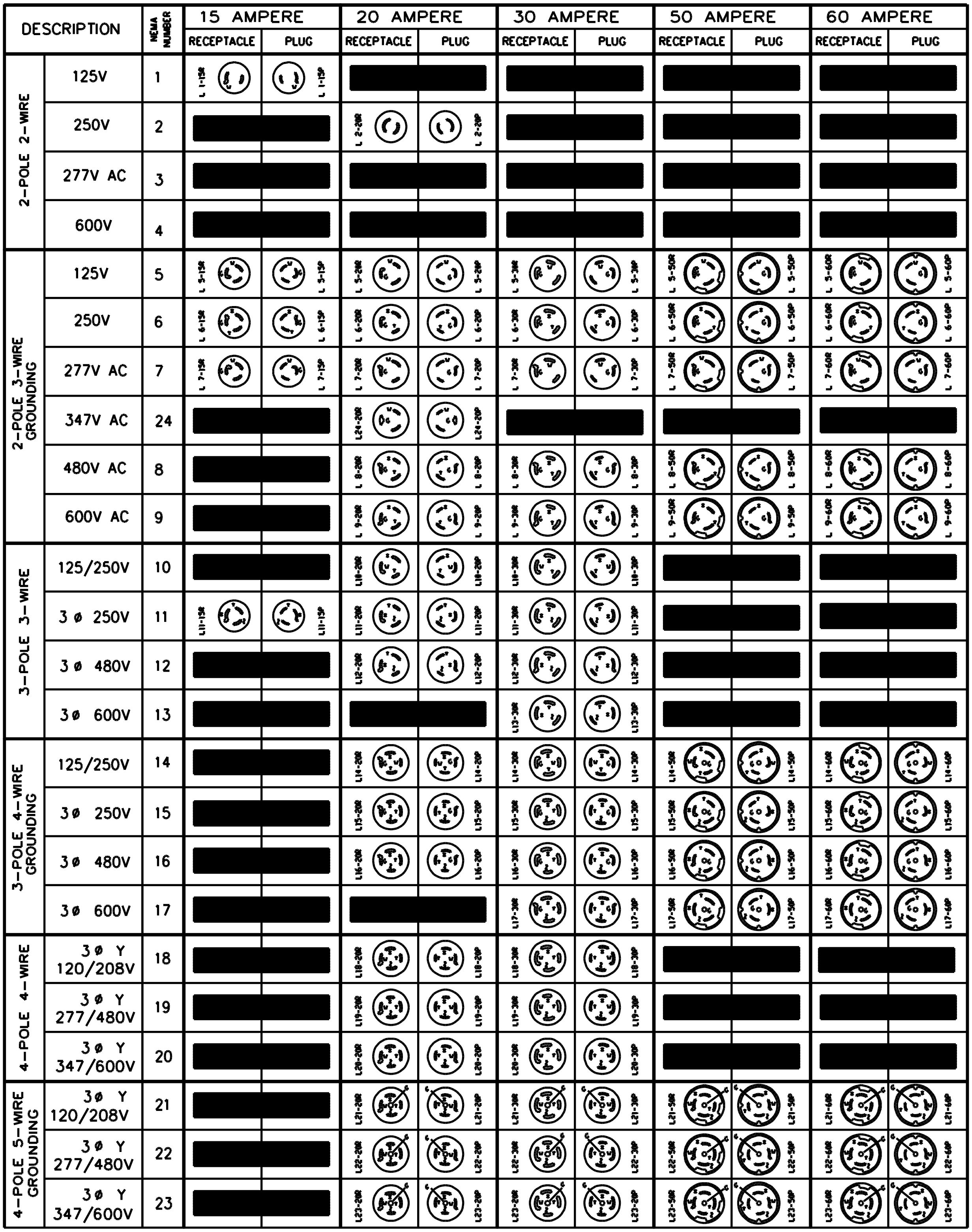
## Figure 3

## NEMA configurations for locking plugs and receptacles




NOTE: BLANK SPACES RESERVED FOR FUTURE CONFIGURATIONS

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