

UL 498

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Attachment Plugs and Receptacles

Underwriters Laboratories Inc. (UL)
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UL Standard for Safety
for
Attachment Plugs and Receptacles, UL 498

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Revisions: This Standard contains revisions through and including January 21, 1999.

A change is indicated by a note following the affected item. The note is preceded and followed by an asterisk.

The new and revised requirements are substantially in accordance with UL's Bulletins on this subject dated July 30, 1998 and August 18, 1998 and Adoption Bulletin dated November 30, 1998. These bulletins are now obsolete and may be discarded.

The revisions dated January 21, 1999 include a reprinted title page (page 1) for this Standard.

As indicated on the title page (page 1), this UL Standard for Safety is an American National Standard. Attention is directed to the note on the title page of this Standard outlining the procedures to be followed to retain the approved text of this ANSI/UL Standard.

As indicated on the title page (page 1), this UL Standard for Safety has been adopted by the Department of Defense.

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The requirements in this Standard are now in effect, except for those paragraphs, sections, tables, figures, and/or other elements of the Standard having future effective dates as indicated in the note following the affected item. The prior text for requirements that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.

New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Listing, Recognition, and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

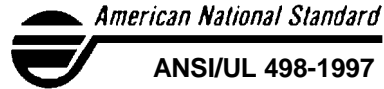
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Revisions of this standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements.

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FOREWORD

A. This Standard contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product employing materials or having forms of construction which conflict with specific requirements of the Standard cannot be judged to comply with the Standard. A product employing materials or having forms of construction not addressed by this Standard may be examined and tested according to the intent of the requirements and, if found to meet the intent of this Standard, may be judged to comply with the Standard.

E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of or reliance upon this Standard.

F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

INTRODUCTION

1 Scope

1.1 General

1.1.1 These requirements cover attachment plugs, receptacles, cord connectors, inlets, some forms of current taps and adapters, 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.

1.1.1 revised January 21, 1999

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

1.1.2.1 These requirements do not cover the current or voltage conversion circuitry that may be used in travel adapters.

1.1.2.1 added November 5, 1997

1.1.3 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this Standard, and that involves a risk of fire, electric shock, or injury to persons shall be evaluated using the appropriate additional component and end-product requirements to determine that the level of safety as originally anticipated by the intent of this Standard is maintained. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this Standard shall not be judged to comply with this Standard. Where appropriate, revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this Standard.

1.1.3 revised January 21, 1999

1.1.4 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) 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;
- c) 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 Data, Signal, Control and Power Applications, UL 1977;
- d) 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 Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations, UL 1010;
- e) Devices intended for use with telecommunications networks, covered by the Standard for Telephone Equipment, UL 1459, or the Standard for Communications Circuit Accessories, UL 1863;

- f) Devices incorporating ground-fault circuit interruption circuitry, covered by the Standard for Ground-Fault Circuit Interrupters, UL 943;
- g) Single- or two-outlet direct plug-in devices incorporating transient voltage surge suppression circuitry, covered by the Standard for Transient Voltage Surge Suppressors, UL 1449; or
- h) Single- or two-outlet direct plug-in devices incorporating electromagnetic interference filter circuitry, covered by the Standard for Electromagnetic Interference Filters, UL 1283.
- i) 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.

1.1.4 added January 21, 1999

1.2 Hospital grade devices

1.2.1 The requirements in Sections 23, 28, 37, 83 – 88, 102 – 111 and 127 – 136 cover Hospital Grade receptacles, attachment plugs, and cord connectors 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 conventional configuration (ANSI C-73) rated 15 or 20 A, 125 or 250 V; 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.

1.2.2 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 Hospital Grade test program in this standard along with any modifications needed to adequately represent the expected use of the device.

1.2.3 These requirements do not cover Hospital Grade molded-on attachment plugs of power-supply cords.

2 References

2.1 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.

3 Glossary

3.1 For the purposes of this standard, the following definitions apply.

3.2 ADAPTER – A device that adapts one blade or slot configuration to another (including a grounding adapter for a nongrounding receptacle), adapts a receptacle to a lampholder, or adapts a lampholder to a receptacle (also known as a separable attachment plug).

3.2.1 ADAPTER, TRAVEL – A device that adapts the attachment plug of a portable appliance to permit its use on an electrical system that employs a male blade or pin configuration other than that used in the United States. This includes adapters employing 2-pole, 2-wire and 2-pole, 3-wire blade or slot configurations rated 15 A, 125 V (ANSI configurations) and non-ANSI blade or slot configurations. See also 1.1.2.1.

3.2.1 added November 5, 1997

3.2.2 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.

3.2.2 added January 21, 1999

3.2.3 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.

3.2.3 added January 21, 1999

3.3 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).

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

3.5 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.

3.6 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.

3.6.1 CONFIGURATION, MULTI- – An outlet device configuration, commonly used in travel adapters, that is designed to mate with more than one attachment plug configuration.

3.6.1 added November 5, 1997

3.7 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.

3.8 CURRENT TAP – A male and female contact device that, when connected to an outlet receptacle or to a lampholder, provides multiple outlet configurations. An outlet configuration may consist of a slot configuration, a screwshell lampholder configuration, or provision for the connection of a flexible cord.

3.9 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.

3.9 effective January 1, 1998

3.10 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.

3.10 effective January 1, 1998

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

3.12 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.

3.13 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.

3.14 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.

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

3.16 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.

3.16 revised June 26, 1998

3.17 RECEPTACLE, DUPLEX – A receptacle having two outlets on a single mounting yoke for flush mounting in a plane surface.

3.17.1 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.

3.17.1 added June 26, 1998

3.18 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.

3.19 RECEPTACLE, SELF-CONTAINED – A receptacle which includes an enclosure and mounting means such that it can be installed without the use of a flush-device or other outlet box.

3.20 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.

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

3.22 RECEPTACLE, TAMPER-RESISTANT – A receptacle which by its construction is intended to limit improper access to its energized contacts and is intended for use in pediatric patient care areas, in accordance with Article 517 of the National Electrical Code.

3.23 SCREW-BASE ATTACHMENT PLUG – A male screw shell and center contact construction for the line connection of a device to a lampholder outlet.

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

3.23.1 added June 26, 1998

3.24 SEPARABLE ATTACHMENT PLUG – An adapter having a male screw shell and a slot configuration outlet.

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

3.26 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.

3.27 TERMINAL, PIN-TYPE – A terminal having a contact pin that punctures the conductor insulation to contact the current-carrying conductor.

3.28 TERMINAL, PRESSURE-WIRE – A terminal where the conductor is clamped under a pressure plate or saddle by one or more screws or nuts.

3.29 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.

3.30 TERMINAL, SET SCREW – A terminal where the clamping pressure is applied by the end of the screw bearing directly on the conductor.

3.31 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.

4 Components

4.1 Except as indicated in 4.2, 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.

4.1 revised April 26, 1996

4.2 A component need not comply with a specific requirement that:

- a) Involves a feature or characteristic not needed in the application of the component in the product covered by this standard, or
- b) Is superseded by a requirement in this standard.

4.2 added April 26, 1996

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

4.3 added April 26, 1996

4.4 Specific components are recognized as being 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 for which they have been recognized.

4.4 added April 26, 1996

5 Units of Measurement

5.1 If a value for measurement is followed by a value in other units in parentheses, the second value may be only approximate. The first stated value is the requirement.

CONSTRUCTION

ALL DEVICES

6 General

6.1 The ratings mentioned throughout this standard including those mentioned in Tables 177.1 and 177.1A, and in the headings for the configurations shown in Sections C1 – C3 of the Standard for Wiring Device Configurations, UL 1681, represent maximum ampacity and maximum operating potential in volts for receptacles and other outlet devices such as cord connectors or current taps. 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.

6.1 revised January 19, 1998

6.2 *Deleted June 26, 1998*

7 Configurations

7.1 The Figures referenced as Sections C1 – C3 contain configurations of various attachment plug and receptacle combinations and are found in the Standard for Wiring Device Configurations, UL 1681.

7.2 Grounding devices that are similar to those illustrated in Figures C1.5 – C1.16, C1.24 – C1.33, C2.3 – C2.15, C2.24 – C2.30, C2.37 – C2.42, C3.1, C3.6 and C3.8 include those with all of the following features:

- a) One blade, pin, or contact is exclusively for grounding.
- b) A grounding blade or pin cannot enter upon and touch a live contact in the mating receptacle.
- c) Each particular configuration is for single ampere and single voltage rating.

8 Insulating Materials

8.1 General

Sub-heading effective January 1, 1998

8.1.1 All parts that act as the electrical insulation or enclosure of a device shall be made of porcelain or another insulating material acceptable for the particular application. Hard rubber is not acceptable.

8.1.1 effective January 1, 1998

8.1.2 Vulcanized fiber may be used for insulating washers, separators, and barriers, but not as the sole support of live parts. The material shall be moisture-resistant in accordance with 64.1 and 64.2.

8.1.2 effective January 1, 1998

8.2 Flammability

Sub-heading effective January 1, 1998

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, VTM-0, 5VA, or 5VB 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 nominal minimum thickness employed within 1/32 inch (0.8 mm) of live parts within the device.

Exception No. 1: The internal insulating systems of components where component requirements exist need not have a flame class rating.

Exception No. 2: A small part meeting all the following criteria need not have a flame class rating:

- a) *Its volume does not exceed 0.122 cubic inch (2 cm³), and*
- 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 need not have a flame class rating.

8.2.1 revised January 21, 1999

8.3 Electrical properties

Sub-heading effective January 1, 1998

8.3.1 A polymeric material used for electrical insulation or enclosure of live parts shall comply with the requirements in Sections 60 – 62.

Exception No. 1: A polymeric material having a maximum Comparative Tracking Index (CTI) rating of 175 V or greater or a performance level class not greater than 3 need not comply with Comparative Tracking Index Test, Section 60.

Exception No. 2: A polymeric material having Hot Wire Ignition (HWI) ratings or performance level class values not greater than those shown in Table 8.1 for the applicable flammability classification need not comply with Glow Wire Test, Section 61. 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 No. 3: A polymeric material having High-Current Arc Resistance to Ignition (HAI) ratings or performance level class values not greater than those shown in Table 8.1 for the applicable flammability classification need not comply with High-Current Arc Resistance to Ignition Test, Section 62. 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 No. 4: The internal insulating systems of components where component requirements exist need not comply with the requirements in Sections 60 – 62.

Exception No. 5: A small part meeting all the following criteria need not comply with the requirements in Sections 60 – 62:

- a) Its volume does not exceed 0.122 cubic inch (2 cm³), and*
- 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. 6: Fiber or similar material that is equal to or less than 0.010 inch (0.25 mm) thick need not comply with the requirements in Sections 60 – 62.

Exception No. 7: 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), need not comply with the requirements in Glow Wire Test, Section 61.

Exception No. 8: 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 need not comply with the requirements in Sections 60 – 62.

8.3.1 revised January 21, 1999

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

Table 8.1 revised January 21, 1999

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, 5VA, 5VB	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.				

8.4 Thermal properties

Sub-heading effective January 1, 1998

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 ±2.0EC (73.4 ±3.6EF)) are acceptable for use at 60EC (140EF) 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)]*

8.4.1 revised January 21, 1999

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, receptacles, and current taps intended for installation on a receptacle without a flush device cover plate)	80 ^c	60 ^c	80 ^c
Cord-connected and direct plug-in devices (including attachment plugs, cord connectors, current taps, and adapters)	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 77, 94, 118, and 161.			

Table 8.2 effective January 1, 1998

8.4.2 Deleted effective January 1, 1998

8.4.3 A sealing compound shall be insulating, waterproof, and shall not soften at a temperature of 65EC (149EF).

8.4.4 A determination of the softening point of a sealing compound is to be made in accordance with the Test Method for Softening Point by Ring-and-Ball Apparatus, ASTM E28-92.

8.4.5 Sulphur is not acceptable as a sealing compound.

8.5 Fuse enclosures

Sub-heading effective January 1, 1998

8.5.1 A fuse enclosure shall be of a moisture-resistant material in accordance with 64.1 and 64.2. Fiber and similar absorptive materials are not acceptable for use as the enclosure of a fuse.

8.5.1 revised and separated into 15.4.1 – 15.4.3 effective January 1, 1998

8.5.2 *Deletion effective date changed from January 1, 1995 to January 1, 1998.*

8.5.3 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.

8.5.3 revised January 21, 1999

8.5.4 *Deletion effective date changed from January 1, 1995 to January 1, 1998.*

8.6 Screw bases

8.6.1 The insulating washer under the center contact of a screw-base attachment plug shall not be less than 1/16 inch (1.6 mm) thick.

9 Accessibility of Live Parts

Effective date for Section 9 changed from January 1, 1995 to January 1, 1998

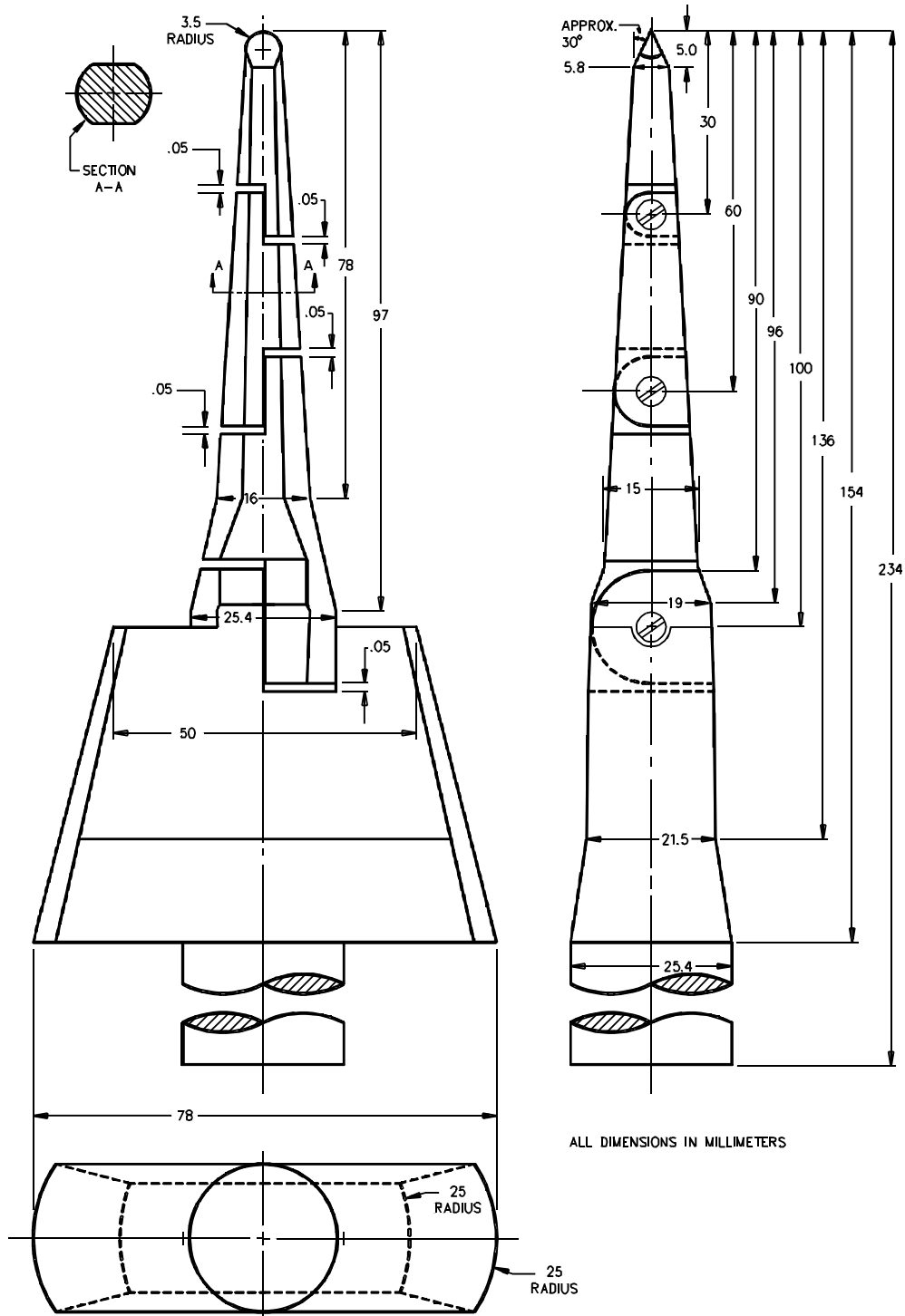
9.1 The probe illustrated in Figure 9.1 is to be applied to any depth that the recessing will permit; and is to be rotated, changed in configuration or angled before, during and after application to any position that is necessary to examine the device. See 63.1.

9.2 The probe mentioned in 9.1 is to be used as a measuring instrument to judge the accessibility provided by the recessing and not as an instrument to judge the strength of a material; it is to be applied with a force of 3 lbf (13.3 N) to determine accessibility.

9.3 During the examination of a product to determine whether it complies with the requirements in 63.1:

- a) The device is to be wired and assembled in accordance with the manufacturer's instructions,
- b) A part, other than an essential part described in 17.1.2 and 17.1.3, that may be opened or removed by the user without using a tool is to be opened or removed.

Figure 9.1
Articulate probe with web stop



PA100A

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, except that stainless steel may be employed for a part not subject to arcing.

10.1.2 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.

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

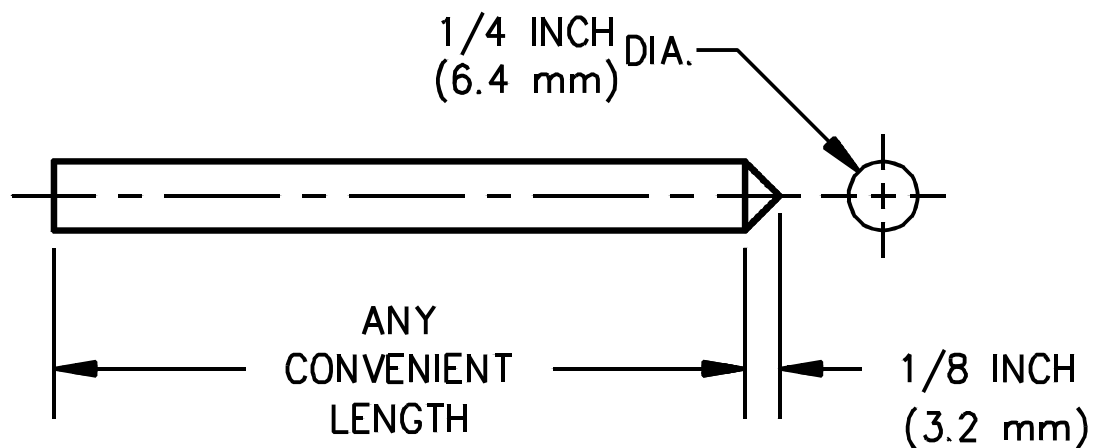
10.1.4 Uninsulated live parts shall be secured in place so that a reduction in the spacings below those required in 14.1 is not likely.

10.2 Contacts

10.2.1 Except as noted in 10.2.5, 24.1.1, and 46.1.8, 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.

Figure 10.1
Probe

* Figure 10.1 revised June 26, 1998*



PA190

10.2.2 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 specified in 10.2.1. Bevels, tapers, or other expansions of the opening to the face of the device do not affect the measurement.

10.2.3 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.

10.2.4 The maximum straight-line dimension is the maximum-length straight-line that will fit within the opening at the plane of measurement.

10.2.5 Devices having openings that close upon removal of the attachment plug, and specific-purpose devices intended only for disconnecting use (see 177.7 and 178.6), are not subject to the requirements in 10.2.1.

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 path through an attachment plug, current tap or cord connector, except for a metal housing or armor, and
- c) The grounding path through a receptacle up to the strap, yoke, or other mounting means. See also 11.3.

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

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

11.4 For the grounding devices illustrated in Figures C1.5 – C1.16, C1.24 – C1.33, C2.3 – C2.15, C2.24 – C2.30, C2.37 – C2.42, C3.1, C3.6, and C3.8, and similar grounding devices, the grounding-path connections shall be secured by riveting, bolting, welding, or equivalent means. Another form of connection may be employed in a cord connector if the connection meets the requirement in 95.1. See also 7.2.

11.5 The requirements in 11.1 – 11.4 apply to the entire grounding-conductor path between the grounding pin, blade, or contact and

- a) The grounding terminal or
- b) 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.

11.6 Except as noted in 19.2, the grounding member (pin, blade, or contact) of the devices illustrated in Figures C1.5 – C1.16, C1.24 – C1.33, C2.3 – C2.15, C2.24 – C2.30, C2.37 – C2.42, C3.1, C3.6, and C3.8, and of similar grounding devices, shall be permanently attached to the body of the device. See also 7.2.

11.7 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.

11.8 For the grounding devices illustrated in Figures C1.5 – C1.16, C1.24 – C1.33, C2.3 – C2.15, C2.24 – C2.30, C2.37 – C2.42, C3.1, C3.6 and C3.8, the grounding terminal shall be connected to the contact that is identified in the illustrations by the letter G. That terminal and the equivalent terminal of similar grounding devices, shall have a permanent identification in accordance with 179.1.1 that is readily recognizable during installation. See also 7.2, 31.7 and 179.2.1, and Tables 179.1 and 179.2.

11.9 Except where isolated from current-carrying parts and wiring other than complete flexible cords, dead-metal parts of a grounding device shall be conductively connected to the grounding-conductor path through the device.

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11.10 Dead metal parts of a device for use in nongrounding applications where there is no provision for grounding the dead metal parts 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. Flexible cords are not considered to be complete where two insulated conductors of a parallel-type of construction are split apart or where the jacket is removed from the insulated conductors of the jacketed type of cord.

11.11 Except as provided in 33.14 and 52.4, iron or steel other than machine screws, washers, nuts, and stainless steel parts shall be protected against corrosion.

12 Terminals

12.1 If a device is intended for the connection of conductors, a means shall be provided for such connection.

12.2 The means for connection mentioned in 12.1 shall include a wiring terminal of the wire-binding screw, clamp or pressure-wire terminal type which utilizes positive screw pressure on a bared conductor, or a factory-assembled fastening of the conductor by means of soldering, welding, riveting or crimping.

12.2 effective January 1, 1998

12.3 Other forms of construction may be accepted if the mechanical features and current-carrying capability are equivalent to those of one of the connections described in 12.2. See 20.1.1, 26.1, 32.1, 32.2 and 49.1.

12.3 effective January 1, 1998

12.4 The setscrew type of wiring terminal shall not be employed in other than a pressure-wire connector as mentioned in 12.11.

12.5 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.

12.6 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 have no fewer than two full threads in the metal.

12.7 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.

12.8 A wire-binding screw shall thread into metal.

12.9 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 that is illustrated in Figure C1.6, the terminal screw that is used for connecting the grounding conductor to the outlet box may 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 if the assembly is capable of withstanding a tightening torque of 16 lbf-in (1.8 N•m) applied to the wire-binding screw without stripping either the screw threads or the terminal plate threads or damaging the slot in the head of the screw. See 12.10.

12.10 To determine compliance with note c of Table 12.1, six devices are to be tested. Solid No. 14 AWG (2.1 mm²) 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).

12.11 The terminals for the connection of circuit wires to a device rated more than 30 A shall consist of soldering lugs, pressure-wire connectors, or the equivalent. See 12.13.

12.12 A device intended for fixed installation to a No. 14, 12, or 10 AWG branch circuit conductor and having wire-binding screw or clamp type terminals shall comply with the requirements of Temperature Test, Section 116.

12.13 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. See also 11.8 and 179.1.1.

12.14 A terminal plate for a soldering lug or pressure-wire connector shall be at least 0.050 inch (1.27 mm) thick and shall have no fewer than two full threads in the metal for a terminal screw.

12.15 A pressure-wire connector, for the connection of aluminum wire or aluminum and copper wire of a device for fixed installation rated 30 A or more shall comply with the applicable requirements for wire connectors in the Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors, UL 486E.

12.16 A pressure-wire connector for the connection of copper wire only, of a device for fixed installation rated 35 A or more shall comply with the applicable requirements for wire connectors in the Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors, UL 486E.

12.17 A direct-bearing setscrew pressure-wire connector for the connection of copper wire only, of a device for fixed installation rated less than 30 A, shall comply with the applicable requirements for wire connectors in the Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors, UL 486E.

12.18 The tightening torque for the field wiring terminals of the devices mentioned in 12.15 – 12.17 shall be specified by the device manufacturer and shall be marked as described in 180.1.1. The specified tightening torque shall not be less than 90 percent of the value employed in the static heating test in UL 486E for the maximum wire size corresponding to the ampere rating of the device. See 180.1.1.

Exception: A lesser torque value may be assigned if the connector is investigated in accordance with UL 486A, UL 486B, or UL 486E using the lesser assigned torque value.

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, 96, or 154.

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 75, 96, or 154, but need not 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).

13.1 revised June 26, 1998

13.2 A device intended solely for factory assembly to the conductors of a flexible cord are 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.

13.2 revised June 26, 1998

13.3 If space is provided within a device for a strain-relief knot in the flexible cord, all surfaces on which the knot may bear shall be smooth and well-rounded.

13.4 An integral clamp, a means of snubbing, or space for a knot shall be provided for securing the individual conductor insulation of a Type SP-1 or SPT-1, or the equivalent, flexible cord in a 15 A parallel- or tandem-blade device of the type mentioned in 13.3.

13.5 A device is acceptable for use with a parallel-conductor cord if:

- a) There is no strain relief external to the device, and
- b) The diameter of a round cord-entry hole or the minor axis of an oblong cord-entry hole is not longer than 1/4 inch (6.4 mm).

13.6 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.

13.7 A metal cord grip may be provided on a cord connected device intended specifically for use with a jacketed type of flexible cord, such as Type S or SJ. A metal-covered device with a metal cord grip is not required to have an insulating bushing.

14 Spacings

14.1 Except where greater spacings are required in 33.4, there shall be a spacing through air or over surface of not less than 3/64 inch (1.2 mm) for a device rated 250 V or less, and not less than 1/8 inch (3.2 mm) for a device rated more than 250 V, between uninsulated live parts of opposite polarity and between 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.

14.2 The dead metal mentioned in 14.1 includes a metal surface (a metal face plate in the case of a flush receptacle) on which the device is mounted in the intended manner. A dead-metal screw head, rivet, or the like is not considered to be exposed to contact by persons after the device is installed in the intended manner, if the dead metal 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) in the clear.

14.3 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, 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.

15.1.6 Exposure (within the limits mentioned in 15.1.5) 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 An outlet device that has a contact configuration illustrated in Figures C1.5 – C1.16, C1.24 – C1.33, C2.3 – C2.15, C2.24 – C2.30, C2.37 – C2.42, C3.1, C3.6 and C3.8, and similar grounding devices, 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 non-grounding, non-polarized, 15 A, 125 V, cord connector, current tap, or adapter 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, Sections 94A or 161A.

15.2.3 revised June 26, 1998

15.2.4 A non-grounding, polarized cord connector, current tap, or adapter having the configuration shown in Figure C1.1 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, Sections 94A or 161A.

15.2.4 revised June 26, 1998

15.3 Mating and interchangeability

15.3.1 A general-use device, including any configuration illustrated in Sections C1 – C3, 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 need not 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, need not comply with this requirement.

Exception No. 3: A travel adapter need not comply with this requirement. See Section 51A.

15.3.1 revised November 5, 1997

15.3.2 *Revised and combined with 15.3.1 November 5, 1997*

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

15.3.4 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 the Standard for Wiring Device Configurations, UL 1681;
- b) Another configuration that is an American National Standard configuration; or
- c) 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 revised January 19, 1998

15.3.5 *Revised and combined with 15.3.4 January 19, 1998*

15.3.6 *Revised and combined with 15.3.4 January 19, 1998*

15.3.7 *Deleted January 19, 1998*

15.3.8 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 177.2, are not prohibited from mating with corresponding devices with the standard current rating and the identical voltage rating.

15.3.8 revised January 19, 1998

15.3.9 *Revised and combined with 15.3.11 January 19, 1998*

15.3.10 *Revised and combined with 15.3.8 January 19, 1998*

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

Exception No. 1: The locking grounding device illustrated in Figure C3.8 and marked "Hospital Only" shall be permitted to be interchangeable with other nongrounding general-use devices which are not so marked. See also 178.9.1.

Exception No. 2: A grounding adapter of the type described in 51.1 is not prohibited from accepting a grounding-type attachment plug.

15.3.11 revised and relocated from 15.3.9 January 19, 1998

15.4 Fuseholders

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

15.4.1 effective January 1, 1998

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

15.4.2 effective January 1, 1998

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

15.4.3 effective January 1, 1998

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. See 178.5.1.

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 Sections C1 – C3, may be provided with a fuse or fuses which is removable when the pins or blades are in a receptacle if the attachment plug is marked in accordance with the requirement in 178.5.2.

15.4.7 A fuse in a fusible device that has a screwshell base shall not be removable when the base is in a lampholder.

15.4.8 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 Special-Use Switches, UL 1054.

15.5.1 added June 26, 1998

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.

16.2 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, and is not depended upon (by itself) to hold contacts or other live parts in place.

17 Enclosure

17.1 General

17.1.1 An attachment plug for use with 15 or 20 A receptacles, wired on flexible cord and assembled as intended, using only those parts essential for the operation of the device, shall have the wire terminations completely enclosed.

17.1.2 A part is essential for the operation of the device if it:

- a) Encloses or completes the enclosure of current-carrying parts other than those on the face of the plug, or
- b) Encloses or completes the enclosure of the flexible cord from which the jacket has been removed for wiring.

17.1.3 A part that performs no function other than to provide strain relief is not considered essential for the operation of the device.

17.1.4 A separable insulating cover or disc applied to the face of a plug, and serving no purpose other than to enclose wiring terminals that would otherwise be exposed, is not considered essential for the operation of the device.

17.1.5 A separable insulating cover applied to the face of a fused plug is considered

- a) Essential for the operation of the device if the cover also serves to provide for the placement and removal of the fuse, or
- b) Not essential for the operation of the device if the cover only serves to provide access to the fuse.

17.1.6 If there is an exposed live part on the face of a plug-in device other than one rated 15 or 20 A as covered in 17.1.1 (attachment plug, current tap, adapter, and the like), the face of the device shall be provided with a substantial disc of 1/32 inch (0.8 mm), or thicker, insulating material securely held in place, and completely covering all exposed live parts.

17.1.7 The minimum thickness of insulating material that is nominally 1/32 inch (0.8 mm) thick is 0.028 inch (0.71 mm). Insulating discs or face covers that may be opened or removed to provide access to the wiring terminals of an attachment plug, current tap, or adapter shall be mechanically secured after wiring by one or more screws, latches, or detents that cannot be unintentionally opened or removed.

17.1.8 A cover that is held in place by only friction without any positive detent action is not considered mechanically secured.

17.1.9 The face cover or disc shall enclose the wiring compartments for live conductors with a fit at the periphery that will not permit the entrance of a 0.030 inch diameter (0.76 mm) probe. 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.

17.1.10 The notch mentioned in 17.1.9 shall comply with all of the following conditions:

- 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.
- 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.

17.1.11 A face cover or disc may have multiple clearance openings to enable its use with a number of blade arrangements. Any unfilled openings shall be located opposite the anticipated insulating face of the corresponding outlet device.

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

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

17.1.14 Except as provided in 17.1.15, 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.

17.1.15 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.

17.1.16 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.

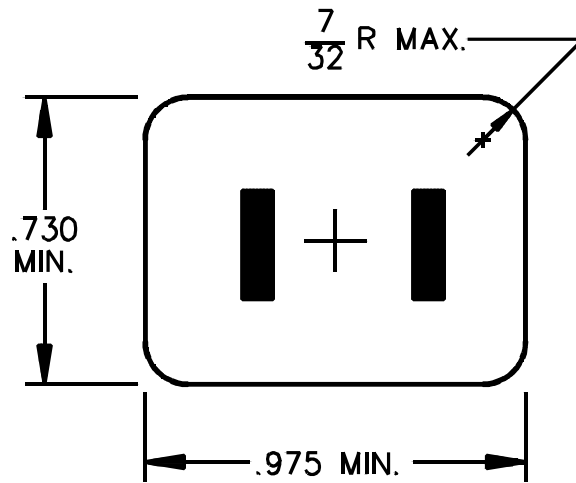
17.2 Grip

17.2.1 A 2-wire parallel-blade attachment plug (Figure C1.1) for use on parallel or vacuum cleaner (SV, SVO, SVT, SVTO, SVE, SVOO, and SVTOO) 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 a 2-wire, parallel-blade attachment plug (Figure C1.1) shall encompass an area equal to or larger than that indicated in Figure 17.1.

Figure 17.1
Minimum attachment plug face dimensions



BLADES CENTERED

SA1945

inch	7/32	0.730	0.975
mm	5.6	18.5	24.8

18 Current-Carrying Parts

18.1 Blades

18.1.1 Blades of the folded-over type employed on attachment plugs shall have dimensions in accordance with the applicable figure in Section C1.

18.1.2 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.

18.1.3 The blades employed in an attachment plug having one of the configurations shown in Figures C1.1 – C1.3, C1.5, C1.6, C1.9, or C1.10, shall comply with the dimensional requirements of the Standard for Attachment Plug Blades for Use in Cord Sets and Power-Supply Cords, UL 1659.

18.1.3 added June 26, 1998

18.2 Screw-base

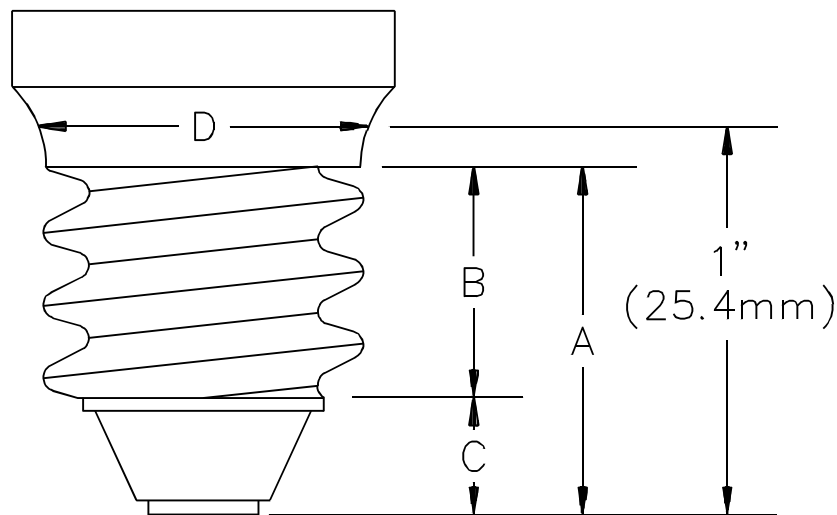
18.2.1 The metal base of a screw-base attachment plug:

- a) Shall be of the medium-base size,
- b) Shall have no fewer than two threads for engagement with a lampholder screw shell;
- c) Shall be of copper, a copper-base alloy, or the aluminum-base alloy described in 18.2.2;
- d) Shall not be less than 0.008 inch (0.203 mm) thick if of copper or a copper-base alloy, or not less than 0.011 inch (0.279 mm) thick if of an aluminum-base alloy;
- e) Shall be secured in place so that it will be prevented from turning with respect to the body and
- f) Shall not be of the skeleton type.

18.2.2 An aluminum-base alloy for use in a screw base is to be a wrought alloy employing manganese, magnesium, or both, as the principal alloying materials (with the possible addition of chromium) and containing no more than 1.5 percent of iron and silicon combined and no more than 1.0 percent of all other impurities usually found in aluminum including a maximum of 0.2 percent of copper.

18.2.3 Dimensions A and D of a screw-base attachment plug, as illustrated in Figure 18.1, shall not be more than 15/16 inch (23.8 mm) and 1.037 inch (26.3 mm) respectively. Dimensions B and C in Figure 18.1 are not specified but are generally 0.43 inch (10.9 mm) minimum for B and 0.51 inch (13.0 mm) maximum for C.

Figure 18.1
Screw-base attachment plug dimensions



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19 Grounding and Dead Metal Parts

19.1 The requirement in 11.6 does not preclude the acceptance of a device in which the grounding member is mounted in soft rubber or similarly flexible material. The requirement contemplates that the element is to be secured in a manner so that it is not readily removable or movable other than as indicated in 19.2.

19.2 The grounding member of the attachment plug illustrated in Figure C1.5 may be of the movable, self-restoring type if the attachment plug is intended for use on the power-supply cord of a hand-held tool or hand-held appliance.

19.3 Except as indicated in 19.4 the grounding terminal mentioned in 11.8 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.

19.4 The conductive connection described in 19.3 need not 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 178.13.1.

19.5 A conductive connection between a blade or pin and a metal part, such as the mounting strap, yoke, or body armor, shall be limited to configurations of attachment plugs and inlets that:

- a) Are either those illustrated in Figures C1.5 – C1.16, C1.24 – C1.33, C2.3 – C2.15, C2.24 – C2.30, C2.37 – C2.42, C3.1, C3.6, and C3.8, or similar grounding devices (see 7.2) or are special, and
- b) Are intended to provide other than 2-wire power supply or are rated in excess of 15 A at 300 V or less or, in excess of 20 A at 150 V or less.

Unless the connection is obvious:

- c) There shall not be a terminal for the grounding contact, or
- d) The screw shall be omitted from the grounding terminal plate.

19.6 For attachment plugs with the configurations illustrated in Figures C1.5 – C1.16, C1.24 – C1.33, C2.3, C2.9, C3.1, and C3.6, a 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 some other 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.

19.7 The grounding blade or grounding pin surface projecting from an attachment plug and constituting a part of the specified plug and constituting a part of the specified blade configuration for a 15 or 20 A nonlocking-type attachment plug shall be continuous without holes or detents. Continuous seams along the length or in the tip of a tubular grounding pin, or any inadvertent small opening in butt joints formed at the tip, are not precluded by this requirement.

19.8 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.

19.9 If the device mentioned in 19.8 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 the requirement in 178.13.1.

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 78 – 82. An attachment plug with pin-type terminals shall have the configuration shown in Figure C1.1. See 180.3.1.

20.1.1 effective January 1, 1998

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. However, 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)
15 A	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 No. 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.

21 Assembly

21.1 An attachment plug having 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 preventing the full seating of the cover.

21.2 The flexible cord used to determine compliance with 21.1 either:

- a) Shall have an ampacity at least equal to the rating of the plug configuration,
- b) Shall be of the type and size marked on the device, or
- c) Shall be of the maximum size that can be accommodated by the cord-entrance opening into the attachment plug.

21.3 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.

21.4 Parallel slots of a screw-base attachment plug shall be in accordance with Figure C1.1. If the slots are polarized, the contact behind the longer slot shall be connected to the screw shell.

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

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

21.7 Live screw heads or nuts on the underside of a base intended for surface mounting shall be countersunk not less than 1/8 inch (3.2 mm) in the clear and then covered with a waterproof insulating sealing compound that will not soften at a temperature of 65EC (149EF) unless such parts are spaced 1/2 inch (12.7 mm) or more through air from the mounting surface and are staked, upset, or otherwise prevented from loosening.

21.8 A determination of the softening point of a sealing compound is to be made in accordance with the Test Method for Softening Point by Ring-and-Ball Apparatus, ASTM E28-92.

21.9 Sealing compound over a live nut or screw head shall not be less than 1/16 inch (1.6 mm) thick. However, if the underside of the base is not recessed, and if it may contact the surface upon which the receptacle is mounted, the sealing compound shall not be less than 1/8 inch (3.2 mm) thick.

21.10 An attachment plug intended for radio-antenna, ground, or both connections 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.

21.10 revised June 26, 1998

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 weather-proof attachment plug, and intended to be exposed after installation, shall be:

- a) A stranded RH, RHW, T, TW, or an equivalent type of wire,
- b) Not smaller than No. 14 AWG (2.1 mm²), and
- c) Not less than 4-1/2 inches (114 mm) long.

23 Hospital Grade

23.1 A Hospital Grade attachment plug shall comply with the requirements in Section 23, and Sections 83 – 88 and with all other applicable requirements in this standard.

23.2 To provide strain relief, 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, Section 84.

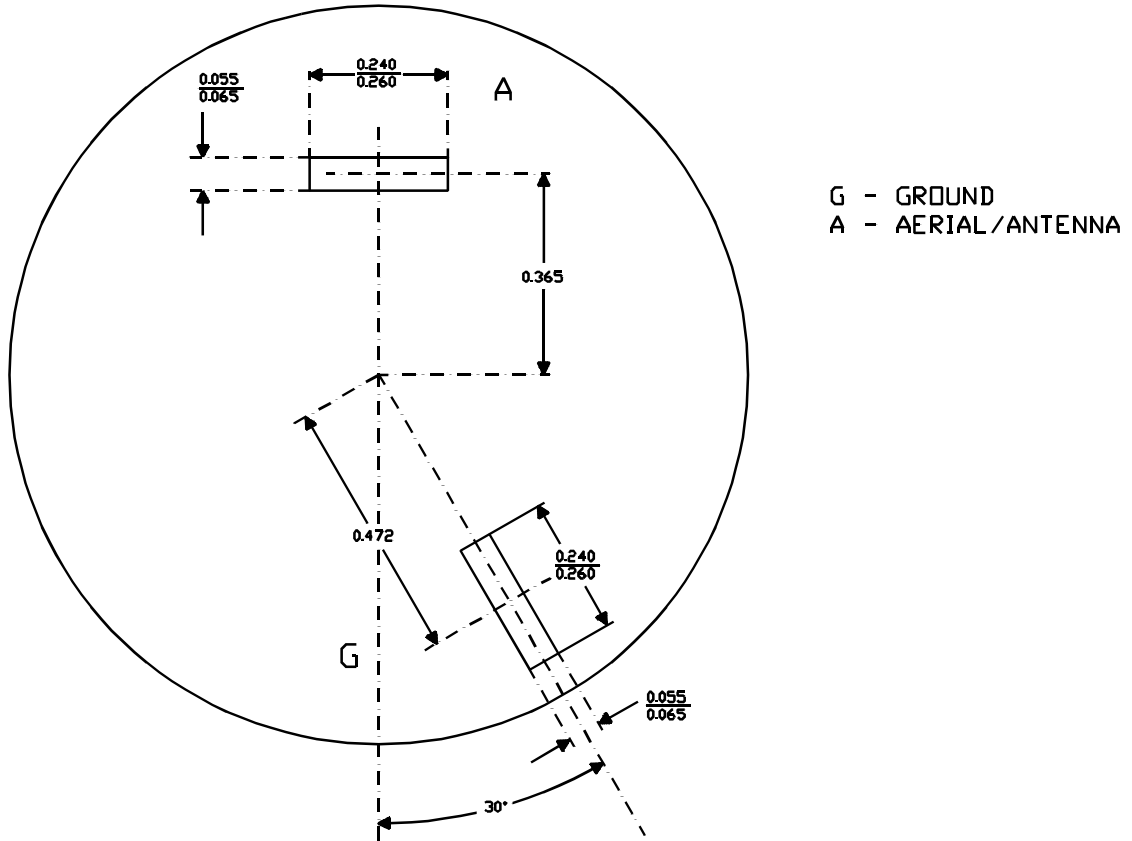
23.3 The wiring terminals shall be located in individual insulating compartments (wiring terminal enclosures) with no joints or seams through which stray strands of the conductor can pass during wiring.

23.4 The wiring terminal individual wiring 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.

Figure 21.1
Example of a radio-antenna plug configuration

Figure 21.1 added June 26, 1998



SM1256

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

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23.5 The attachment plug housing 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.

23.6 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.

23.7 The blades shall be formed of solid brass material in conformance with the ANSI C-73 Standards for Dimensions of Attachment Plugs and Receptacles. The grounding pin shall not be capable of being easily bent or removed without the use of tools.

CORD CONNECTORS

24 Enclosure

24.1 General

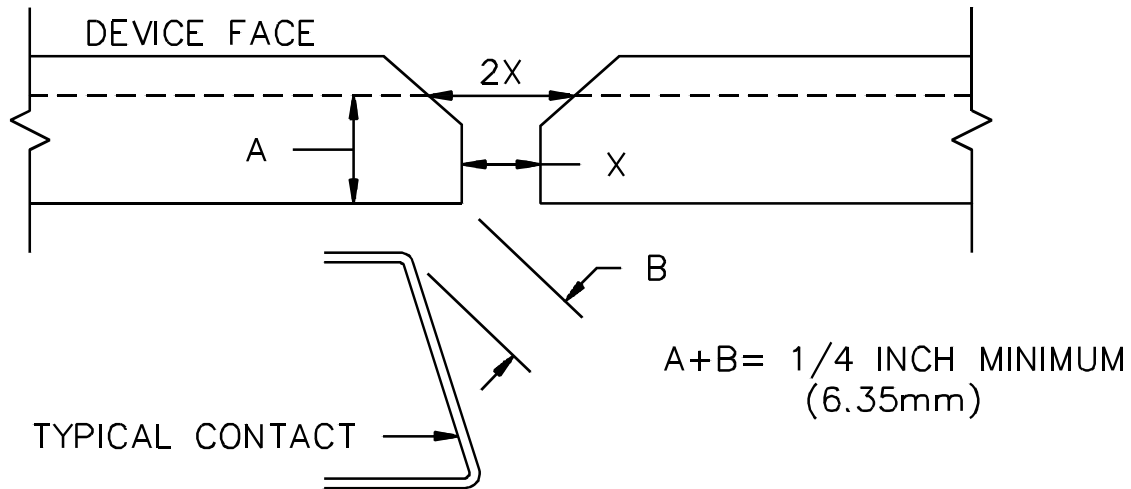
24.1.1 A 2-wire, parallel-slot (Figure C1.1) cord connector intended for use on general-use cord sets employing parallel or vacuum cleaner (SV, SVT, SVO, SVE, SVOO, SVTO, and SVTOO) type flexible cord shall have their contacts and other live parts spaced not less than 1/4 inch (6.35 mm) behind the face when measured from the plane of each slot opening through air and over insulating surfaces.

24.1.2 With regard to the requirement of 24.1.1, the plane of the slot opening is that plane perpendicular to the major axis of the inserted plug and nearest the face of the device in which the slot dimensions are within the specified values.

Exception: The plane of a slot opening that is bevelled to facilitate the entrance of a plug blade is considered to be 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 slot configuration in Figure C1.1. See Figure 24.1.

Figure 24.1
Typical slot cross section (with bevel)

Figure 24.1 revised June 26, 1998



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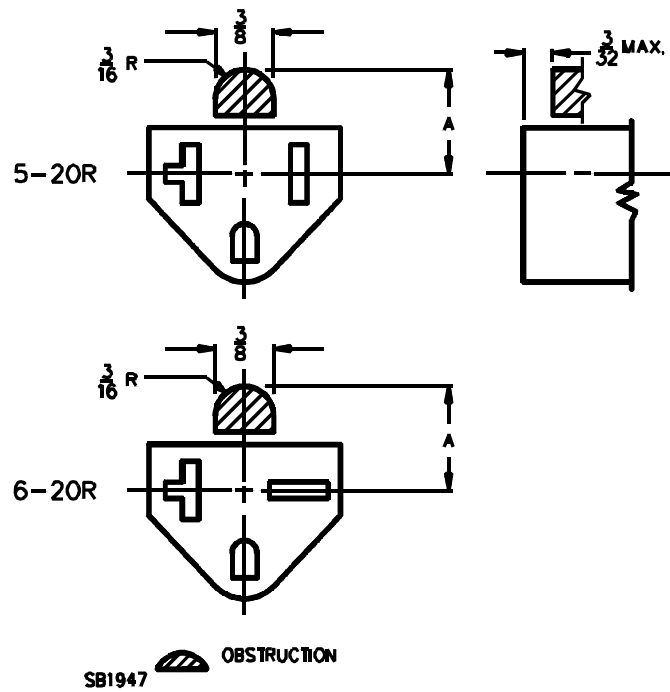
24.2 Face size

24.2.1 The face of the 2-pole, 3-wire (grounding) cord connectors of the types illustrated in Figures C1.6 and C1.10 shall obstruct the insertion of the 2-pole, 3-wire (grounding) attachment plug devices of the types illustrated in Figures C1.10 and C1.6, 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.

24.2.2 The obstruction required by 24.2.1 is to have the minimum size and shape indicated as the shaded portions of Figure 24.2. The obstructions are to be coplanar with the face or recessed by not more than 3/32 inch (2.4 mm). Cord connectors having rigid bodies, materials having a minimum hardness of 90 when measured on the "A" scale of a Shore Durometer, may have the indicated "A" dimension reduced to 0.531 inch (13.5 mm).

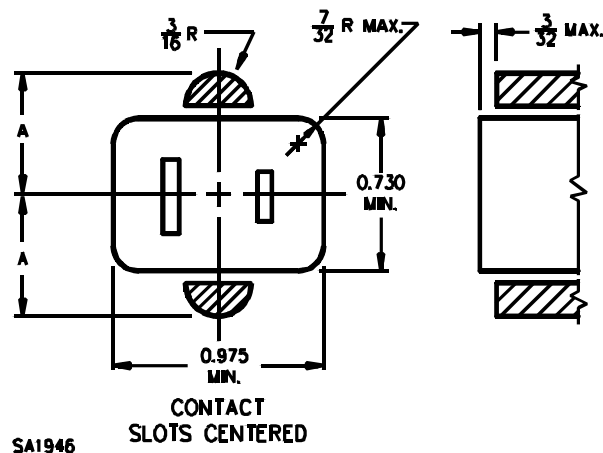
24.2.3 The outlet face of a 2-wire, parallel-slot cord connector (Figure C1.1) shall have a perimeter that encompasses an area equal to or larger than that indicated in Figure 24.3, and shall include an obstruction whose minimum size and location are indicated by the shaded portions of that figure. The obstructions shall be coplanar with the face or recessed by not more than 3/32 inch (2.4 mm). Cord connectors having rigid bodies, materials having a minimum hardness of 90 when measured on the "A" scale of a Shore Durometer, may have the indicated "A" dimension reduced to 0.531 inch (13.5 mm).

Figure 24.2
Faces of outlet devices showing location
and minimum dimensions of obstructions



inch	$\frac{3}{32}$	$\frac{3}{16}$	$\frac{3}{8}$
mm	2.4	4.8	9.5
Dimension A	Shore durometer hardness		
inch (mm)	(scale A)		
0.625 (15.9)	less than 90		
0.531 (13.5)	90 or more		

Figure 24.3
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

25 Grounding and Dead Metal Parts

25.1 The grounding terminal mentioned in 11.8 and 25.2 and its corresponding contact shall be conductively connected to the armor of an armored cord connector.

25.2 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.

25.3 If the device mentioned in 25.2 is intended for use with armored cable, and if the grounding contact is conductively connected to the armor, no wiring terminal is necessary. 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 the requirement in 178.12.1.

25.4 A conductive connection between a contact and a metal part, such as body armor, shall be limited to configurations of cord connectors that:

- a) Are either those illustrated in Figures C1.5 – C1.16, C1.24 – C1.33, C2.3 – C2.15, C2.24 – C2.30, C2.37 – C2.42, C3.1, C3.6, and C3.8, or similar grounding devices (see 7.2 and 11.8) or are special, and
- b) Are intended to provide other than 2-wire power supply or are rated in excess of 15 A at 300 V or less or, in excess of 20 A at 150 V or less.

Unless the connection is obvious:

- c) There shall not be a terminal for the grounding contact, or
- d) The screw shall be omitted from the grounding terminal plate.

25.5 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.

26 Terminals

26.1 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 97 – 101. A cord connector with pin-type terminals shall have the configuration shown in Figure C1.1. See 180.3.1.

26.1 effective January 1, 1998

27 Assembly

27.1 General

27.1.1 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) in the clear.

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

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

27.1.4 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.

27.1.5 The requirement in 27.1.4 does not preclude the acceptance of a conventional flatiron or appliance plug for use on a household heating appliance.

27.1.6 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).

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

27.1.8 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.

27.1.9 A table tap is intended to rest on a table or similar surface and to be connected to a supply circuit by means of an attached flexible cord and attachment plug.

27.1.10 A cord connector shall comply with the requirements in 13.1 – 13.7 for strain relief, bushings, and cord grips.

27.2 Outlet separation

27.2.1 Cord connectors having 2 or more outlets of the 2-wire, parallel-slot configuration (Figure C1.1) shall provide for the full insertion of attachment plugs in all outlets simultaneously using plugs having the face size indicated in Figure 17.1.

28 Hospital Grade

28.1 A Hospital Grade cord connector shall comply with the requirements in Section 28, and Sections 102 – 111 and with all other applicable requirements in this standard.

28.2 To provide strain relief, 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 and pulling) are not transmitted to the wiring terminal. See also Strain Relief Tests, Section 111.

28.3 The wiring terminals 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.

28.4 The wiring terminal individual wiring compartment insulating walls or barriers are to either:

- a) Extend not less than 1/32 inch (0.79 mm) above the metal parts of wired terminals and provide a spacing between metal parts of adjacent wired 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 of sufficient size 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.

28.5 The cord connector housing that is grasped in handling shall be an insulating material with no accessible metal parts on the outside that extend into wiring or cord compartments which may contain unclamped or stray flexible cord conductor strands. Metal strain relief clamps are not prohibited by this requirement.

28.6 The grounding contact shall enable free insertion of a U-shaped grounding pin at any possible angle permitted by the clearance opening for the grounding pin.

RECEPTACLES

29 Insulating Materials

29.1 *Deletion effective date changed from January 1, 1995 to January 1, 1998.*

29.2 *Deletion effective date changed from January 1, 1995 to January 1, 1998.*

29.3 *Deletion effective date changed from January 1, 1995 to January 1, 1998.*

29.4 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.

29.5 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.

Effective date for 29.5 changed from January 1, 1995 to January 1, 1998

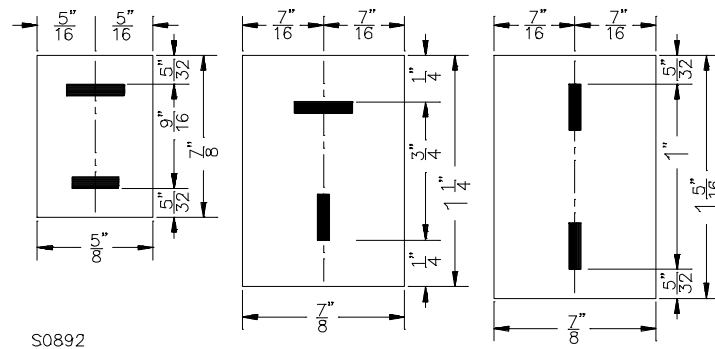
29.6 Fiber may be employed in an insulating plate if it is not less than 1/16 inch (1.6 mm) thick, is impregnated to resist the absorption of moisture in accordance with 64.1 and 64.2 and is not depended upon (by itself) to hold contacts or other live parts in place.

Effective date for 29.6 changed from January 1, 1995 to January 1, 1998

30 Enclosure

30.1 If the dimensions of a receptacle face are smaller than shown in Figure 30.1 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.

Figure 30.1
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

31 Grounding and Dead Metal Parts

31.1 Except as indicated in 31.2 the grounding terminal mentioned in 11.8 and its corresponding contact shall be conductively connected to the mounting means (yoke or strap) of a receptacle.

31.2 The conductive connection described in 31.1 need not be provided in a receptacle for use in fixtures or appliances, or a receptacle having a recessed cord-storage space in an integral flush-device box cover (commonly used with wall clocks), provided all of the following conditions are met:

- The mounting bracket, yoke, strap, or flange is constructed of an insulating material.
- The lack of grounding continuity to the mounting means is obvious to the installer.
- The device is plainly marked in accordance with 178.13.1.

31.3 The conductive connection described in 31.1 need not be provided in receptacles for use only with a nonmetallic wiring system (not adaptable to a metallic wiring system).

31.4 The conductive connection described in 31.1 need not be provided in a grounding receptacle that is intended to be insulated from the metallic wiring system in order to reduce electrical noise (electromagnetic interference) on the grounding circuit. Such a receptacle may have its grounding terminal purposely insulated from any connection through its mounting means to the intended metallic wiring system provided it is marked in accordance with 178.15.1 and 180.4.1.

31.5 The conductive connection described in 31.1 need not be provided in receptacles that comply with all of the following conditions:

- a) The mounting bracket, yoke, strap, or flange is to be constructed of an insulating material.
- b) The lack of grounding continuity to the mounting means is to be obvious to the installer.
- c) The device is to be plainly marked in accordance with 178.13.1.
- d) A 6 inch (152 mm) or longer lead of the proper wire size and colored green, with or without one or more yellow stripes, is to be connected to the grounding terminal.

31.6 The requirements in 31.1 do not preclude the acceptance of a receptacle construction that does not include a terminal for the connection of a grounding conductor 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, and the like (not adaptable to a nonmetallic wiring system), and
- b) The connection between the grounding contact and the metal raceway is automatically completed as the receptacle is installed.

31.7 The grounding terminal mentioned in 11.8 need not be provided in a receptacle for use only in a metal raceway system.

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

31.9 A conductive connection between a contact and a metal part, such as the mounting strap, yoke, or body armor, shall be limited to configurations of receptacles that:

- a) Are either those illustrated in Figures C1.5 – C1.16, C1.24 – C1.33, C2.3 – C2.15, C2.24 – C2.30, C2.37 – C2.42, C3.1, C3.6, and C3.8, or similar grounding devices (see paragraphs 7.2 and 11.8) or are special, and
- b) Are intended to provide other than 2-wire power supply or are rated in excess of 15 A at 300 V or less or, in excess of 20 A at 150 V or less.

Unless the connection is obvious:

- c) There shall not be a terminal for the grounding contact, or
- d) The screw shall be omitted from the grounding terminal plate.

31.10 Dead-metal parts including the grounding wiring terminals shall not have sharp edges or points that, upon installation in an outlet box as intended, may be forced against the wiring in the box.

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

31.12 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.

32 Terminals and Leads

32.1 A push-in (screwless) wiring terminal (one in which a stripped copper conductor is inserted and automatically locked in a wire-entrance hole) may be accepted for a current-carrying connection only if it meets the tests described in Pullout Test, Section 120, and Temperature Test, Section 121, for factory-wired devices and Sections SA14 – SA18 for field-wired devices. See also 178.17.1 and 179.1.1 and Section SA19.

32.2 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 126.

32.2 effective January 1, 1998

32.3 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 31.10.

32.4 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.

32.5 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.

32.6 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.

32.7 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 32.1.

Table 32.1
Smallest acceptable sizes of receptacle leads

Current rating of receptacle	Copper supply leads – AWG (mm ²)	Copper grounding leads – AWG (mm ²)
15 A	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 No. 16 AWG supply and grounding leads are acceptable only if the receptacle is intended for mounting in an appliance.

32.8 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).

32.9 For a receptacle intended for mounting in an electric lighting fixture or appliance, the length of integral leads is not specified.

33 Assembly

33.1 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) in the clear.

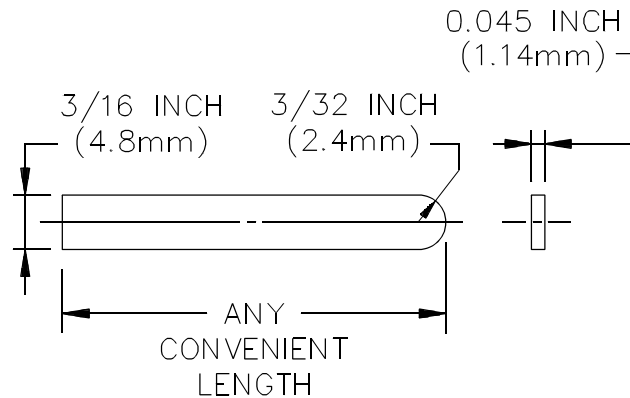
33.2 When internal connections exist in a multiple-outlet device, similar and corresponding contacts of individual outlets shall be connected together.

33.3 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.

33.4 The grounding terminal of a general-use receptacle such as illustrated in Figures C1.5 – C1.16, C1.24 – C1.33, C2.3 – C2.15, C2.24 – C2.30, C2.37 – C2.42, C3.1, C3.6, and C3.8 (and similar grounding devices – see 7.2 and 11.8) and intended for installation in an outlet box 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. See 14.1 and 33.6.

33.5 The spacings required in 33.4 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 33.1
Flat probe



PA215A

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

33.6 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 33.1.

33.7 A receptacle of the type illustrated in Figure C1.1 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 that illustration.

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

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

33.10 Live screw heads or nuts on the underside of a base intended for surface mounting shall be countersunk not less than 1/8 inch (3.2 mm) in the clear and then covered with a waterproof insulating sealing compound that will not soften at a temperature of 65EC (149EF) unless such parts are spaced 1/2 inch (12.7 mm) or more through air from the mounting surface and are staked, upset, or otherwise prevented from loosening.

33.11 A determination of the softening point of a sealing compound is to be made in accordance with the Test Method for Softening Point by Ring-and-Ball Apparatus, ASTM E28-92.

33.12 Sealing compound over a live nut or screw head shall not be less than 1/16 inch (1.6 mm) thick. However, if the underside of the base is not recessed, and if it may contact the surface upon which the receptacle is mounted, the sealing compound shall not be less than 1/8 inch (3.2 mm) thick.

33.13 A flush receptacle shall be provided with means for mounting in a standard flush-device box or on a standard outlet box cover. A yoke, strap, or mounting ears shall be of 0.040 inch (1.02 mm) or thicker metal which, if steel, shall be protected against corrosion by an acceptable coating or its equivalent. If nonferrous metal is used, it shall provide mechanical strength and rigidity equal to that of 0.040 inch thick (1.02 mm) steel.

33.14 Cadmium or zinc coating provide acceptable corrosion protection. Copper-plated or oxidized finishes are acceptable coatings. The yoke, strap, and mounting ears may be provided with extension plaster ears which may be scored or perforated so that they can be broken off when not needed.

33.15 With reference to 33.13, the corrosion protection for a receptacle for use in a flush-device box or on an outlet box cover shall be a zinc or cadmium coating not less than 0.00015 inch (0.0038 mm) thick as determined in accordance with the requirements in the Protection Against Corrosion Section of the Standard for Metallic Outlet Boxes, UL 514A, or other coatings determined to possess equivalent corrosion protection properties.

33.15 revised November 5, 1997

33.16 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.

33.17 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.

34 Flush Plates

34.1 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.

34A Flush Receptacles

Section 34A added June 26, 1998

34A.1 A flush receptacle having one of the configurations illustrated in Figures C1.5, C1.6, C1.9 or C1.10 shall comply with the requirements in Supplement SA and with all applicable requirements in this standard. See 112.1, 178.14A.1 and 180.3A.1.

35 CO/ALR Type

35.1 Receptacles intended for use with aluminum conductors or copper and aluminum conductors in addition to the requirements in this standard shall:

- a) Have only binding screw terminals,
- b) Be rated 15 or 20 A,
- c) Be intended for mounting in an outlet box,
- d) Be marked in accordance with 178.18.1, and
- e) Meet the performance requirements for receptacles and switches intended for use with aluminum wire, UL 1567.

36 Tamper-Resistant

36.1 A tamper-resistant receptacle shall comply with the requirements in 178.19.1, Sections 122 – 125, and with all other applicable requirements in this Standard.

37 Hospital Grade

37.1 A Hospital Grade receptacle shall comply with the requirements in Section 37, Supplement SA, and with all other applicable requirements in this standard. See 127.1, 178.20.1 and 178.20.4 – 178.20.6.

37.1 revised June 26, 1998

37.2 The ground contact shall enable free insertion of a U-shaped grounding pin at any possible angle permitted by the clearance opening for the grounding pin.

SELF-CONTAINED RECEPTACLES FOR USE WITHOUT A SEPARATE OUTLET BOX

38 General

38.1 The requirements in Sections 38 – 44 and 137 – 149 are applicable to self-contained general-use receptacles rated 15 and 20 A, 125 and 250 V, for flush mounting without a separate outlet box and for connection to one or more nonmetallic sheathed cables containing copper conductors. They are for use in accordance with the National Electrical Code and primarily used in mobile homes, recreational vehicles, manufactured buildings, and on-site frame construction.

38.2 Self-contained receptacles shall comply with the applicable construction requirements of this standard as modified by the requirements in Sections 39 – 44.

39 Spacings

39.1 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.

40 Insulating Materials

40.1 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) One of the materials in Table 40.1 or
- b) Another insulating material determined to be acceptable by means of an appropriate investigation which shall include the following requirements:
 - 1) The material shall have a temperature index of at least 80EC (176EF) at the thickness used, or the equivalent.
 - 2) The enclosure material shall have:
 - i) A high ampere arc ignition index of at least 30 arcs and
 - ii) A hot wire ignition index of at least 15 seconds.
 - 3) The enclosure material shall have a minimum V-2 flammability classification or comply with the requirements of the Specimen Flammability Test, Section 149.

Table 40.1
List of acceptable insulating materials

Materials: Generic name
Molded phenolic ^b
Molded melamine ^b
Molded melamine-phenolic ^b
Urea formaldehyde ^b
Molded alkyd ^b
Molded epoxy ^{a,b}
Molded diallyl phthalate ^b
Molded polyester ^{a,b}
^a Includes heat- and pressure-molded types only, not those intended for casting or pouring.
^b Includes materials having filler systems of fibrous (other than synthetic organic) types but excludes fiber reinforcement systems using resins which are applied in a liquid form.

41 Enclosure

41.1 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.

41.2 The overall insulating enclosure shall be at least 0.100 inches (2.54 mm) thick or a thickness determined to be acceptable for the material when used as the enclosure of an outlet box.

Exception: Knockouts to be removed for the installation of cable may have a reduced thickness but shall comply with the test described in Knockouts Test, Section 146.

42 Mounting Means

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

42.2 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.

42.3 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.

42.4 A self-contained device intended for flush installation may be provided with a mounting bracket for fastening the device to a structural member in the walls of frame construction. The mounting bracket 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 43, for requirements for mounting brackets.

43 Frame-Construction Mounting Brackets

43.1 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 need not 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.

43.2 The mounting bracket shall also comply with the Mounting Strength Test, Section 141.

44 Field Replacement

44.1 Receptacles marketed as replacement devices shall be capable of installation without the use of special tools.

44.2 Those receptacles which require replacement with specific devices of similar design shall be marked to include the information indicated in 178.21.2.

CURRENT TAPS AND ADAPTERS

45 General

45.1 A current tap shall not accommodate more than three attachment plugs, lamps, or combinations thereof. If the current tap has a cord-outlet hole, it shall not accommodate more than two plugs, or the like.

Exception: A current tap may have six outlet receptacles and one set of line connections, provided that it effectively inhibits the electrical use of the other outlet receptacle when mounted on or plugged into a duplex receptacle in any position.

45.2 A current tap may employ a screw base or blades on the line side only.

45.3 The requirement in 45.1 does not preclude the acceptance of a device in the form of an outlet multiplier for permanent attachment to a duplex receptacle rated 15 A at 125 V. This device is usually in the form of a current tap that has a permanent means of attachment to a duplex receptacle and may contain more than three outlets, provided:

- a) There are no more than three outlets per set of blades,
- b) Continuity of the grounded circuit conductor is provided by use of a polarized (wide) blade connected to the wide-slot outlet,
- c) A means exists to provide electrical continuity between any flush plate and the plate-holding screw on the receptacle to which the assembly is attached.

46 Enclosure

46.1 Wire terminals – enclosure

46.1.1 If there is an exposed live part on the face of a current tap or adapter, other than one rated 15 or 20 A as covered in 17.1.1, the face of the device shall be provided with a substantial disc of 1/32 inch (0.8 mm), or thicker, insulating material securely held in place, and completely covering all exposed live parts.

46.1.2 The minimum thickness of insulating material that is nominally 1/32 inch (0.8 mm) thick is 0.028 inch (0.71 mm). Insulating discs or face covers that may be opened or removed to provide access to the wiring terminals of an attachment plug, current tap, or adapter shall be mechanically secured after wiring by one or more screws, latches, or detents that cannot be unintentionally opened or removed.

46.1.3 A cover that is held in place by only friction without any positive detent action is not considered mechanically secured.

46.1.4 The face cover or disc shall enclose the wiring compartments for live conductors with a fit at the periphery that will not permit the entrance of a 0.030 inch diameter (0.76 mm) probe. 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.

46.1.5 The notch mentioned in 46.1.4 shall comply with all of the following conditions:

- 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.
- 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.

46.1.6 A face cover or disc may have multiple clearance openings to enable its use with a number of blade arrangements. Any unfilled openings shall be located opposite the anticipated insulating face of the corresponding outlet device.

46.1.7 A current tap, or adapter having a separable face cover or disc shall be shipped with the cover attached to the device but not necessarily mechanically secured.

46.1.8 A 2-wire, parallel-slot (Figure C1.1) current tap intended for use on general-use cord sets employing parallel or vacuum cleaner (SV, SVT, SVO, SVE, 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.

46.1.9 With regard to the requirement of 46.1.8, the plane of the slot opening is that plane perpendicular to the major axis of the inserted plug and nearest the face of the device in which the slot dimensions are within the specified values.

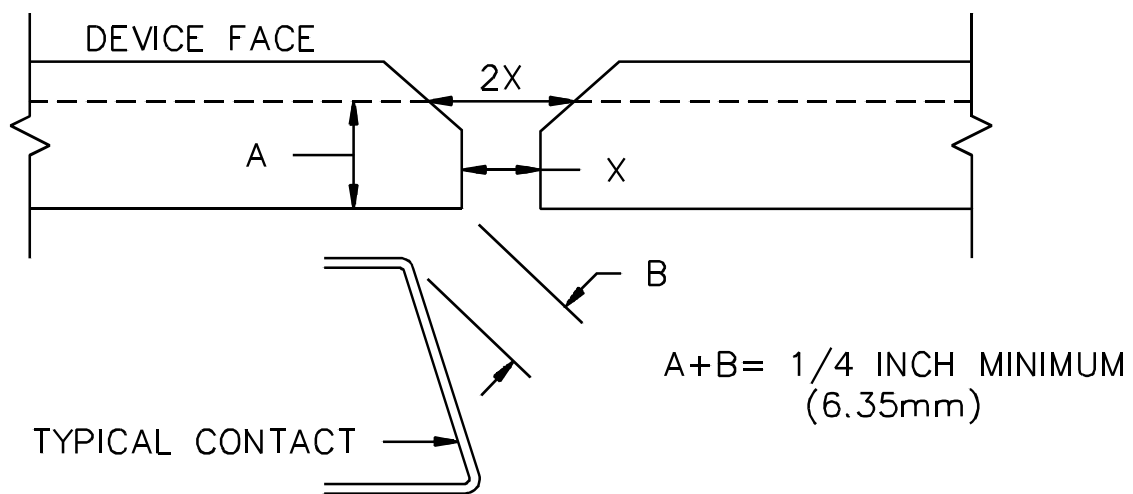
Exception: The plane of a slot opening that is bevelled to facilitate the entrance of a plug blade is considered to be that plane nearest the face of the device in which the minor dimensions of the slots are no more than twice the value specified for the slot configuration in Figure C1.1. See Figure 46.1.

46.2 Male face size

46.2.1 The perimeter of the male face of a 2-wire, parallel-blade current tap or adapter of the Figure C1.1 configuration shall encompass an area equal to or larger than that indicated in Figure 46.2.

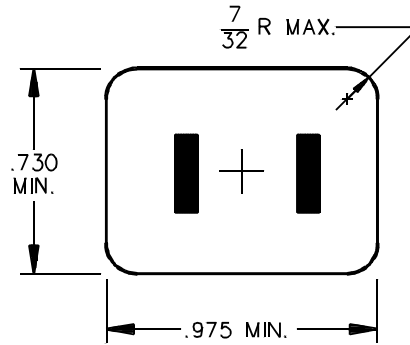
46.2.1 revised November 5, 1997

Figure 46.1
Typical slot cross section (with bevel)



SA1815

Figure 46.2
Minimum current tap or adapter face dimensions



BLADES CENTERED

SA1945

inch	7/32	0.730	0.975
mm	5.6	18.5	24.8

Figure 46.2 revised November 5, 1997

46.3 Noninterchangeability obstructions

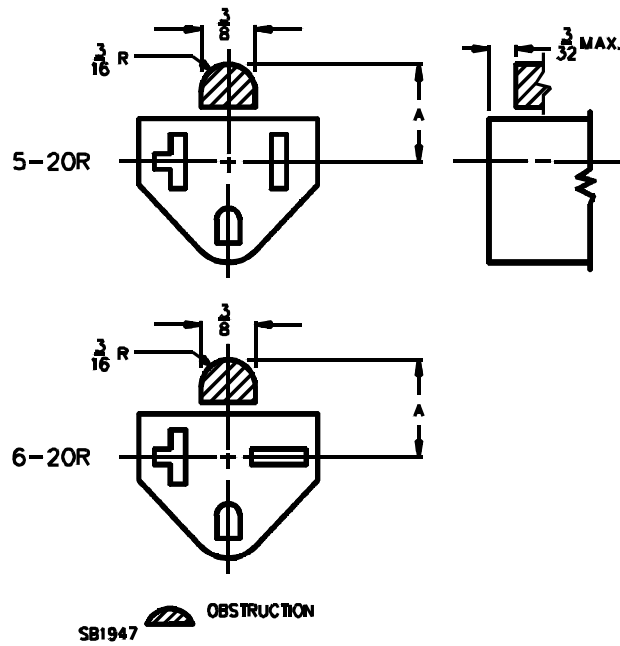
46.3.1 The female face of a 2-pole, 3-wire (grounding) current tap or adapter of the Figure C1.6 or C1.10 configurations, or a multi-configuration adapter that accepts attachment plugs with the Figure C1.6 or C1.10 configurations, shall obstruct the insertion of a 2-pole, 3-wire (grounding) attachment plug of the Figure C1.10 and C1.6 configurations, 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.

46.3.1 revised November 5, 1997

46.3.2 The obstruction required by 46.3.1 is to have the minimum size and shape indicated as the shaded portions of Figure 46.3. The obstructions are to be coplanar with the face or recessed by not more than 3/32 inch (2.4 mm). Current taps or adapters having rigid bodies, materials having a minimum hardness of 90 when measured on the "A" scale of a Shore Durometer, may have the indicated "A" dimension reduced to 0.531 inch (13.5 mm).

46.3.2 revised November 5, 1997

Figure 46.3
Faces of outlet device showing location
and minimum dimensions of obstructions



inch	$\frac{3}{32}$	$\frac{3}{16}$	$\frac{3}{8}$
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

46.4 Adapters employing standard configurations female outlets (Figure C1.1 or C1.5) and non-ANSI standard male configurations

46.4.1 **Revised and relocated as Section 51A November 5, 1997**

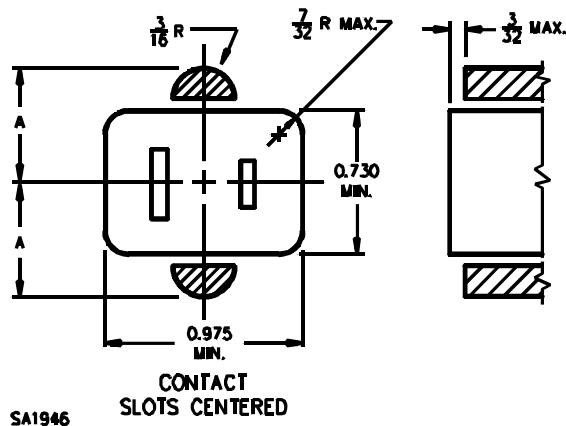
46.4.2 **Revised and relocated as Section 51A November 5, 1997**

46.5 Female face size

46.5.1 The outlet face of a 2-wire, parallel-slot current tap or adapter of the Figure C1.1 configuration, or a multi-configuration adapter that accepts attachment plugs with the Figure C1.1 configuration, shall have a perimeter that encompasses an area equal to or larger than that indicated in Figure 46.4, and shall include an obstruction whose minimum size and location are indicated by the shaded portions of that figure. The obstructions shall be coplanar with the face or recessed by not more than 3/32 inch (2.4 mm). Current taps or adapters having rigid bodies, materials having a minimum hardness of 90 when measured on the "A" scale of a Shore Durometer, may have the indicated "A" dimension reduced to 0.531 inch (13.5 mm).

46.5.1 revised November 5, 1997

Figure 46.4
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

46.5.2 A current tap or adapter shall enclose all live parts in insulating material. The integrity of the enclosure of the female contacts shall be maintained when tested as described in Contact Security Test, Section 155.

46.5.2 revised November 5, 1997

46.6 Noninterchangeability obstructions

46.6.1 **Deleted November 5, 1997**

47 Current-Carrying Parts

47.1 Blades

47.1.1 Parallel slots of a screw-base attachment plug provided on a current tap or adapter shall be in accordance with Figure C1.1. If the slots are polarized, the contact behind the longer slot shall be connected to the screw shell.

47.1.2 Blades of the folded-over type employed on current taps shall have dimensions in accordance with the applicable figure in Section C1.

47.1.2.1 The folded-over blades of 15 or 20 A current taps 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 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.

47.1.2.1 effective April 26, 1996

47.1.3 The blades employed in a current tap having one of the configurations shown in Figures C1.1 – C1.3, C1.5, C1.6, C1.9, or C1.10, shall comply with the dimensional requirements of the Standard for Attachment Plug Blades for Use in Cord Sets and Power-Supply Cords, UL 1659.

47.1.3 added June 26, 1998

47.2 Screw bases

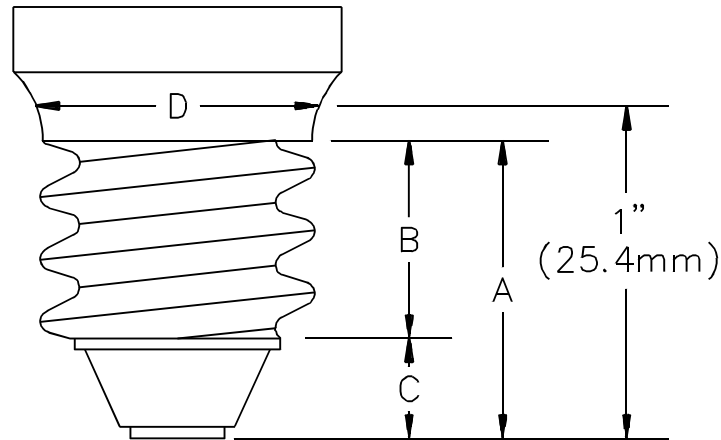
47.2.1 The metal base of a screw-base current tap:

- a) Shall be of the medium-base size;
- b) Shall have no fewer than two threads for engagement with a lampholder screw shell;
- c) Shall be of copper, a copper-base alloy, or the aluminum-base alloy described in 47.2.2;
- d) Shall not be less than 0.008 inch (0.203 mm) thick if of copper or a copper-base alloy, or not less than 0.011 inch (0.279 mm) thick if of an aluminum-base alloy;
- e) Shall be secured in place so that it will be prevented from turning with respect to the body and
- f) Shall not be of the skeleton type.

47.2.2 An aluminum-base alloy for use in a screw base is to be a wrought alloy employing manganese, magnesium, or both, as the principal alloying materials (with the possible addition of chromium) and containing no more than 1.5 percent of iron and silicon combined and no more than 1.0 percent of all other impurities usually found in aluminum including a maximum of 0.2 percent of copper.

Figure 47.1
Screw-base attachment plug dimensions

Figure 47.1 revised June 26, 1998



S0891A

47.2.3 Dimensions A and D of a screw-base attachment plug, as illustrated in Figure 47.1, shall not be more than 15/16 inch (23.8 mm) and 1.037 inch (26.3 mm) respectively. Dimensions B and C in Figure 47.1 are not specified but are generally 0.43 inch (10.9 mm) minimum for B and 0.51 inch (13.0 mm) maximum for C.

48 Grounding and Dead Metal Parts

48.1 General

48.1.1 The requirement in 11.6 does not preclude the acceptance of a device in which the grounding member is mounted in soft rubber or similarly flexible material. The requirement contemplates that the element is to be secured in a manner so that it is not readily removable or movable other than as indicated in 19.2.

48.1.2 A conductive connection between a contact and a metal part, such as the mounting strap, yoke, or body armor, shall be limited to configurations that:

- a) Are either those illustrated in Figures C1.5 – C1.16, C1.24 – C1.33, C2.3 – C2.15, C2.24 – C2.30, C2.37 – C2.42, C3.1, C3.6, and C3.8, or similar grounding devices (see 7.2 and 11.8) or are special, and
- b) Are intended to provide other than 2-wire power supply or are rated in excess of 15 A at 300 V or less or, in excess of 20 A at 150 V or less.

Unless the connection is obvious:

- c) There shall not be a terminal for the grounding contact, or
- d) The screw shall be omitted from the grounding terminal plate.

48.1.3 The current tap mentioned in 45.3 and any other similar device:

- a) That can accommodate a 3-wire grounding attachment plug having one of the configurations indicated in Figures C1.5, C1.6, C1.9, C1.10, C1.13, C1.24, and C1.29, and
- b) That is provided with a means for fixed attachment to a receptacle,

shall meet the Grounding Contact Tests, Section 162. An example of the fixed attachment is a current tap that can be held in place by a receptacle cover-plate screw. See also 51.2.

48.2 Blades

48.2.1 For attachment plugs provided on current taps or adapters, with the configurations illustrated in Figures C1.5 – C1.16, C1.24 – C1.33, C2.3, C2.9, C3.1, and C3.6, a 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 some other 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.

48.2.2 The grounding blade or grounding pin surface projecting from an attachment plug and constituting a part of the specified plug and constituting a part of the specified blade configuration for a 15 or 20 A nonlocking-type attachment plug shall be continuous without holes or detents. Continuous seams along the length or in the tip of a tubular grounding pin, or any inadvertent small opening in butt joints formed at the tip, are not precluded by this requirement.

No Text on This Page

48.3 Contacts

48.3.1 The grounding contact in a grounding-type outlet 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.

49 Terminals

49.1 A pin-type terminal of a current tap 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 163 – 167. A current tap with pin-type terminals shall have the configuration shown in Figure C1.1. See 180.3.1.

49.1 effective January 1, 1998

49.2 If an attachment plug provided on a current tap or adapter 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. However, if tinsel cord is employed, the conductors may be secured to the blades under the heads of rivets or by an equivalent means.

50 Assembly

50.1 General

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

50.1.2 A current tap or adapter shall not accommodate an attachment plug other than one that is specifically intended for use with the outlet.

Exception: A travel adapter which complies with 51A.5 need not comply with this requirement.

50.1.2 revised November 5, 1997

50.1.3 An attachment plug or current tap having 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 preventing the full seating of the cover.

50.1.4 The flexible cord use to determine compliance with 50.1.3 either:

- a) Shall have an ampacity at least equal to the rating of the plug configuration,
- b) Shall be of the type and size marked on the device, or
- c) Shall be of the maximum size that can be accommodated by the cord-entrance opening into the attachment plug.

50.1.5 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.

50.2 Outlet separation

50.2.1 Current taps or adapters having 2 or more outlets of the 2-wire, parallel-slot configuration (Figure C1.1) shall provide for the full insertion of attachment plugs in all outlets simultaneously using plugs having the face size indicated in Figure 46.2.

50.2.2 If the outlet contacts of a current tap or adapter are polarized, the blades shall be polarized and the internal connections between the blades and the contacts shall maintain the polarization.

Exception: A travel adapter which complies with 51A.4 need not comply with this requirement.

50.2.2 revised November 5, 1997

50.2.3 Parallel slots and parallel blades of a current tap shall have the arrangement and dimensions shown in the illustration in Figure C1.1.

50.2.4 In a current tap that has a polarized outlet and a medium screw base, the contact behind the longer slot shall be connected to the screw shell.

50.2.5 **Deleted November 5, 1997**

51 Adapters

51.1 A device whose purpose is to adapt the grounding-type attachment plug shown in Figure C1.5 for use in the parallel-blade receptacle shown in Figure C1.1 shall be provided with either:

- a) A fixed grounding ear, lug, or similar device that can be secured under the head of the outlet box cover or flush-plate mounting screw (see 51.3) and that is electrically connected to the female grounding contact in the adapter, or
- b) A male grounding member of the movable, self-restoring type. See also 178.14.1. An adapter employing a movable grounding member shall not be separable from the grounding attachment plug that is intended to be plugged into it. See 178.14.2.

51.2 The adapter mentioned in 51.1 and any other similar device:

- a) That can accommodate a 3-wire grounding attachment plug having one of the configurations indicated in Figures C1.5, C1.6, C1.9, C1.10, C1.13, C1.24 and C1.29, and
- b) That is provided with a means for fixed attachment to a receptacle,

shall meet the Grounding Contact Tests, Section 162. Adapters that can be held in place by the receptacle cover-plate screw and adapters with locking-configuration blades are examples of devices with provision for fixed attachment. See also 48.1.3.

51.3 The fixed grounding ear, lug, or similar device mentioned in 51.1:

- a) Shall be rigid enough so that the member will not touch either line blade as a result of any bending or forming,
- b) Shall be provided with a means for connection to the intended receptacle,
- c) Shall enable full tightening to the receptacle without:

- 1) Preventing the full insertion of the adapter line blades in the receptacle, and
 - 2) Without tilting the adapter body with respect to the receptacle face, and
- d) Shall be finished to show a green color.

51.4 The blades of an adapter of the type described in 51.1 and 51.3 shall be polarized. See Figure C1.1. The wide blade of the adapter shall be conductively connected to the outlet contact that is marked W in Figure C1.5.

51.5 If the blades of a lampholder adapter are polarized, the wide blade shall be conductively connected to the screw shell.

51A Travel Adapters

Section 51A revised and relocated from 46.4.1 and 46.4.2 November 5, 1997

51A.1 The outlet face of a travel adapter employing an outlet that accepts a 2- or 3-wire, parallel-blade attachment plug of the Figure C1.1 or C1.5 configuration shall comply with the noninterchangeability obstruction and outlet face size requirements in 46.3.1, 46.3.2, 46.5.1, and 46.5.2.

51A.2 A travel adapter employing a non-ANSI standard blade or slot configuration shall comply with the dimensional requirements of the appropriate non-ANSI standard specification. A non-ANSI standard configuration is one not included in Section C1 or C2.

51A.3 The male end of a travel adapter shall be provided with a grounding blade or pin if the outlet face employs a grounding configuration.

51A.4 Polarization shall be maintained through the blades and contacts of a travel adapter. The outlet slots are to be non-polarized if the male blades or pins are non-polarized. The outlet slots are to be polarized only if the male blades or pins are polarized.

Exception : A travel adapter employing male blades or pins for use in an electrical system that does not have provision for polarization, may employ polarized outlet slots if it is marked in accordance with 178.22.2.

51A.5 A travel adapter that allows an attachment plug to mate with an outlet device having a different current or voltage rating than that of the plug shall be marked in accordance with 178.22.1.

FLATIRON AND APPLIANCE PLUGS

52 Material

52.1 *Deletion effective date changed from January 1, 1995 to January 1, 1998.*

52.2 Current-carrying parts of iron or steel shall be protected against corrosion by a metallic plating or otherwise acceptably metal coated.

52.3 Copper coating and oxidized finishes are acceptable for use on contacts and their integral screw terminals on flatiron and appliance plugs.

52.4 In a plug, steel may be used for contacts and for wiring terminals that are integral with the steel contacts. However, steel is not acceptable for current-carrying parts of a switching mechanism or for wiring terminals in a 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 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 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 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 176.1.

Exception: A rigid guard is acceptable if it demonstrates protection equivalent to a flexible cord guard. See 176.1 and 176.2.

54 Strain Relief

54.1 The construction of a 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 plug body. The configuration and dimensions of the contacts shall be such that the pins detailed in Table 55.1 are accommodated.

55.2 Contacts need not be rigidly attached to the 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 plug body, holes for female contacts should be no larger than necessary to accommodate the male pins.

55.4 Female contacts and associated live parts in the contact opening of a plug 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 (see 55.7) dimension of the opening or 3/64 inch (1.2 mm), whichever is larger.

55.5 The plane of the opening used to determine the minimum recess specified in 55.4 is that plane nearest the face of the device having the minimum opening for the pin clearance. Bevels, tapers, or other expansions of the contact opening are not to be included in the measurement.

55.6 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.

55.7 The maximum straight-line dimension mentioned in 55.4 is the maximum-length straight line that will fit within the opening at the plane of measurement.

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 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.

56 Terminals

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

- a) No. 18 AWG (0.82 mm²) if the maximum current rating of the plug is 10 A, and
- b) No. 16 AWG (1.3 mm²) if the rating is 15 A.

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

56.2 A terminal plate for a wire-binding screw shall be of metal not less than 0.030 inch (0.76 mm) thick and have no fewer than two full threads in the metal.

56.3 For a wire-binding screw that has 32 or more threads per inch (per 25.4 mm), a terminal plate formed from 0.030 inch (0.76 mm) stock may have the metal extruded to provide two full threads at the hole tapped for the wire-binding screw.

56.4 A wire-binding screw shall thread into metal.

56.5 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).

56.6 A wiring terminal with a wire-binding screw shall be provided with upturned lugs or an equivalent means for holding a wire under the head of the screw.

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 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 3/16 inch (4.8 mm) and is recessed not less than 3/16 inch (4.8 mm) in the clear.

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 Tables 59.1 and 59.2.

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

59.4 Receptacles are to be subjected to the appropriate tests outlined in Tables 59.5, 59.6 and 59.7.

Exception No. 1: A flush receptacle having one of the configurations illustrated in Figures C1.5, C1.6, C1.9, or C1.10 shall be subjected to the tests outlined in Table 59.5 except as modified by Table SA4.1. See 112.1.

Exception No. 2: A Hospital Grade receptacle shall be subjected to the tests outlined in Table 59.5 and Table 59.6 except as modified by Table SA4.1. See 127.1.

Exception No. 3: A self-contained receptacle having one of the configurations illustrated in Figures C1.5, C1.6, C1.9, or C1.10 shall be subjected to the tests outlined in Table 59.5 and Table 59.7 except as modified by Table SA4.1. See 137.1.

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.
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 plugs.
63	Mold Stress Relief		Plugs employing thermoplastic material.
65	Dielectric Voltage Withstand (Repeated)		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	Accelerated Aging	6	Materials to be evaluated in accordance with the Exception to 8.4.1.
70	Security of Blades		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.
68A	Reserved for future use		
70	Security of Blades	6	Plugs rated 15 A or less and 250 V or less that are not subjected to the Accelerated Aging Test.
71	Secureness of Cover	6	Plugs with separable face covers as described in 17.1.1 - 17.1.12.

(Continued)

Table 59.1 (Cont'd)

Section	Test sequences	No. of devices ^a	Details
72	Crushing	6	Plugs with Figure C1.1, C1.2, C1.5 and C1.9 configurations only.
73	Torque	6	Screw-base plugs only.
74	Attachment Plug Grip	3	Plugs with Figure C1.1 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.
75A	Self-Hinge Flexing	18	Plugs employing self-hinges in the enclosure.
76	Terminal Temperature	6	Not conducted on plugs with soldered, brazed, or welded cord connections or with wire-binding, pressure-wire or solder terminals.
77	Fuseholder Temperature	6	Plugs with fuseholders only.
78	Assembly	12	Plugs employing pin-type terminals. Number of devices indicated assumes plug accommodates No. 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 79.2.
79	Temperature		
82	Dielectric Voltage-Withstand		
78	Assembly	12	Plugs employing pin-type terminals. Number of devices indicated assumes plug accommodates No. 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 80.2.
80	Strain Relief		
78	Assembly	6	Plugs employing pin-type terminals. Number of devices indicated assumes plug accommodates No. 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.
81	Fault Current		
^a A set of representative devices may be used for more than one group of tests if agreeable to all concerned.			

Table 59.1 revised June 26, 1998

Table 59.2
Summary of tests^a
Hospital grade attachment plugs

Section	Test sequences	No. of devices ^b	Details
84	Strain Relief – static pull	6	
84	Strain Relief – rotary pull	3	
84	Strain Relief – abrupt removal		
	Straight plugs	8	
	Angle plugs	16	
85	Crushing	6	
86	Impact Resistance	6	
87	Mechanical Drop	6	
88	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.			

Table 59.2 revised June 26, 1998

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	Dielectric Voltage Withstand	6	All cord connectors.
63	Mold Stress Relief		Cord connectors employing thermoplastic materials.
65	Dielectric Voltage Withstand (Repeated)		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 or 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.
68A	Reserved for future use		
90	Retention of Plugs	6	Cord connectors with Figure C1.1, C1.5, C1.6, C1.9 and C1.10 configurations.
91	Overload		Test based on current rating.
92	Temperature		
90	Retention of Plugs Repeated		Cord connectors with Figure C1.1, C1.5, C1.6, C1.9 and C1.10 configurations.
93	Resistance to Arcing		Not required for devices employing phenolic, urea or melamine in the outlet face.
91	Overload (horsepower)	6	Conducted on cord connectors with horsepower ratings only.
94	Fuseholder Temperature	6	Cord connectors with fuseholders only.
94A	Improper Insertion	12	Cord connectors with Figure C1.1 configuration only.

(Continued)

Table 59.3 (Cont'd)

Section	Test sequences	No. of devices ^a	Details
95	Potential Drop in Grounding Connections	6	Cord connectors with grounding connections secured by means other than riveting, bolting, welding or equivalent.
96	Integrity of Assembly	6	Not conducted on Hospital Grade cord connectors or connectors employing pin terminals, strain relief knots, or certain strain relief constructions. Refer to test description.
96A	Self-Hinge Flexing	12	Cord connectors employing self-hinges in the enclosure.
97	Assembly	12	Cord connectors employing pin-type terminals. Number of devices indicated assumes connector accommodates No. 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 98.2.
98	Temperature		
101	Dielectric Voltage-Withstand		
97	Assembly	12	Cord connectors employing pin-type terminals. Number of devices indicated assumes connector accommodates No. 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 99.2.
99	Strain Relief		
97	Assembly	6	Cord connectors employing pin-type terminals. Number of devices indicated assumes connector accommodates No. 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.
100	Fault Current		
^a A set of representative devices may be used for more than one group of tests if agreeable to all concerned.			

Table 59.3 revised June 26, 1998

Table 59.4
Summary of tests^a
Hospital grade cord connectors

Section	Test sequences	No. of devices ^b	Details
103	Grounding Contact Temperature	8	
104	Resistance		
105	Grounding Contact Overstress	6	
106	Plug Connection and Separation		
107	Crushing	6	
108	Impact Resistance	6	
109	Mechanical Drop	6	
110	Mold Stress Relief	6	May be combined with Mold Stress Relief Test in Section 63. See Table 59.3.
111	Strain Relief – static pull	6	
111	Strain Relief – rotary pull	3	
111	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 than one test sequence of agreeable to all concerned.			

Table 59.4 revised June 26, 1998

Table 59.5
Summary of tests^a
Receptacles

Section	Test sequences	No. of devices ^b	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 receptacles.
63	Mold Stress Relief		Receptacles employing thermoplastic materials.
65	Dielectric Voltage Withstand (Repeated)		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.
68A	Reserved for future use		
114	Retention of Plugs	6	Receptacles with Figure C1.1, C1.5, C1.6, C1.9 and C1.10 configurations.
115	Overload		Test based on current rating.
116	Temperature		
114	Retention of Plugs Repeated		Receptacles with Figure C1.1, C1.5, C1.6, C1.9 and C1.10 configurations.
117	Resistance to Arcing		Not required for devices employing phenolic, urea or melamine in the outlet face.
115	Overload (horsepower)	6	Conducted on receptacles with Figure C1.1 – C1.38, C2.1 – C2.13, C2.16 – C2.22, C2.24 – C2.29, C2.30 – C2.34 and C2.37 – C2.40 configurations and other receptacles with horsepower ratings only.
118	Fuseholder Temperature	6	Receptacles with fuseholder only.

(Continued)

Table 59.5 (Cont'd)

Section	Test sequences	No. of devices ^b	Details
119	Grounding Contact	6	Receptacles with Figure C1.5, C1.6, C1.9, C1.10, C1.13, C1.24 and C1.29 configurations only.
119A	Reserved for future use		
119B	Reserved for future use		
119C	Reserved for future use		
120	Pullout	6	Factory-wired push-in terminals only.
121	Temperature	6	Factory-wired push-in terminals only.
122	Probe	6	Tamper-resistant receptacles only.
123	Impact		
122	Probe (repeated)		
125	Dielectric Withstand		
122	Probe	6	Tamper-resistant receptacles only.
124	Mechanical Endurance		
122	Probe (repeated)		
125	Dielectric Withstand		
126	Heat Cycling and Vibration	6	Pin-type or insulation-displacement terminals only.
^a See also Table SA4.1 for flush receptacles with Figure C1.5, C1.6, C1.9, and C1.10 configurations.			
^b A set of representative devices may be used for more than one test sequence if agreeable to all concerned.			

Table 59.5 revised June 26, 1998

No Text on This Page

Table 59.6
Summary of tests^a
Hospital grade receptacles

Section	Test sequences	No. of devices ^b	Details
128	Abrupt Plug Removal	8	Represents the Fault Current Test required by Section SA10.
129	Grounding Contact Temperature		
130	Resistance		
131	Fault Current		
132	Grounding Contact Overstress	6	
133	Terminal Strength	3	Superseded by the Terminal Strength Test required by Section SA11 for flush receptacles.
134	Assembly Security	3	
135	Impact	6	
136	Mold Stress Relief	6	May be combined with the Mold Stress Relief Test in Section 63. See Table 59.5.
^a To be conducted in addition to any applicable tests specified in Table 59.5.			
^b A set of representative devices may be used for more than one test sequence if agreeable to all concerned.			

Table 59.6 revised June 26, 1998

Table 59.7
Summary of tests^a
Self-contained receptacles

Table 59.7 revised January 21, 1999

Section	Test sequences	No. of devices ^b	Details
138	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.
139	Cable Pullout	6	Test to be conducted on separate sets of devices rated 15 A and 20 A.
140	Conductor Pullout	3	Test to be conducted on separate sets of devices rated 15 A and 20 A.
141	Mounting Strength	6	Test to be conducted on separate sets of devices if mounted in paneling or mounted to frame construction by bracket.
142	Wall-Mounting Secureness	6	
143	Assembly Security	9	
144	Field Replacement	1	
145	Fault Current Withstand	3	
146	Knockouts	3	
147	Creep	6	
148	Mold Stress	6	May be combined with the Mold Stress Relief Test in Section 63. See Table 59.5.
149	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 Tables 59.5 and SA4.1. ^b A set of representative devices may be used for more than one test sequence if agreeable to all concerned.			

59.5 Current taps and adapters are to be subjected to the appropriate tests outlined in Table 59.8.

Table 59.8
Summary of tests
Current taps and adapters

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 devices.
63	Mold Stress Relief		Devices employing thermoplastic materials.
65	Dielectric Voltage Withstand (Repeated)		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	Accelerated Aging	6	Materials to be evaluated in accordance with the Exception to 8.4.1.
151	Security of Blades		Devices 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	Devices employing wire leads only.
68A	Reserved for future use		
151	Security of Blades	6	Devices rated 15 A or less and 250 V or less that are not subjected to the Accelerated Aging Test.
152	Secureness of Cover	6	Devices for wiring onto flexible cord that employ separable face covers as described in 46.1.1 – 46.1.7.
153	Torque	6	Screw-base devices only.
154	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.

(Continued)

Table 59.8 (Cont'd)

Section	Test sequences	No. of devices ^a	Details
154A	Self-Hinge Flexing	18	Devices employing self-hinges in the enclosure only.
155	Contact Security	6	Devices with Figure C1.1 configuration blades only.
157	Retention of Plugs	6	Devices with Figure C1.1, C1.5, C1.6, C1.9 and C1.10 configurations.
158	Overload		
159	Temperature		
157	Retention of Plugs (Repeated)		
160	Resistance to Arcing		Not required for devices employing phenolic, urea, or melamine in the outlet face.
161	Fuseholder Temperature	6	Devices with fuseholders only.
161A	Improper Insertion	12	Devices with Figure C1.1 outlet face configuration only.
162	Grounding Contact	6	Devices intended for fixed installation on receptacles employing Figure C1.5, C1.6, C1.9, C1.10, C1.13, C1.24 and C1.29 configurations only.
162B	Reserved for future use		
162C	Reserved for future use		
163	Assembly	12	Devices employing pin-type terminals. Number of devices indicated assumes device accommodates No. 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 164.2.
164	Temperature		
167	Dielectric Voltage-Withstand		
163	Assembly	12	Devices employing pin-type terminals. Number of devices indicated assumes device accommodates No. 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 165.2.
165	Strain Relief		
163	Assembly	6	Devices employing pin-type terminals. Number of devices indicated assumes device accommodates No. 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.
166	Fault Current		

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

Table 59.8 revised June 26, 1998

59.6 Flatiron and appliance plugs are to be subjected to the tests outlined in Table 59.9.

Table 59.9
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	Dielectric Voltage Withstand	6	All plugs.
63	Mold Stress Relief		Plugs employing thermoplastic materials.
65	Dielectric Voltage Withstand (Repeated)		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.
68A	Reserved for future use		
169	Millivolt Drop	6	
170	Overload		
171	Heating		
172	Millivolt Drop (Repeated)		
173	Crushing	6	
174	Mechanical Endurance	6	Not required for thermostatically-controlled appliance plugs.
175	Accelerated Aging	6	Devices employing rubber cord guards.
176	Cord Guard	6	

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

Table 59.9 revised June 26, 1998

ALL DEVICES

60 Comparative Tracking Index Test

60.1 A polymeric material used for electrical insulation or enclosure of live parts 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.

60.1 effective January 1, 1998

61 Glow Wire Test

61.1 A polymeric material used for electrical insulation or enclosure of live parts is to 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.

61.1 effective January 1, 1998

61.2 Devices are to be subjected to the Glow-Wire Ignitability test described in the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A. As a result of this test, there shall not be ignition of the insulating material during 30 seconds of application of the probe.

Effective date for 61.2 changed from January 1, 1995 to January 1, 1998

62 High-Current Arc Resistance to Ignition Test

62.1 A polymeric material used for electrical insulation or enclosure of live parts 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 93, 117, or 160, as appropriate, need not 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 to 62.1 may be judged acceptable for use in other applications without being subjected to this test.

62.1 effective January 1, 1998

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

Table 62.1 revised January 21, 1999

Flame Class	No. of Arcs
HB	60
V-2, VTM-2	15
V-1, VTM-1, 5VA, 5VB	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.

62.2 effective January 1, 1998

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.

62.3 effective January 1, 1998

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.

Effective date for 62.4 changed from January 1, 1995 to January 1, 1998

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.

Effective date for 62.5 changed from January 1, 1995 to January 1, 1998

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.

Effective date for 62.6 changed from January 1, 1995 to January 1, 1998

63 Mold Stress Relief Test

Effective date for Section 63 changed from January 1, 1995 to January 1, 1998

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 need not be subjected to this test.

63.2 The devices are to be placed in a circulating air oven maintained at a temperature of 70EC (158EF) 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 Withstand Test as described in Section 65. The devices need not be subjected to the humidity conditioning described in 65.2.

64 Moisture Absorption Resistance Test

Effective date for Section 64 changed from January 1, 1995 to January 1, 1998

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 ±5EC for 1 hour;
- b) Weighed (W_1);
- c) Immersed in distilled water at 23 ±1EC 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 the Test Method for Water Absorption of Plastics [ASTM D 570-81(1988)] described in the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A, need not be tested.

65 Dielectric Withstand Test

Effective date for Section 65 changed from January 1, 1995 to January 1, 1998

65.1 Devices intended for permanent or fixed installation shall withstand without breakdown a 50 – 60 Hz essentially sinusoidal potential applied as described in 65.3 for one minute between live parts of opposite polarity and between live parts and grounding or dead metal parts immediately following the humidity conditioning described in 65.2.

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

65.2 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 ±1EC (167 ±1.8EF) at a relative humidity of 92 ±3 percent.
- b) 16 hours at a temperature of 75 ±1EC (167 ±1.8EF) at a relative humidity of 40 ±3 percent.
- c) 4 hours at a temperature of 30 ±1EC (86 ±1.8EF) at a relative humidity of 60 ±3 percent.

65.3 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.

65.4 The mating attachment plugs used in 65.2 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.

65.5 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.

65.6 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 65.3. A test potential of 2000 V is then to be applied again across the two adjacent line terminals.

65.7 Devices intended for other than fixed or permanent installation and devices intended for installation on flexible cords, 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

Sub-heading effective January 1, 1998

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.

66.1.1 effective January 1, 1998

66.2 Rubber, EPDM, and TEE compounds

Sub-heading effective January 1, 1998

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.

66.2.1 effective January 1, 1998

66.2.2 If possible, 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 100EC (212EF). 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.

66.2.2 effective January 1, 1998

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 70.6.1 or 151.5.1.

66.2.3 revised June 26, 1998

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.

66.2.4 effective January 1, 1998

66.3 PVC compounds and copolymers

Sub-heading effective January 1, 1998

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

66.3.1 effective January 1, 1998

66.3.2 The device is to be placed in a full-draft air-circulating oven for 96 hours at a temperature of 100EC (212EF). 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.

66.3.2 effective January 1, 1998

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.

67.5 revised June 26, 1998

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 No. 18 AWG (0.82 mm²) or larger in size. If a smaller conductor is used, the force is to be 8 lbf (36 N).

68.1 revised June 26, 1998

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.

68.2 revised June 26, 1998

ATTACHMENT PLUGS

All Devices

69 General

69.1 The performance of an attachment plug is to be investigated by means of the applicable tests described in Sections 60 – 68, and 70 – 82. For Hospital Grade devices, see 83.1.

70 Security of Blades Test

70.1 *Revised and relocated as added 70.6.1 June 26, 1998*

70.2 *Relocated as added 70.6.2 and 70.6.3 June 26, 1998*

70.3 *Relocated as added 70.6.4 June 26, 1998*

70.4 *Relocated as the Exception to added 70.6.1 June 26, 1998*

70.5 *Relocated as added 70.6.2 June 26, 1998*

70.6 General

70.6.1 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 Figures C1.1 – C3.8.

70.6.1 added as relocated from 70.1 and 70.4 June 26, 1998

70.6.2 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 that will permit the blades, pins, or both to pass through it. 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.

70.6.2 added as revised and relocated from 70.2 and 70.5 June 26, 1998

70.6.3 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.

70.6.3 added as relocated from 70.2 June 26, 1998

70.6.4 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.

70.6.4 added as relocated from 70.3 June 26, 1998

70.7 Self-hinged plugs

70.7.1 If the attachment plug employs a self-hinge that is relied upon to hold the plug face in place, the tests described in 70.6.1 – 70.6.4 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 75A.

70.7.1 added June 26, 1998

71 Secureness-Of-Cover Test

71.1 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 71.2.

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

72 Crushing Test

72.1 Each of the attachment plugs illustrated in Figures C1.1, C1.2, C1.5, and C1.9 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.

72.2 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.

73 Torque Test

73.1 A medium-base screw base that is part of an attachment plug shall not turn, pull off, or become loose or distorted enough to affect the assembly adversely when a torque of 20 lbf in (2.3 N•m) is applied to the screw base for 1 minute. A torque of 10 lbf in (1.1 N•m) is to be used for a body (adapter) of a separable attachment plug.

73.2 The screw base is to be tested by means of a screw shell (threaded receptacle) that can be screwed onto the screw base and to which the prescribed value of torque can be imparted.

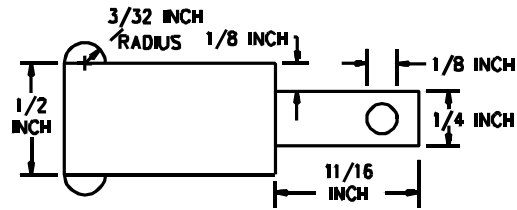
74 Attachment Plug Grip Tests

74.1 The attachment plug is to be tested as described in 74.2 – 74.9 to determine compliance with 17.2.1.

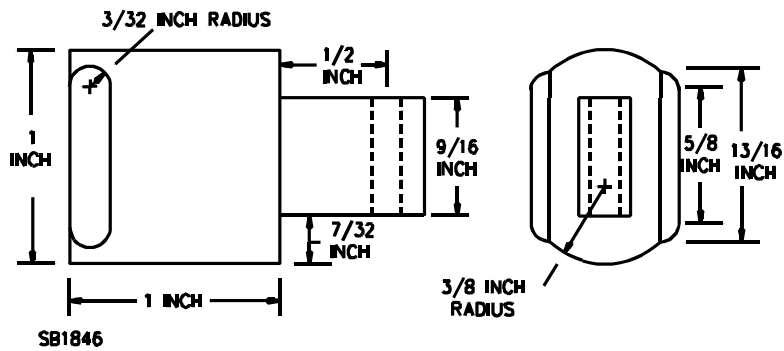
74.2 Prior to testing, the reference plug shown in Figure 74.1 is to be cleaned with a metal cleaner. The reference plug, the test plugs, and the hands of each individual conducting the test are to be washed with soap and water, rinsed, and then dried.

Figure 74.1
Reference plug

Figure 74.1 revised June 26, 1998



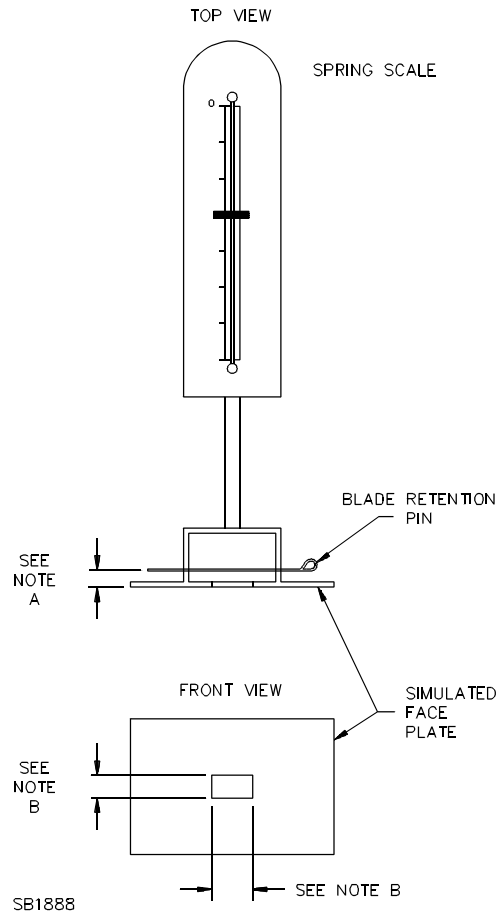
MATERIAL - BRASS



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

Figure 74.2 revised June 26, 1998



NOTES

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

B – Large enough for blades to pass through

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.

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.

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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 *Revised and relocated as added 75.3.1 June 26, 1998*

75.2 *Relocated as added 75.3.3 June 26, 1998*

75.3 General

75.3.1 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 and 13.4 need not 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 need not be subjected to this test.

Exception No. 3: Attachment plugs employing pin-type terminals instead shall be subjected to the Strain Relief Test, Section 80.

Exception No. 4: Hospital Grade attachment plugs instead shall be subjected to the Strain Relief Test, Section 84.

75.3.1 added as revised and relocated from 75.1 June 26, 1998

75.3.2 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 180.2.

75.3.2 added June 26, 1998

75.3.3 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 No. 18 AWG (0.82 mm²) or larger conductors, and
- b) 20 lbf (89 N) for a cord with conductors smaller than No. 18 AWG (0.82 mm²),

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

75.3.3 added as relocated from 75.2 June 26, 1998

75.4 Self-hinged plugs

75.4.1 If the attachment plug employs a self-hinge that is relied upon to hold the flexible cord in place, the tests described in 75.3.1 – 75.3.3 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 75A.

75.4.1 added June 26, 1998

75A Self-Hinge Flexing Test

Section 75A added June 26, 1998

75A.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.

75A.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 100EC (212EF); and
- c) Group 3 - Cold conditioned for 2 hours at -10EC (14EF) and allowed to return to room temperature.

75A.3 The hinge of each device shall be completely opened and closed for 100 cycles of operation.

76 Terminal Temperature Test

76.1 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 30EC (54EF).

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

76.1 effective January 1, 1998

76.2 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.

76.2 effective January 1, 1998

76.3 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.

76.3 effective January 1, 1998

76.4 Temperature readings are to be obtained by means of thermocouples consisting of Nos. 28 – 32 AWG (0.08 – 0.032 mm²) iron and constantan wires. It is a common practice to employ thermocouples consisting of No. 30 AWG (0.05 mm²) iron and constantan wires with a potentiometer type of indicating instrument. This equipment will be used if a referee measurement of temperature is necessary.

77 Fuseholder Temperature Test

Section 77 effective January 1, 1998

77.1 When tested as described in this Section, the temperature rise of an attachment plug or male inlet incorporating a fuseholder shall not exceed the following:

- a) 30EC (54EF) on the fuse clips when tested with a dummy fuse;
- b) 85EC (153EF) on the fuse clips when tested with a live fuse;
- c) 30EC (54EF) at the wiring terminals or cord connections at any time (see 77.7); and
- d) The relative thermal index of the surrounding insulating material, minus an assumed ambient of 25EC (77EF), at any time (see 77.7).

77.2 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 77.6 and 77.7).

Exception: The test may be conducted in conjunction with the Terminal Temperature Test, Section 76, if agreeable to all concerned.

77.3 The devices are to be wired in a series circuit with the blades of the attachment plugs or inlets connected by the shortest possible length of solid copper wire soldered across the blades. For an attachment plug intended for use with flexible cord, each connection to the device being tested is to be made by means of a 6 inch (150 mm) or shorter length of the appropriate type of flexible cord that has an ampacity at least equal to that of the device. For a male inlet, Type RH or Type TW lead-in wires no more than 6 inches (150 mm) long 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.

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77.4 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.

77.5 The test is to continue for at least 4 hours even though stabilized temperatures may be attained in a somewhat shorter interval of time. A temperature is considered to be stabilized when three consecutive readings, taken at 5 minute intervals, indicate no further rise above the ambient temperature.

77.6 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.

77.7 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, UL 512. The dummy fuse size for devices employing miscellaneous, miniature and micro fuses is to be as indicated in Table 77.1. To represent the heating of a live fuse, 20EC (36EF) is to be added to the recorded temperature rise on the wiring terminals, cord connections, and surrounding insulating materials.

Table 77.1
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)

77.8 The thermocouples are to consist of Nos. 28 – 32 AWG ($0.08 - 0.032 \text{ mm}^2$) iron and constantan wires. It is a common practice to employ thermocouples consisting of No. 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

78 Assembly Test

78.1 *Revised and separated into added 78.2 and 78.3 January 21, 1999*

78.2 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.

78.2 added as revised and separated from 78.1 January 21, 1999

78.3 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 70 - 82.

Exception: The device is not required to be assembled and tested with those cord types and sizes excluded by the marking specified in 180.3.1 (c).

78.3 added as revised and separated from 78.1 January 21, 1999

79 Temperature Test

79.1 *Revised and separated into 79.3 and 79.5 January 21, 1999*

79.2 *Revised and relocated as added 79.4 January 21, 1999*

79.3 The temperature rise shall not be more than 30EC (54EF) when the attachment plug is carrying the current corresponding to the ampacity of the size cord that the device is intended to accommodate.

79.3 added as revised and separated from 79.1 January 21, 1999

79.4 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 No. 18 AWG (0.82 mm²) 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 No. 18 AWG (0.82 mm²) 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 No. 18 AWG (0.82 mm²) polyvinyl chloride insulated Type SPT-1 cord having a minimum overall width of 0.210 in (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.

79.4 added as revised and relocated from 79.2 January 21, 1999

79.5 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.

79.5 added as revised and separated from 79.1 January 21, 1999

79.6 Following the completion of this test, three assemblies using each of the flexible cord sizes and types specified in 79.4 are to be selected and subjected to the Dielectric-Voltage Withstand Test described in Section 82.

79.6 added January 21, 1999

80 Strain Relief Test

80.1 *Revised and relocated as added 80.3 (date of publication)*

80.2 *Revised and separated into added 80.4, 80.5, and 80.6 (date of publication)*

80.3 When assembled to the intended flexible cord, an attachment plug 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.

80.3 added as revised and relocated from 80.1 (date of publication)

80.4 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 No. 18 AWG (0.82 mm²) 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 79.4.

b) When cords other than No. 18 AWG (0.82 mm²) 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.

80.4 added as revised and separated from 80.2 (date of publication)

80.5 One set of devices for each cord size and type is to be subjected to the test described in 80.6 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 67.0EC (152.6EF).

80.5 added as revised and separated from 80.2 (date of publication)

80.6 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 No. 18 AWG (0.82 mm²) or larger, or
- b) 20 lbf (89 N) when the conductors are smaller than No. 18 AWG (0.82 mm²).

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

80.6 added as revised and separated from 80.2 (date of publication)

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81 Fault Current Test

81.1 *Revised and separated into added 81.2, 81.4, and 81.5 (date of publication)*

81.2 When assembled to the intended flexible cord, an attachment plug 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.

81.2 added as revised and separated from 81.1 (date of publication)

81.3 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 No. 18 AWG (0.82 mm²) 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 79.4.

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.

81.3 added (date of publication)

81.4 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 81.5 following assembly in the as-received condition.

b) The second set is to be subjected to the test described in 81.5 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 81.5 after being conditioned in an oven at 67.0EC (152.6EF) for 30 days.

81.4 added as revised and separated from 81.1 (date of publication)

81.5 A standard screw terminal receptacle of the 5-15 configuration (2-pole, 3-wire, 15A, 125V) is to be wired in a circuit capable of delivering 1000 A rms 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 No. 12 AWG (3.3 mm²) 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.

81.5 added as revised and separated from 81.1 (date of publication)

82 Dielectric Voltage-Withstand Test

82.1 The assembly of a cord and attachment plug device 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 79.

82.1 revised (date of publication)

82.2 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.

Hospital Grade Attachment Plugs

83 General

83.1 Fifty-five Hospital Grade attachment plugs are required for each complete investigation including, the general testing specified elsewhere in this standard. Previously untested plugs are to be used for each test.

84 Strain Relief Tests

84.1 General

84.1.1 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.

84.1.2 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 No. 16 AWG (1.3 mm²), Type SJT cord. A 15 A plug is to be assembled onto No. 18 AWG (0.83 mm²), 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 No. 18 AWG (0.83 mm²) 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.

84.2 Method A – static pull

84.2.1 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.

84.3 Method B – rotary pull

84.3.1 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 and Soldering Lugs for Use with Copper Conductors, UL 486A, or in the Standard for Wire Connectors for Use with Aluminum Conductors, UL 486B.)

84.4 Method C – abrupt removal

84.4.1 Each attachment plug previously assembled onto flexible cord is to be subjected to one abrupt removal from a Hospital Grade receptacle in accordance with the procedure described in Abrupt Plug Removal Test, Section 128, (receptacle abrupt removal) as modified by 84.5.1 and 84.6.1 that specifically address straight versus angle plugs. 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.

84.5 Straight attachment plugs

84.5.1 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 84.4.1).

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84.6 Angle attachment plugs

84.6.1 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 84.4.1).

85 Crushing Test

85.1 A Hospital Grade 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.

85.2 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.

85.3 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 180.2.1.

86 Impact Resistance Test

86.1 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.

86.2 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.

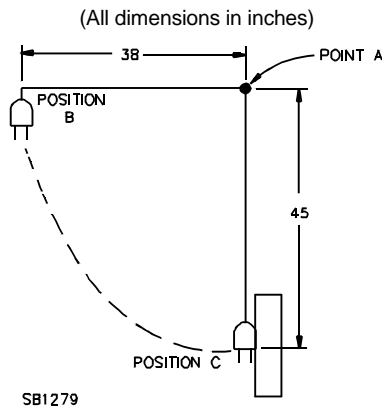
86.3 The flexible cord used to wire the attachment plugs is to be the minimum size and type of flexible cord specified for use by the manufacturer in accordance with 180.2.1.

87 Mechanical Drop Test

87.1 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 87.4.

Figure 87.1
Mechanical drop test apparatus



inch	38	45
m	0.96	1.14

Figure 87.1 revised September 22, 1997

87.2 Each of the devices is to be assembled onto No. 18 AWG (0.8 mm^2) flexible cord of a length sufficient for mounting on the test apparatus shown in Figure 87.1. 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 87.1 and then release it causing the plug to fall freely and strike the impact block at point C.

87.3 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.

87.4 The mechanical drop testing in 87.2 and 87.3 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.

88 Mold Stress Relief Test

88.1 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.

88.2 The unwired attachment plugs are to be placed in a circulating air oven for 7 hours at 70EC (158EF). The devices are to be removed from the oven and allowed to cool to room temperature before determining compliance.

CORD CONNECTORS

All Devices

89 General

89.1 The performance of a cord connector is to be investigated by means of the tests described in Sections 60 – 68 and 90 – 101. For Hospital Grade devices, see 102.1.

90 Retention of Plugs Tests

90.1 The contacts of the cord connectors illustrated in Figures C1.1, C1.5, C1.6, C1.9, and C1.10 shall be capable of holding an attachment plug so that a force of 3 – 15 lbf (13 – 67 N) is required to withdraw the plug when tested as described in this Section.

Exception: A cord connector that has provision for locking the plug in place after the blades have been inserted in the female contacts need not be subjected to this test.

90.2 Each device is to be subjected to ten conditioning cycles of insertion and withdrawal of a standard solid-blade attachment plug of a type with which the device is intended for use and that has American National Standard detent holes in rigidly mounted blades, following which the plug is to be fully reinserted into the device. 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 results are unacceptable if there is any displacement of the plug.

90.3 The cord connector is then to be subjected to the regular overload and temperature tests, following which the entire procedure described above is to be repeated. In the repeated test, the results are unacceptable if the plug is displaced by the 3 lbf (13 N) pull, but it is required that the cap be withdrawn when the pull is increased to 15 lbf (67 N). If the device is intended to accommodate either a 2- or 3-wire plug, the entire procedure described above is to be performed with a 2-wire plug, after which a 3-wire plug inserted into the device is required to be withdrawn by a 15 lbf (67 N) pull.

91 Overload Tests

91.1 *Revised and relocated as added 91.19.1 June 26, 1998*

91.2 *Revised and relocated as Exception No. 1 to added 91.19.1 June 26, 1998*

91.3 *Relocated as added 91.19.5 and 91.19.8 June 26, 1998*

91.4 *Relocated as added 91.19.8 June 26, 1998*

- 91.5 *Relocated as added 91.19.6 June 26, 1998*
- 91.6 *Revised and relocated as added 91.19.7 June 26, 1998*
- 91.7 *Revised and relocated as added 91.19.10 June 26, 1998*
- 91.8 *Relocated as added 91.19.4 June 26, 1998*
- 91.9 *Revised and relocated as added 91.20.2 June 26, 1998*
- 91.10 *Revised and relocated as the Exception to added 91.20.2 June 26, 1998*
- 91.11 *Relocated as added 91.19.4 June 26, 1998*
- 91.12 *Revised and relocated as added 91.19.9 June 26, 1998*
- 91.13 *Revised and relocated as added 91.19.2 June 26, 1998*
- 91.14 *Revised and relocated as added 91.19.1 and 91.19.3 June 26, 1998*
- 91.15 *Revised and relocated as added 91.20.1 June 26, 1998*
- 91.16 *Revised and relocated as added 91.19.1 June 26, 1998*

91.17 *Revised and separated into 91.21.2 and 91.21.3 June 26, 1998*

91.18 *Revised and relocated as Exception No. 2 to added 91.19.1 and 91.21.1 June 26, 1998*

91.19 General

91.19.1 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, need not be subjected to this test. See also 177.7 and 178.6.1.

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.

91.19.1 added as revised and relocated from 91.1, 91.2, 91.16, and 91.18 June 26, 1998

91.19.2 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.

91.19.2 added as revised and relocated from 91.13 June 26, 1998

91.19.3 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.

91.19.3 added as revised and relocated from 91.14 June 26, 1998

91.19.4 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. 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.

91.19.4 added as revised and relocated from 91.8 and 91.11 June 26, 1998

91.19.5 Each device 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. If 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 91.19.3.

91.19.5 added as relocated from 91.3 June 26, 1998

91.19.6 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.

91.19.6 added as relocated from 91.5 June 26, 1998

91.19.7 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 91.19.8.

91.19.7 added as revised and relocated from 91.6 June 26, 1998

91.19.8 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.

91.19.8 added as relocated from 91.3 and 91.4 June 26, 1998

91.19.9 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.

91.19.9 added as revised and relocated from 91.12 June 26, 1998

91.19.10 In the event that unacceptable results are obtained in the machine testing described in 91.19.6 or 91.19.7, referee tests may be conducted manually under conditions similar to those described in 91.19.6 or 91.19.7.

91.19.10 added as revised and relocated from 91.7 June 26, 1998

91.20 Current overload test

91.20.1 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 UL 1681, 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.

91.20.1 added as revised and relocated from 91.15 June 26, 1998

91.20.2 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.

91.20.2 added as revised and relocated from 91.9 and 91.10 June 26, 1998

91.21 Horsepower overload test

91.21.1 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.

91.21.1 added as revised and relocated from 91.18 June 26, 1998

91.21.2 For devices with standard configurations illustrated in UL 1681, the test current corresponding to the AC horsepower rating shall be as specified in Table 91.1. 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 with the configurations C2.14, C2.15, C2.23, C2.30, C2.35, C2.36, C2.41 – C2.44, and C3.1 – C3.12 do not have assigned horsepower ratings and need not be subjected to the horsepower overload test.

91.21.2 added as revised and relocated from 91.17 June 26, 1998

91.21.3 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.

91.21.3 added as revised and relocated from 91.17 June 26, 1998

Table 91.1
Test current (locked rotor amperes) for
horsepower rated NEMA configuration cord connectors

Figure	AC HP rating ^a	LRA (amperes)	AC test voltage
C1.1	0.5	58.8	125
C1.2	1.5 ^b	60 66	250 208
C1.3	2 ^b	72 79.2	250 208
C1.4	2 ^b	72 79.2	250 208
C1.5	0.5	58.8	125
C1.6	1	96	125
C1.7	2	144	125
C1.8	2	144	125
C1.9	1.5 ^b	60 66	250 208
C1.10	2 ^b	72 79.2	250 208
C1.11	2 ^b	72 79.2	250 208
C1.12	3 ^b	102 112.2	250 208
C1.13	2	59.8	277
C1.14	2	59.8	277
C1.15	3	84.7	277
C1.16	5	139.4	277
C1.17	2 L-L ^b	72 79.2	250 208
	1 L-N	96	125
C1.18	2 L-L ^b	72 79.2	250 208
	2 L-N	144	125
C1.19	3 L-L ^b	102 112.2	250 208
	2 L-N	144	125
C1.20	2	40.8	250
C1.21	3	57.6	250
C1.22	3	57.6	250
C1.23	7.5	132	250

(Continued)

Table 91.1 (Cont'd)

Figure	AC HP rating ^a	LRA (amperes)	AC test voltage
C1.24	1.5 L-L ^b	60	250
		66	208
C1.25	0.5 L-N	58.8	125
	2 L-L ^b	72	250
C1.26		79.2	208
	1 L-N	96	125
C1.27	2 L-L ^b	72	250
		79.2	208
C1.28	2 L-N	144	125
	3 L-L ^b	102	250
C1.29		112.2	208
	2 L-N	144	125
C1.30	3 L-L ^b	102	250
		112.2	208
C1.31	2 L-N	144	125
	2	40.8	250
C1.32	3	57.6	250
C1.33	3	57.6	250
C1.34	7.5	132	250
C1.35	10	168	250
C1.36	2	44.9	208
C1.37	2	44.9	208
C1.38	3	63.4	208
	7.5	145.2	208
	7.5	145.2	208
C2.1	0.5	58.8	125
C2.2	2 ^b	72	250
		79.2	208
C2.3	0.5	58.8	125
C2.4	1	96	125
C2.5	2	144	125
C2.6	1.5 ^b	72	250
		79.2	208
C2.7	2 ^b	72	250
		79.2	208
C2.8	2 ^b	72	250
		79.2	208

(Continued)

Table 91.1 (Cont'd)

Figure	AC HP rating ^a	LRA (amperes)	AC test voltage
C2.9	2	59.8	277
C2.10	2	59.8	277
C2.11	3	84.7	277
C2.12	3	51	480
C2.13	5	84	480
C2.16	2 L-L ^b	72	250
		79.2	208
	1 L-N	96	125
C2.17	2 L-L ^b	72	250
		79.2	208
	2 L-N	144	125
C2.18	2	40.8	250
C2.19	3	57.6	250
C2.20	3	57.6	250
C2.21	5	45.6	480
C2.22	10	84	480
C2.24	2 L-L ^b	72	250
		79.2	208
	1 L-N	96	125
C2.25	2 L-L ^b	72	250
		79.2	208
	2 L-N	144	125
C2.26	3	57.6	250
C2.27	3	57.6	250
C2.28	5	45.6	480
C2.29	10	84	480
C2.31	2	44.9	208
C2.32	3	63.4	208
C2.33	5	45.6	480
C2.34	10	84	480
C2.37	2	44.9	208
C2.38	3	63.4	208
C2.39	5	45.6	480
C2.40	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.

92 Temperature Test

92.1 The temperature rise of a cord connector, when measured at the points described in 92.2 shall not be more than 30EC (54EF) when the device is carrying its maximum rated current.

92.2 The temperature measurement mentioned in 92.1 is to be made on the wiring terminals of the device if they are accessible for the mounting of thermocouples. If the wiring terminals are inaccessible, or if the device has no wiring terminals, temperatures are to be measured at points as close to the face of the device as possible on the male blades of an attachment plug inserted in the outlet.

92.3 The temperature test is to be made following the overload test on the device and is to continue for 4 hours even though stabilized temperatures may be attained in a somewhat shorter interval of time. The generation of heat from sources other than the female contacts is to be minimized as much as possible. For example, each connection to the device being tested is to be made by means of a 6 inch (150 mm) or shorter length of the appropriate type of flexible cord that has an ampacity at least equal to that of the device. Wires of the indicated ampacity are to be used regardless of the size of cord which is intended to be used with the device. The contacts of the device being tested 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 appropriate flexible cord as described above. The terminals are to be tightened to the marked torque limit or, if no tightening torque is 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.

92.4 Temperature readings are to be obtained by means of thermocouples consisting of No. 28 – 32 AWG (0.08 – 0.032 mm²) iron and constantan wires. It is a common practice to employ thermocouples consisting of No. 30 AWG (0.05 mm²) iron and constantan wires with a potentiometer type of indicating instrument. This equipment will be used if a referee measurement of temperature is necessary.

93 Resistance to Arcing Test

Effective date for Section 93 changed from January 1, 1995 to January 1, 1998

93.1 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 91, 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 90.2) 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 plug used for this test may be changed after every 50 operations.

93.2 Alternatively one set of devices may be subjected to the 50 cycles of operation in the overload test described in Overload Tests, Section 91, 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.

94 Fuseholder Temperature Test

Section 94 effective January 1, 1998

94.1 When tested as described in this Section, the temperature rise of a cord connector incorporating a fuseholder shall not exceed the following:

- a) 30EC (54EF) on the fuse clips when tested with a dummy fuse;
- b) 85EC (153EF) on the fuse clips when tested with a live fuse;
- c) 30EC (54EF) at the wiring terminals or cord connections at any time (see 94.7); and
- d) The relative thermal index of the surrounding insulating material, minus an assumed ambient of 25EC (77EF), at any time (see 94.7).

94.2 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 94.6 and 94.7).

Exception: The test may be conducted in conjunction with the Temperature Test, Section 92, if agreeable to all concerned.

94.3 The cord connectors are to be wired in a series circuit as described in the Temperature Test, Section 92.

94.4 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.

94.5 The test is to continue for at least 4 hours even though stabilized temperatures may be attained in a somewhat shorter interval of time. A temperature is considered to be stabilized when three consecutive readings, taken at 5 minute intervals, indicate no further rise above the ambient temperature.

94.6 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.

94.7 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, UL 512. The dummy fuse size for devices employing miscellaneous, miniature and micro fuses is to be as indicated in Table 94.1. To represent the heating of a live fuse, 20EC (36EF) is to be added to the recorded temperature rise on the wiring terminals, cord connections, or surrounding insulating materials.

Table 94.1
**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)

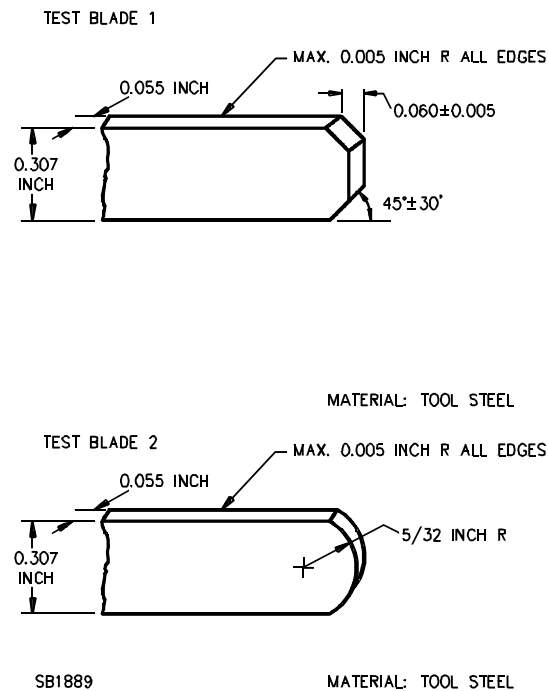
94.8 The thermocouples are to consist of Nos. 28 – 32 AWG ($0.08 - 0.032 \text{ mm}^2$) iron and constantan wires. It is a common practice to employ thermocouples consisting of No. 30 AWG (0.05 mm^2) iron and constantan wires with a potentiometer type of indicating instrument. This equipment will be used if a referee measurement of temperature is necessary.

94A Improper Insertion Test

Section 94A added June 26, 1998

94A.1 To determine compliance with 15.2.3 and 15.2.4, a cord connector shall obstruct the attempted insertion of the test blades illustrated in Figure 94A.1, when tested as described in 94A.2 and 94A.3.

Figure 94A.1
Improper insertion test blades



94A.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.

94A.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.

95 Potential Drop in Grounding Connections Test

95.1 A pressure connection that is secured by a means other than riveting, bolting, or welding in the grounding path of a cord connector of the type represented in Figures C1.5 – C1.16, C1.24 – C1.33, C2.3 – C2.15, C2.24 – C2.30, C2.37 – C2.42, C3.1, C3.6, and C3.8, 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.

96 Integrity of Assembly Test

96.1 *Revised and relocated as added 96.3.1 June 26, 1998*

96.2 *Relocated as added 96.3.3 June 26, 1998*

96.3 General

96.3.1 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 and 13.4 need not 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 need not 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 99.

Exception No. 4: A Hospital Grade cord connector instead shall be subjected to the Strain Relief Test, Section 111.

96.3.1 added as revised and relocated from 96.1 June 26, 1998

96.3.2 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 180.2.

96.3.2 added June 26, 1998

96.3.3 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 No. 18 AWG (0.82 mm²) or larger conductors, and
- b) 20 lbf (89 N) for a cord with conductors smaller than No. 18 AWG (0.82 mm²),

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

96.3.3 added as relocated from 96.2 June 26, 1998

96.4 Self-hinged cord connectors

96.4.1 If the cord connector employs a self-hinge that is relied upon to hold the flexible cord in place, the tests described in 96.3.1 – 96.3.3 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 96A.

96.4.1 added June 26, 1998

96A Self-Hinge Flexing Test

Section 96A added June 26, 1998

96A.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.

96A.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 100EC (212EF); and
- c) Group 3 - Cold conditioned for 2 hours at -10EC (14EF) and allowed to return to room temperature.

96A.3 The hinge of each device shall be completely opened and closed for 100 cycles of operation.

Pin-Type Terminals

97 Assembly Test

97.1 *Revised and separated into added 97.2 and 97.3 (date of publication)*

97.2 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.

97.2 added as revised and separated from 97.1 (date of publication)

97.3 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 90 - 101.

Exception: The device is not required to be assembled and tested with those cord types and sizes excluded by the marking specified in 180.3.1 (c).

97.3 added as revised and separated from 97.1 (date of publication)

98 Temperature Test

98.1 *Revised and separated into added 98.3 and 98.5 (date of publication)*

98.2 *Revised and relocated as added 98.4 (date of publication)*

98.3 The temperature rise shall not be more than 30EC (54EF) when the cord connector is carrying the current corresponding to the ampacity of the size cord that the device is intended to accommodate.

98.3 added as revised and separated from 98.1 (date of publication)

98.4 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 No. 18 AWG (0.82 mm²) 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 No. 18 AWG (0.82 mm²) 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 No. 18 AWG (0.82 mm²) 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.

98.4 added as revised and relocated from 98.2 (date of publication)

98.5 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.

98.5 added as revised and separated from 98.1 (date of publication)

98.6 Following the completion of this test, three assemblies using each of the flexible cord sizes and types specified in 98.4 are to be selected and subjected to the Dielectric-Voltage Withstand Test described in Section 101.

98.6 added (date of publication)

99 Strain Relief Test

99.1 *Revised and relocated as added 99.3 (date of publication)*

99.2 *Revised and separated into added 99.4, 99.5, and 99.6 (date of publication)*

99.3 When assembled to the intended flexible cord, a cord connector 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.

99.3 added as revised and relocated from 99.1 (date of publication)

99.4 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 No. 18 AWG (0.82 mm²) 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 98.4.
- b) When cords other than No. 18 AWG (0.82 mm²) 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.

99.4 added as revised and separated from 99.2 (date of publication)

99.5 One set of devices for each cord size and type is to be subjected to the test described in 99.6 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 67.0EC (152.6EF).

99.5 added as revised and separated from 99.2 (date of publication)

99.6 While the cord connector 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 No. 18 AWG (0.82 mm²) or larger, or
- b) 20 lbf (89 N) when the conductors are smaller than No. 18 AWG (0.82 mm²).

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

99.6 added as revised and separated from 99.2 (date of publication)

100 Fault Current Test

100.1 *Revised and separated into added 100.2, 100.4, and 100.5 (date of publication)*

100.2 When assembled to the intended flexible cord, a cord connector 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.

100.2 added as revised and separated from 100.1 (date of publication)

100.3 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 No. 18 AWG (0.82 mm²) 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 98.4.
- 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.

100.3 added (date of publication)

100.4 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 No. 12 AWG (3.3 mm²) 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 100.5 following assembly in the as-received condition.
- b) The second set is to be subjected to the test described in 100.5 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 100.5 after being conditioned in an oven at 67.0EC (152.6EF) for 30 days.

100.4 added as revised and separated from 100.1 (date of publication)

100.5 A standard screw terminal receptacle of the 5-15 configuration (2-pole, 3-wire, 15A, 125V) is to be wired in a circuit capable of delivering 1000 A rms 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 No. 12 AWG (3.3 mm²) 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.

100.5 added as revised and separated from 100.1 (date of publication)

101 Dielectric Voltage-Withstand Test

101.1 The assembly of a cord and cord connector device 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 98.

101.1 revised (date of publication)

101.2 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.

Hospital Grade Cord Connectors

102 General

102.1 Sixty Hospital Grade cord connectors are required for each complete investigation including the general testing specified elsewhere in this standard. If a cord connector employs the same construction strain-relief means as a Hospital Grade attachment plug, only 45 devices are required.

103 Grounding Contact Temperature Test

103.1 The acceptability of the grounding path in a Hospital Grade cord connector shall be demonstrated by a temperature rise not exceeding 30EC (54EF) when subjected to the test described in this Section.

103.2 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.

103.3 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 No. 12 AWG (3.3 mm²) 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 30EC (54EF) at any time.

104 Resistance Test

104.1 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.

104.2 The devices previously subjected to the Grounding Contact Temperature Test, Section 103, are to be used for this test.

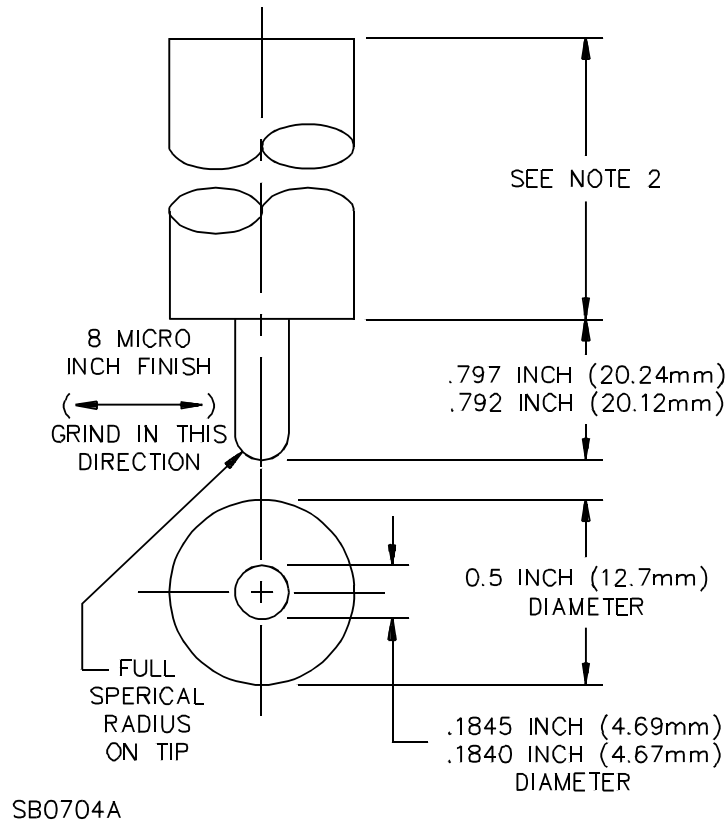
104.3 Compliance with 104.1 is to be determined by passing an alternating current of 22 A from a power supply of 12 V or less from the attachment plug grounding terminal to the cord connector grounding terminal. The resulting drop in potential is to be measured between these two points. The resistance in ohms is to be determined by dividing the drop in potential in volts by the current in amperes passing between the two points.

105 Grounding Contact Overstress Test

105.1 A cord connector shall be capable of retaining the standard test pin shown in Figure 105.1 for at least 1 minute without displacement following the conditioning described in 105.2. There shall not be any breakage that adversely affects the integrity of the enclosure of live parts.

105.2 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 105.2. For testing, the test pin illustrated in Figure 105.1 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 105.1
Standard grounding pin

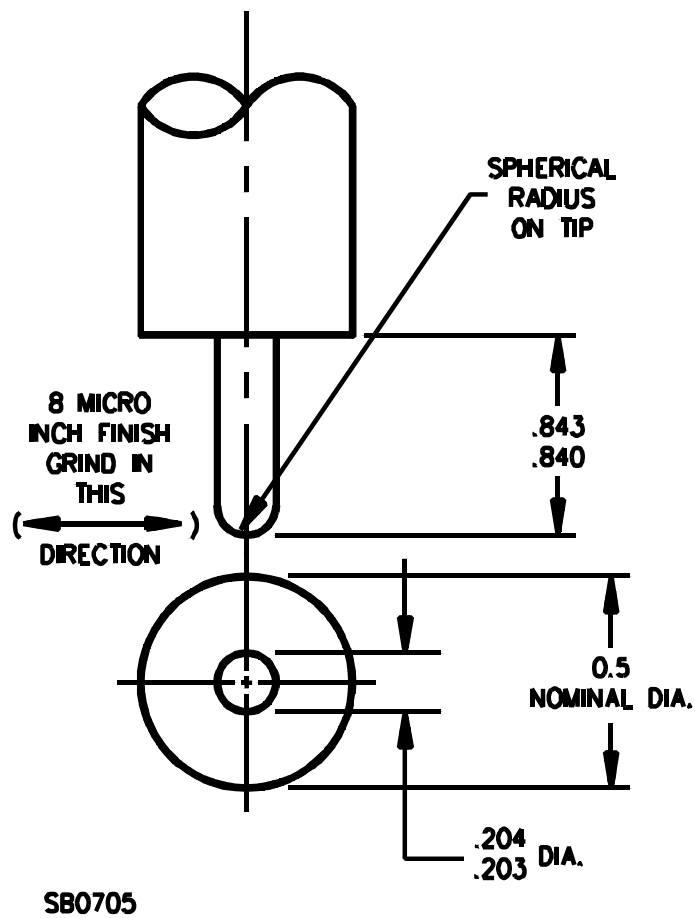


NOTES

- 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		

Figure 105.2
Oversize grounding pin



NOTES

- 1) All dimensions in inches.
- 2) Length not specified for tool handle.
- 3) Hardened steel pin.

	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		

106 Plug Connection and Separation Test

106.1 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 105.1 without displacement.

106.2 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.

106.3 After the separation conditioning, the test pin shown in Figure 105.1 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.

107 Crushing Test

107.1 A Hospital Grade 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.

107.2 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.

107.3 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 180.2.1.

108 Impact Resistance Test

108.1 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.

108.2 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.

108.3 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 180.2.1.

109 Mechanical Drop Test

109.1 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 109.4.

109.2 Each of the devices is to be assembled onto No. 18 AWG (0.82 mm²) flexible cord of a length sufficient for mounting on the test apparatus shown in Figure 109.1. 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 109.1 and then release it causing the plug to fall freely and strike the impact block at point C.

Figure 109.1
Mechanical drop test apparatus

(All dimensions in inches)

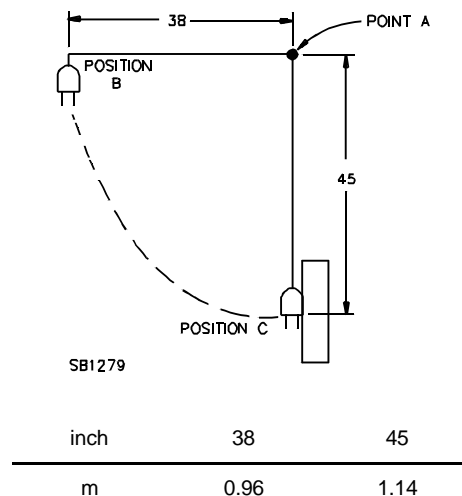


Figure 109.1 revised September 22, 1997

109.3 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.

109.4 The mechanical drop testing in 109.2 and 109.3 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.

110 Mold Stress Relief Test

110.1 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.

110.1 revised February 28, 1997

110.2 The unwired cord connectors are to be placed in a circulating air oven for 7 hours at 70EC (158EF). The devices are to be removed from the oven and allowed to cool to room temperature before determining compliance.

111 Strain Relief Tests

111.1 General

111.1.1 A cord connector shall withstand the strain relief tests described in this Section. Fifteen devices are necessary to accomplish strain-relief testing. If a cord connector uses the same construction as a Hospital Grade attachment plug, strain relief testing is not required on the cord connector.

111.1.2 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.

111.1.3 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 No. 16 AWG (1.3 mm²), Type SJT cord. A 15 A connector is to be assembled onto No. 18 AWG (0.82 mm²), 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 No. 18 AWG (0.82 mm²) 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).

111.2 Method A – static pull

111.2.1 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.

111.3 Method B – rotary pull

111.3.1 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 and Soldering Lugs for Use with Copper Conductors, UL 486A, or in the Standard for Wire Connectors for Use with Aluminum Conductors, UL 486B.)

111.4 Method C – abrupt removal

111.4.1 Each of six cord connectors previously assembled onto flexible cord is to be subjected to one abrupt removal from a Hospital Grade attachment plug fixed in place in accordance with the procedure described in Abrupt Plug Removal Test, Section 128 (receptacle abrupt removal) as modified by 111.4.2. A new plug is to be used for each abrupt removal.

111.4.2 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. The abrupt removal force is to be applied to the flexible cord in a direction 60 degrees from the plane of the cord connector face.

RECEPTACLES

All Devices

112 General

112.1 The performance of a receptacle is to be investigated by means of the applicable tests described in Sections 60 – 68 and 113 – 126. A flush receptacle having one of the configurations illustrated in Figures C1.5, C1.6, C1.9, or C1.10 is to be subjected to the tests described in Sections 60 – 68, 119 and in Supplement SA. For Hospital Grade receptacles, see also 127.1. For self-contained receptacles, see also 137.1.

112.1 revised June 26, 1998

113 Strength of Insulating Base and Support Test

113.1 A device for field connection of fixed wiring shall not be damaged when 110 percent of the specified terminal tightening torque is applied to the wire securing means of a pressure wire connector securing the maximum intended size conductor.

113.2 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.

113.3 The terminal tightening torque to be used for this test is to be that assigned by the manufacturer in accordance with 12.18 and marked in accordance with 180.1.1.

114 Retention of Plugs Test

114.1 The contacts of the receptacles illustrated in Figures C1.1, C1.5, C1.6, C1.9, and C1.10 shall be capable of holding an attachment plug so that a force of 3 – 15 lbf (13 – 67 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 need not be subjected to this test.

114.2 Each device is to be subjected to ten conditioning cycles of insertion and withdrawal of a standard solid-blade attachment plug of a type with which the device is intended for use and that has American National Standard detent holes in rigidly mounted blades, following which the plug is to be fully reinserted into the device. 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 results are unacceptable if there is any displacement of the plug.

114.3 The receptacle is then to be subjected to the regular overload and temperature tests, following which the entire procedure described above is to be repeated. In the repeated test, the results are unacceptable if the plug is displaced by the 3 lbf (13 N) pull, but it is required that the cap be withdrawn when the pull is increased to 15 lbf (67 N). If the device is intended to accommodate either a 2- or 3-wire plug, the entire procedure described above is to be performed with a 2-wire plug, after which a 3-wire plug inserted into the device is required to be withdrawn by a 15 lbf (67 N) pull.

115 Overload Test

115.1 *Revised and relocated as added 115.19.1 June 26, 1998*

115.2 *Relocated as Exception No. 1 to added 115.19.1 June 26, 1998*

115.3 *Relocated as added 115.19.5 and 115.19.8 June 26, 1998*

115.4 *Relocated as added 115.19.8 June 26, 1998*

115.5 *Relocated as added 115.19.6 June 26, 1998*

115.6 *Relocated as added 115.19.7 June 26, 1998*

115.7 *Revised and relocated as added 115.19.10 June 26, 1998*

115.8 *Relocated as added 115.19.4 June 26, 1998*

115.9 *Revised and relocated as added 115.20.2 June 26, 1998*

115.10 *Relocated as the Exception to added 115.20.2 June 26, 1998*

115.11 *Relocated as added 115.19.4 June 26, 1998*

115.12 *Revised and relocated as added 115.19.9 June 26, 1998*

115.13 *Relocated as added 115.19.2 June 26, 1998*

115.14 *Revised as added 115.19.1 and 115.19.3 June 26, 1998*

115.15 *Revised and relocated as added 115.20.1 June 26, 1998*

115.16 *Revised and relocated as 115.19.1 June 26, 1998*

115.17 *Revised and relocated as added 115.21.2 and 115.21.3 June 26, 1998*

115.18 *Revised and relocated as Exception No. 2 to added 115.19.1 and 115.21.1 June 26, 1998*

115.19 General

115.19.1 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, need not be subjected to this test. See also 177.7 and 178.6.1.

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.

115.19.1 added as revised and relocated from 115.1, 115.14, 115.16, and 115.18 June 26, 1998

115.19.2 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.

115.19.2 added as relocated from 115.13 June 26, 1998

115.19.3 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.

115.19.3 added as revised and relocated from 115.14 June 26, 1998

115.19.4 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.

115.19.4 added as revised and relocated from 115.8 and 115.11 June 26, 1998

115.19.5 Each device 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. If 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 115.19.3.

115.19.5 added as relocated from 115.3 June 26, 1998

115.19.6 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.

115.19.6 added as relocated from 115.5 June 26, 1998

115.19.7 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 115.19.8.

115.19.7 added as revised and relocated from 115.6 June 26, 1998

115.19.8 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.

115.19.8 added as relocated from 115.3 and 115.4 June 26, 1998

115.19.9 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.

115.19.9 added as revised and relocated from 115.12 June 26, 1998

115.19.10 In the event that unacceptable results are obtained in the machine testing described in 115.19.6 or 115.19.7, referee tests may be conducted manually under conditions similar to those described in 115.19.6 or 115.19.7.

115.19.10 added as relocated from 115.7 June 26, 1998

115.20 Current overload test

115.20.1 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 UL 1681, 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.

115.20.1 added as revised and relocated from 115.15 June 26, 1998

115.20.2 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.

115.20.2 added as revised and relocated from 115.9 and 115.10 June 26, 1998

115.21 Horsepower overload test

115.21.1 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.

115.21.1 added as revised and relocated from 115.18 June 26, 1998

115.21.2 For devices with standard configurations illustrated in UL 1681, the test current corresponding to the AC horsepower rating shall be as specified in Table 115.1. 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 the configurations C2.14, C2.15, C2.23, C2.30, C2.35, C2.36, C2.41 – C2.44, and C3.1 – C3.12 do not have assigned horsepower ratings and need not 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.

115.21.2 added as revised and relocated from 115.17 June 26, 1998

115.21.3 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.

115.21.3 added as revised and relocated from 115.17 June 26, 1998

Table 115.1
Test current (locked rotor amperes) for horsepower
rated NEMA configuration receptacles

Figure	AC HP rating ^a	LRA (amperes)	AC test voltage
C1.1	0.5	58.8	125
C1.2	1.5 ^b	60 66	250 208
C1.3	2 ^b	72 79.2	250 208
C1.4	2 ^b	72 79.2	250 208
C1.5	0.5	58.8	125
C1.6	1	96	125
C1.7	2	144	125
C1.8	2	144	125
C1.9	1.5 ^b	60 66	250 208
C1.10	2 ^b	72 79.2	250 208
C1.11	2 ^b	72 79.2	250 208
C1.12	3 ^b	102 112.2	250 208
C1.13	2	59.8	277
C1.14	2	59.8	277
C1.15	3	84.7	277
C1.16	5	139.4	277
C1.17	2 L-L ^b	72 79.2	250 208
	1 L-N	96	125
C1.18	2 L-L ^b	72 79.2	250 208
	2 L-N	144	125
C1.19	3 L-L ^b	102 112.2	250 208
	2 L-N	144	125
C1.20	2	40.8	250
C1.21	3	57.6	250
C1.22	3	57.6	250
C1.23	7.5	132	250

(Continued)

Table 115.1 (Cont'd)

Figure	AC HP rating ^a	LRA (amperes)	AC test voltage
C1.24	1.5 L-L ^b	60	250
		66	208
C1.25	0.5 L-N	58.8	125
	2 L-L ^b	72	250
C1.26		79.2	208
	1 L-N	96	125
C1.27	2 L-L ^b	72	250
		79.2	208
C1.28	2 L-N	144	125
	3 L-L ^b	102	250
C1.29		112.2	208
	2 L-N	144	125
C1.30	3 L-L ^b	102	250
		112.2	208
C1.31	2 L-N	144	125
	2	40.8	250
C1.32	3	57.6	250
C1.33	3	57.6	250
C1.34	7.5	132	250
C1.35	10	168	250
C1.36	2	44.9	208
C1.37	2	44.9	208
C1.38	3	63.4	208
	7.5	145.2	208
	7.5	145.2	208
C2.1	0.5	58.8	125
C2.2	2 ^b	72	250
		79.2	208
C2.3	0.5	58.8	125
C2.4	1	96	125
C2.5	2	144	125
C2.6	1.5 ^b	72	250
		79.2	208
C2.7	2 ^b	72	250
		79.2	208
C2.8	2 ^b	72	250
		79.2	208

(Continued)

Table 115.1 (Cont'd)

Figure	AC HP rating ^a	LRA (amperes)	AC test voltage
C2.9	2	59.8	277
C2.10	2	59.8	277
C2.11	3	84.7	277
C2.12	3	51	480
C2.13	5	84	480
C2.16	2 L-L ^b	72	250
		79.2	208
	1 L-N	96	125
C2.17	2 L-L ^b	72	250
		79.2	208
	2 L-N	144	125
C2.18	2	40.8	250
C2.19	3	57.6	250
C2.20	3	57.6	250
C2.21	5	45.6	480
C2.22	10	84	480
C2.24	2 L-L ^b	72	250
		79.2	208
	1 L-N	96	125
C2.25	2 L-L ^b	72	250
		79.2	208
	2 L-N	144	125
C2.26	3	57.6	250
C2.27	3	57.6	250
C2.28	5	45.6	480
C2.29	10	84	480
C2.31	2	44.9	208
C2.32	3	63.4	208
C2.33	5	45.6	480
C2.34	10	84	480
C2.37	2	44.9	208
C2.38	3	63.4	208
C2.39	5	45.6	480
C2.40	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.

116 Temperature Test

116.1 The temperature rise of a receptacle when measured at the points described in 116.2 shall not be more than 30EC (54EF) when the device is carrying its maximum rated current.

116.2 The temperature measurement mentioned in 116.1 is to be made on the wiring terminals of the device if they are accessible for the mounting of thermocouples. If the wiring terminals are inaccessible, or if the device has no wiring terminals, temperatures are to be measured at points as close to the face of the device as possible on the male blades of an attachment plug inserted in the outlet.

116.3 The temperature test is to be made following the overload test on the device and is to continue for 4 hours even though stabilized temperatures may be attained in a somewhat shorter interval of time. The generation of heat from sources other than the female contacts is to be minimized as much as possible. For example, each connection to the device being tested is to be made by means of a 6 inch (150 mm) or shorter length of Type RH or Type T wire that has an ampacity of at least equal to that of the device. The contacts of the device being tested 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 wires as described above. The terminals are to be tightened to the marked torque limit or, if no tightening torque is 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.

116.4 If a receptacle that has a current rating of 15 or 20 A at 125 or 250 V is provided with wiring terminals for through connection, the temperature rise of the terminals shall not be more than 30EC (54EF) when a current of 20 A is passed through both terminals.

116.5 The test is to be made in accordance with 116.3 but without a load on the receptacle contacts. Approximately 12 inch (300 mm) lengths of No. 12 AWG (3.3 mm²) wire are to be used for connections. Generally it will not be necessary to conduct the test on a receptacle that employs the conventional form of terminal plate with two wire-binding screws or pressure-wire connectors.

116.6 Temperature readings are to be obtained by means of thermocouples consisting of No. 28 – 32 AWG (0.8 – 0.032 mm²) iron and constantan wires with a potentiometer type of indicating instrument. This equipment will be used if a referee measurement of temperature is necessary.

117 Resistance to Arcing Test

Effective date for Section 117 changed from January 1, 1995 to January 1, 1998

117.1 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 115, 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 114.2) 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.

117.2 Alternatively one set of devices may be subjected to the 50 cycles of operation in the overload test described in Overload Test, Section 115, 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.

118 Fuseholder Temperature Test

Section 118 effective January 1, 1998

118.1 When tested as described in this Section, the temperature rise of a receptacle incorporating a fuseholder shall not exceed the following:

- a) 30EC (54EF) on the fuse clips when tested with a dummy fuse;
- b) 85EC (153EF) on the fuse clips when tested with a live fuse;
- c) 30EC (54EF) at the wiring terminals or cord connections at any time (see 118.7); and
- d) The relative thermal index of the surrounding insulating material, minus an assumed ambient of 25EC (77EF), at any time (see 118.7).

118.2 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 118.6 and 118.7).

Exception: The test may be conducted in conjunction with the Temperature Test, Section 116, if agreeable to all concerned.

118.3 The receptacles are to be wired in a series circuit as described in the Temperature Test, Section 116.

118.4 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.

118.5 The test is to continue for at least 4 hours even though stabilized temperatures may be attained in a somewhat shorter interval of time. A temperature is considered to be stabilized when three consecutive readings, taken at 5 minute intervals, indicate no further rise above the ambient temperature.

118.6 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.

118.7 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, UL 512. The dummy fuse size for devices employing miscellaneous, miniature and micro fuses is to be as indicated in Table 118.1. To represent the heating of a live fuse, 20EC (36EF) is to be added to the recorded temperature rise on the wiring terminals, cord connections, and surrounding insulating materials.

Table 118.1
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)

118.8 The thermocouples are to consist of Nos. 28 – 32 AWG ($0.08 - 0.032 \text{ mm}^2$) iron and constantan wires. It is a common practice to employ thermocouples consisting of No. 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.

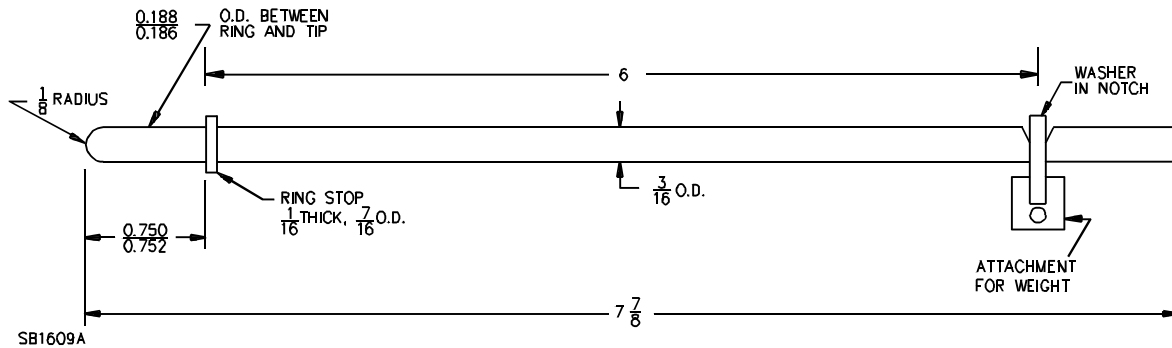
119 Grounding Contact Test

119.1 Grounding receptacles having the standard configurations indicated in Figures C1.5, C1.6, C1.9, C1.10, C1.13, C1.24 and C1.29, [U-shaped grounding pin clearance opening intended to receive an 0.184 – 0.190 by 0.843 inch (4.67 – 4.83 by 21.41 mm) maximum attachment plug grounding pin] are to be subjected to the tests in this Section.

119.2 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 No. 14 AWG (2.1 mm^2) copper conductor is to be connected to the receptacle grounding terminal.

119.3 With the receptacle oriented to create the maximum contact displacement (possible distortion of contact affecting its contact ability), the test pin A, Figure 119.1 is to be fully inserted in the grounding contact. A 5 lb (1.27 kg) weight is to be gradually suspended from 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 119.1
Test pin A



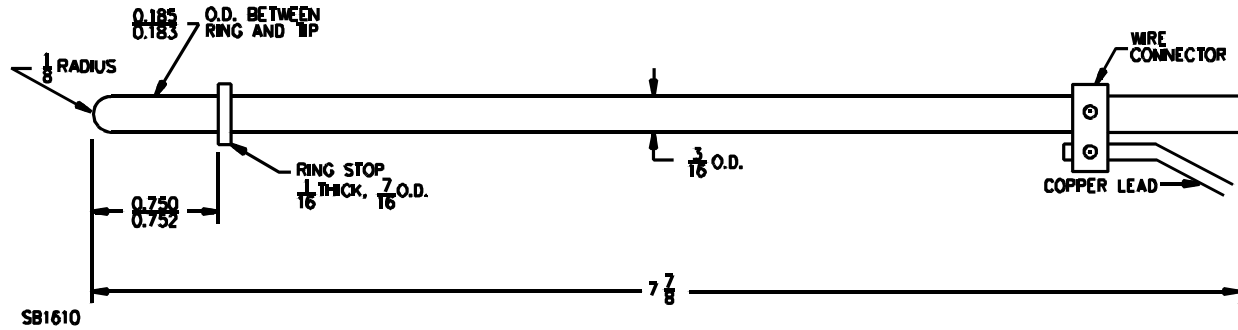
Pin material – tool steel, Rockwell Hardness C58 to C60

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

119.4 As a result of the test described in 119.3, 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.

119.5 Each device is then to be tested for electrical continuity between the receptacle grounding contact and the fully inserted test pin B, Figure 119.2. 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 the like, is to be used.

Figure 119.2
Test pin B



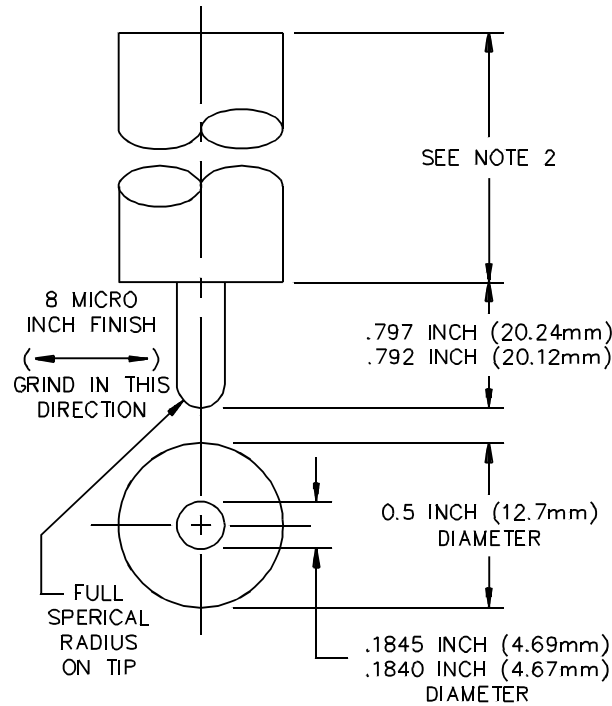
Pin material – solid brass rod.

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

119.6 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 Figures 119.3 and 119.4, for 1 minute each when fully inserted in the grounding pin opening.

Figure 119.3
2 oz (57 g) ground pin

(All dimensions in inches)



SB0704A

Material: Pin-Steel, Rockwell Hardness C58 to C60.
Handle – cold rolled steel

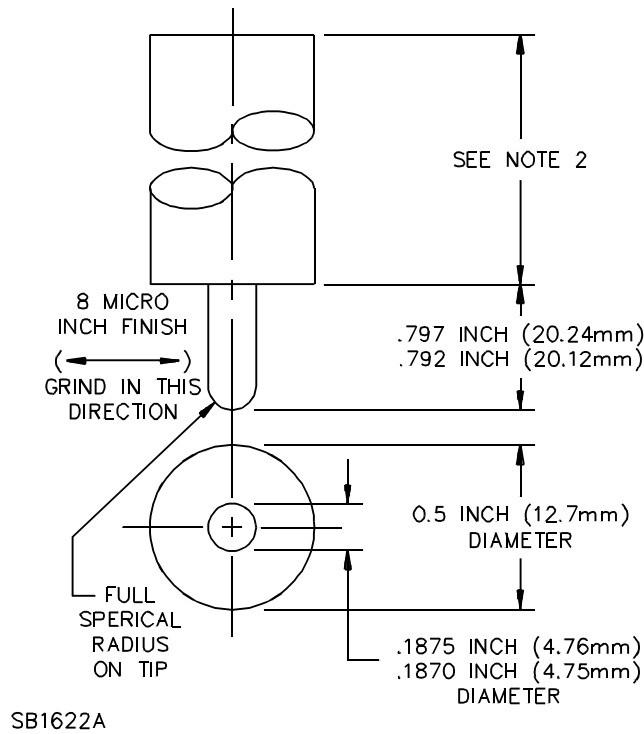
NOTES

- 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.

inch	0.1840	0.1845	0.792	0.797	0.5
mm	4.694	4.686	20.11	20.24	12.7
	microinch			8	
	micrometer			0.2	

Figure 119.4
4 oz (113 g) ground pin

(All dimensions in inches)



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.

inch	0.1870	0.1875	0.792	0.797	0.5
mm	4.750	4.763	20.11	20.24	12.7
	microinch		8		
	micrometer		0.2		

Push-In Terminals

120 Pullout Test

120.1 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 Pullout Test, Section 120 and Temperature Test, Section 121, 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.

120.2 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.

120.3 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 120.4.

120.4 Six conductors of the intended size, either solid or stranded or both (six each), are to be connected to the terminals in accordance with the manufacturer's instructions. Each assembly is to be subjected to a pull on the wire that is to be gradually increased to 5 lbf (22 N).

121 Temperature Test

121.1 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 30EC (54EF) based on an ambient temperature of 25EC (77EF).

121.2 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.

121.3 The assemblies described in 121.2 are to be tested for 30 days without interruption. The device temperature is to be measured at the end of each working day.

121.4 The test described in this Section may be conducted in conjunction with the temperature test described in 116.1 – 116.3.

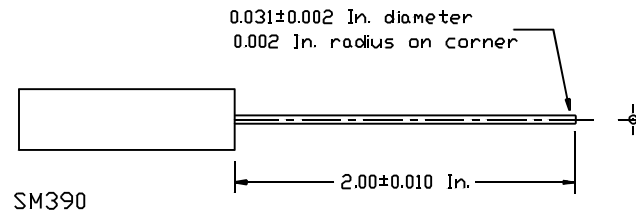
Tamper-Resistant Receptacles

122 Probe Test

122.1 A tamper-resistant receptacle shall not permit contact to be made between the probe shown in Figure 122.1 and any live part of the receptacle through the outlet slots when tested as described in this Section.

122.2 Twelve previously untested devices are to be used for this test. The probe is to be applied to each of the outlet slot openings of the receptacle with a force of 8 ounces (1 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.

Figure 122.1
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

123 Impact Test

123.1 A tamper-resistant receptacle shall withstand the 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 123.2. The receptacle shall be capable of functioning as intended after completion of the test.

123.2 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 122; and
- c) Subjected to the Dielectric Withstand Test described in Section 125.

123.3 Six devices which were previously subjected to the Probe Test are to be used. The devices are to be mounted in a single gangable metallic flush outlet box fastened to a frame as shown in Figure 123.1. A nonmetallic flush device cover plate is to be installed on the receptacle in the intended manner. The frame shown in Figure 123.1 is to be clamped firmly in place or otherwise provided with rigid support to not permit movement during the application of the impact force.

123.4 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). The steel sphere is to be suspended by a cord and swung as a pendulum as shown in Figure 123.2, dropping through the vertical distance necessary to cause it 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 123.1
Test frame

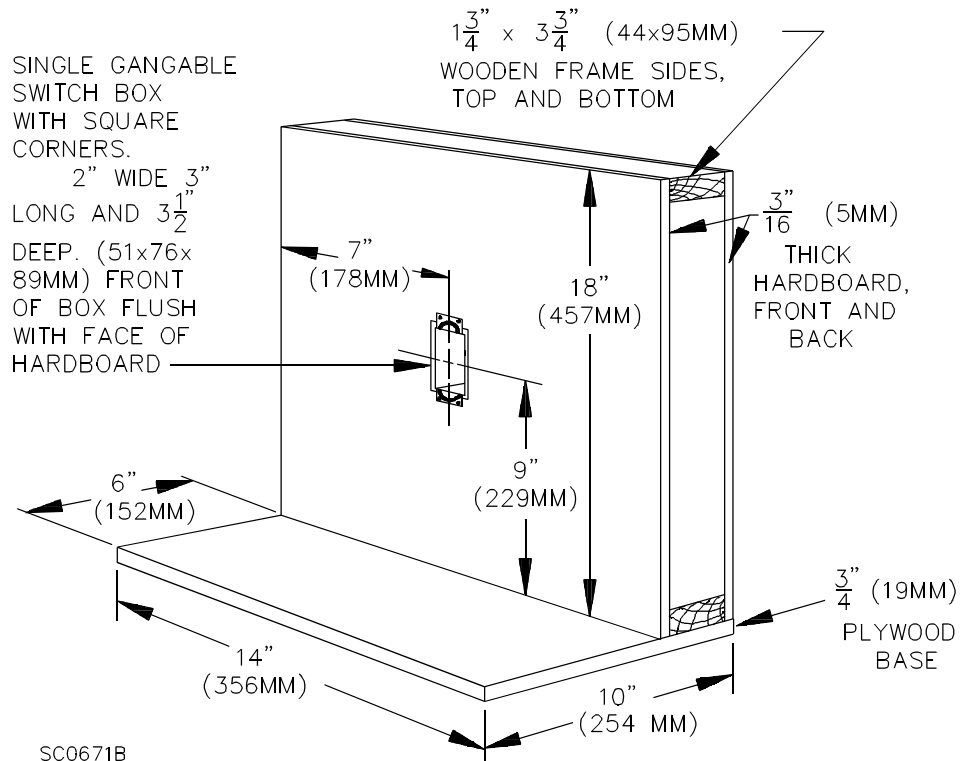
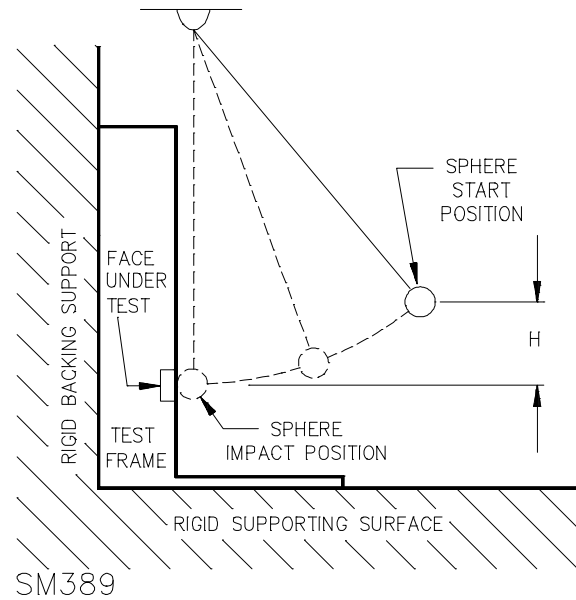


Figure 123.2
Ball impact test

Figure 123.2 revised June 26, 1998



NOTES

- 1) H indicates the vertical distance the sphere must travel to produce the desired impact.
- 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.

124 Mechanical Endurance Test

124.1 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 124.2. The tamper-resistance mechanism shall be capable of performing its intended function.

124.2 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 122; and
- c) Subjected to the Dielectric Withstand Test described in Section 125.

124.3 Six devices which were previously subjected to the Probe Test described in Section 122 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. If 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.

124.4 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.

124.5 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.

125 Dielectric Withstand Test

125.1 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.

125.2 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.

Pin-Type or Insulation-Displacement Terminals

126 Heat Cycling and Vibration Tests

Section 126 effective January 1, 1998

126.1 General

126.1.1 Following the Heat Cycling and Vibration Tests described in this Section, each fixture, equipment, or appliance outlet shall comply with the thermal stability criteria described in 126.5.1 and not have demonstrated a temperature rise of more than 100EC (180EF).

126.1.2 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.

126.1.3 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.

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126.1.4 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.

126.1.5 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.

126.2 Heat cycling test

126.2.1 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.

126.2.2 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.

126.2.3 Temperature readings are to be obtained by means of thermocouples consisting of No. 28 – 32 AWG (0.08 – 0.032 mm²) iron and constantan wires. It is a common practice to employ thermocouples consisting of No. 30 AWG (0.05 mm²) 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.

126.2.4 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.

126.3 Vibration test

126.3.1 Following approximately 125 cycles of heat cycling as described in 126.2.1 – 126.2.4, the three devices mounted to the test rack are to be disconnected from the circuit and subjected to vibration testing as described in 126.3.2.

126.3.2 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.

126.3.3 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 126.4.1, for a total of 500 cycles.

126.4 Heat cycling test (Continued)

126.4.1 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).

126.5 Calculations

126.5.1 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 126.2.4 and 126.4.1), 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 10EC (18EF). There shall not be a temperature rise greater than 100EC (180EF) above the room ambient temperature on any device during the heat cycling test.

Hospital Grade Receptacles

127 General

127.1 A Hospital Grade receptacle is to be subjected to the tests described in Sections 60 – 68, 119, 128 – 136, and Supplement SA. Unless otherwise stated, previously untested devices are to be used for each test.

127.1 revised June 26, 1998

127.2 The Hospital Grade attachment plugs necessary to perform the tests in Grounding Contact Temperature Test, Section 129, Resistance Test, Section 130, and Fault Current Test, Section 131, shall have a U-shaped grounding pin.

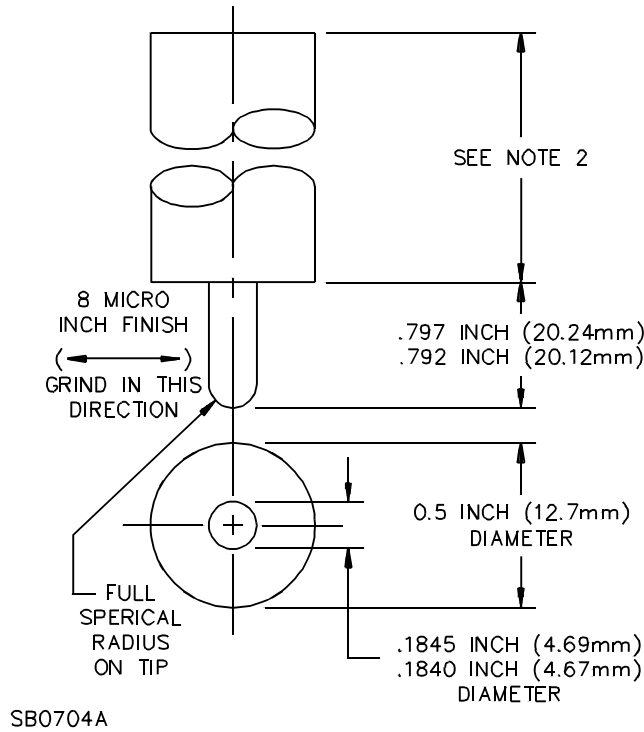
128 Abrupt Plug Removal Test

128.1 A Hospital Grade receptacle shall retain the test pin illustrated in Figure 128.1 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.

128.2 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, without displacement, the fully inserted test pin illustrated in Figure 128.1 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.

Figure 128.1
Standard grounding pin

Figure 128.1 revised June 26, 1998



NOTES

- 1) All dimensions in inches.
- 2) Length not specified.
- 3) Total tool weight of 4 oz (113 g).
- 4) Hardened steel pin.

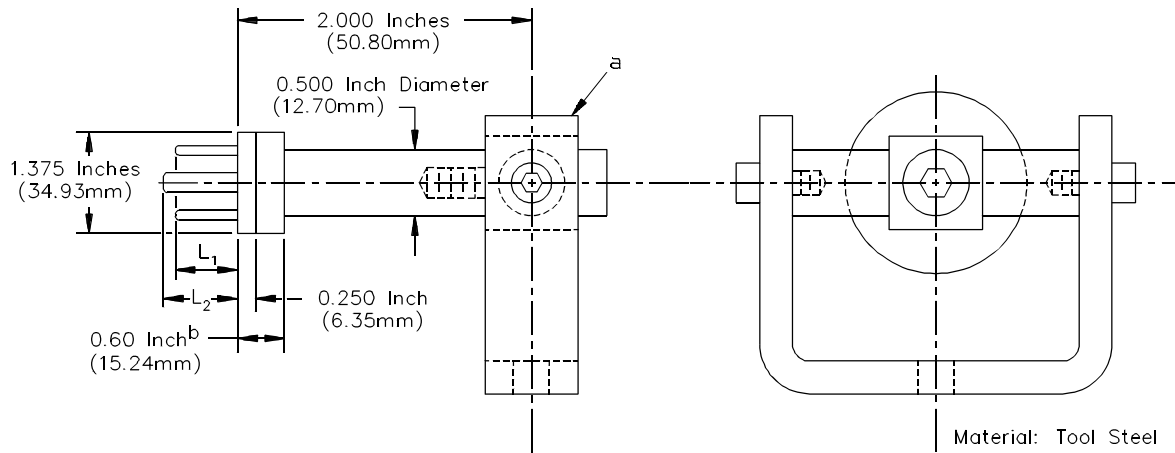
microinch	8
nanometer	200

128.3 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 128.5 and 128.6.

128.4 The outlets tested as described in 128.2 and subsequently mounted as described in 128.3 are to then each be subjected to a series of abrupt removals of the test plug illustrated in Figure 128.2 as follows. 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 128.3). The applied force shall cause the removal of the test plug in one continuous motion. New blades are to be used in the test plug for each abrupt removal.

Figure 128.2
Typical test plug for abrupt plug removals

Figure 128.2 revised June 26, 1998



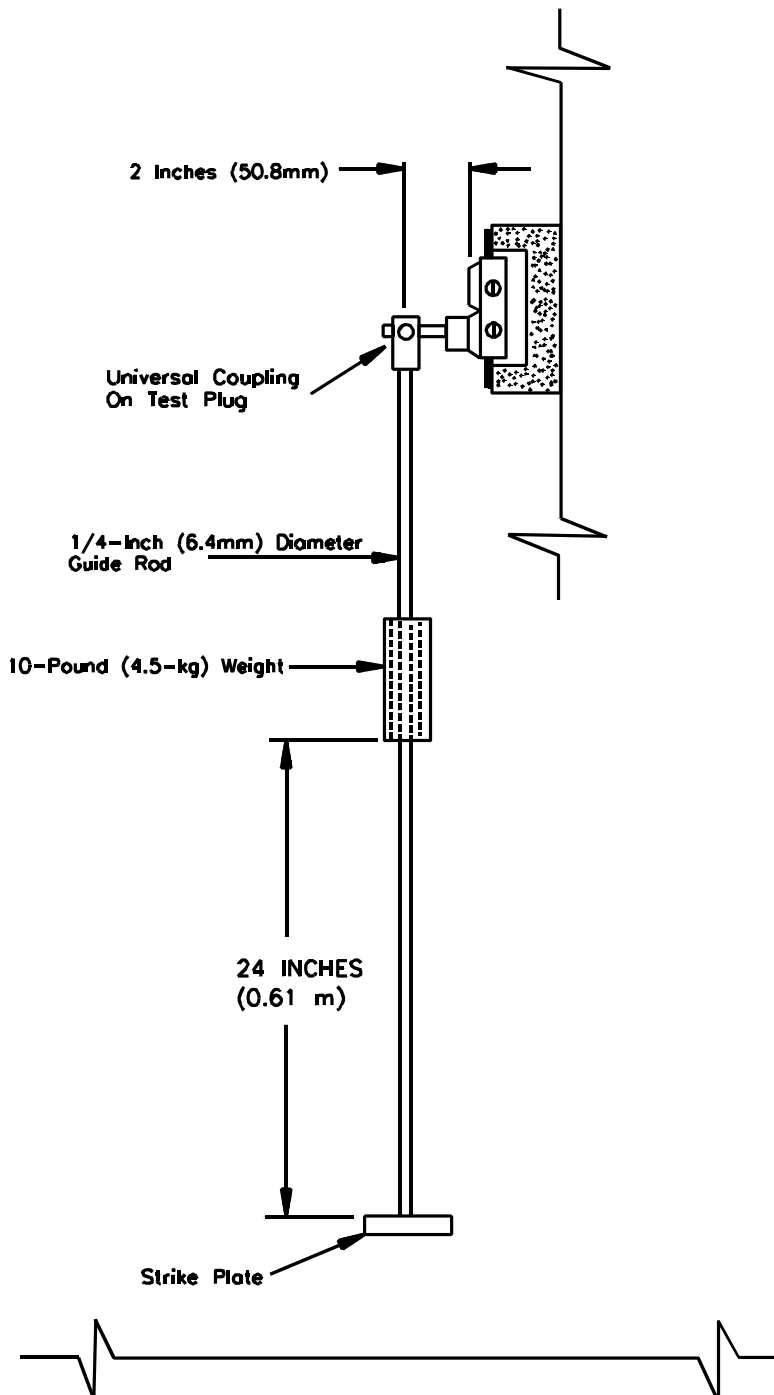
NOTES:

- 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.

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Figure 128.3
Test set-up for abrupt removals test



128.5 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.

128.6 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.

128.7 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.

128.8 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.

128.9 After the conditioning described in 128.2 and the abrupt plug removals described in 128.4 – 128.6, each outlet shall retain without displacement the fully inserted test pin illustrated in Figure 128.1 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.

128.10 In addition to retaining the fully inserted test pin as described in 128.9, 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 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.

129 Grounding Contact Temperature Test

129.1 The acceptability of the grounding path in a Hospital Grade receptacle shall be demonstrated by a temperature rise not exceeding 30EC (54EF) when subjected to the test described in this Section.

129.2 The devices previously subjected to the Abrupt Plug Removal Test in Section 128 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 No. 12 AWG (3.3 mm²) solid copper wire. Attachment plugs are to be wired using No. 12 AWG (3.3 mm²) 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 30EC (54EF) at any time.

130 Resistance Test

130.1 The total resistance between the mated attachment plug grounding terminal and receptacle grounding terminal shall not exceed 0.01 ohms when tested as follows.

130.2 The devices previously subjected to the Grounding Contact Temperature Test, Section 129 are to be used for this test.

130.3 Compliance with 130.1 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.

131 Fault Current Test

131.1 When 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.

131.2 The devices previously used for the Resistance Test, Section 130 are to be used for this test.

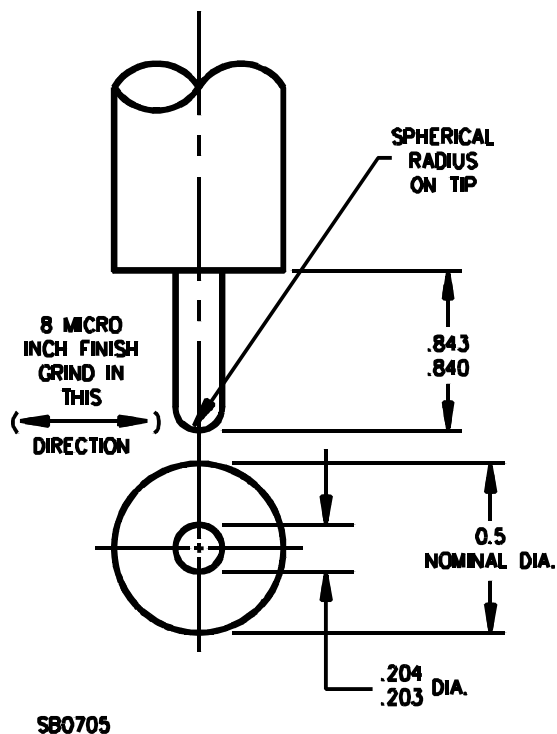
131.3 Each receptacle is to be tested on a circuit capable of delivering 1000 A through shorted bus bars. The line and ground terminal of each receptacle is to be wired to the test terminals using a total of 4 ft (1.22 m) of No. 12 AWG (3.3 mm²) wire with the receptacle installed in a flush device box 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 grounding-type Hospital Grade attachment plug with a 2 ft (0.61 m) length of flexible cord having No. 14 AWG (2.1 mm²) conductors with the bared ends of the ungrounded and grounding conductors twisted and soldered together. Each receptacle is to be tested once.

132 Grounding Contact Overstress Test

132.1 A receptacle is to be capable of retaining the standard test pin shown in Figure 128.1 for at least 1 minute without displacement following the conditioning described in 132.2. There shall not be any breakage that adversely affects the integrity of the enclosure of live parts.

132.2 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 132.1. 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 132.1
Oversize grounding pin



NOTES

- 1) All dimensions in inches.
- 2) Length not specified for tool handle.
- 3) Hardened steel pin.

	0.204		0.843
inch	0.203	0.5	0.840
mm	5.18	13	21.41
	5.16		21.34
microinch		8	
nanometers		200	

133 Terminal Strength Test

133.1 The terminal strength is to be evaluated by the method in this Section following which there shall not be any damage to the terminals or receptacle. There shall not be any visible displacement of the wires following the test pull applied as described in 133.3.

133.2 The terminals of three untested devices are to be wired with a solid copper No. 12 AWG (3.3 mm²) conductor by applying a tightening torque of 14 in-lbf (1.6 N•m) to the terminal. Each termination is then to be disassembled and the test repeated four additional times using newly stripped wire for each test.

133.3 Each terminal is to be subjected to a straight 20 lbf (89 N) pull applied to each wire for 1 minute.

133.4 Back-wired terminals intended for one or more wires to be clamped under the same pressure plate and secured by the action of a single screw are to be tested as follows:

- a) One device with one wire in one wire entrance hole,
- b) One device with one wire in the other entrance hole, and
- c) One device with one wire in each of the two entrance holes, at the same time.

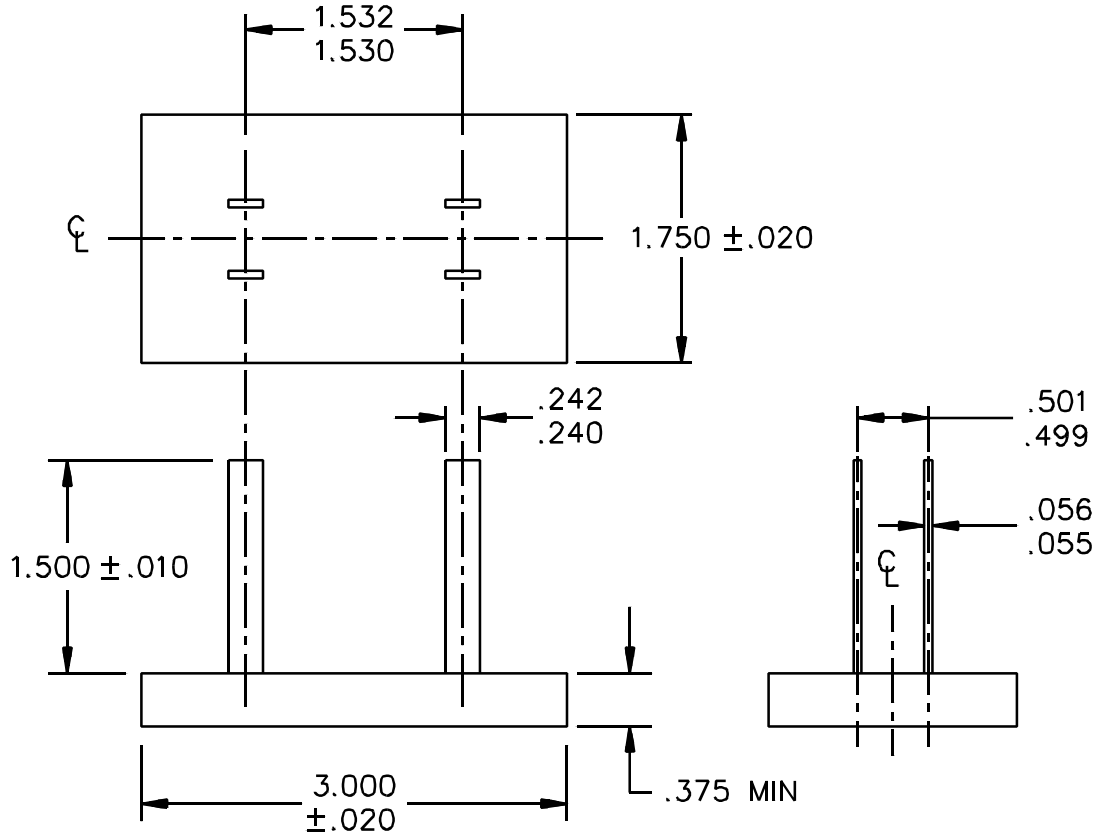
133.5 Receptacles with provision for both back and side wiring, are to be tested using three terminals back wired and three terminals side wired.

134 Assembly Security Test

134.1 A duplex Hospital Grade receptacle rated 15 or 20 A shall withstand the application of a 100 lbf (445 N) using a pushout tool as shown in Figure 134.1 having blade projections matching the line-slot configuration of the receptacle. The force is to be applied to each of three previously untested receptacles supported on the test fixture shown in Figure 134.2 for at least 10 seconds without any indication of body breakage or permanent deformation of the yoke.

**Figure 134.1
Pushout tool**

(All dimensions in inches)



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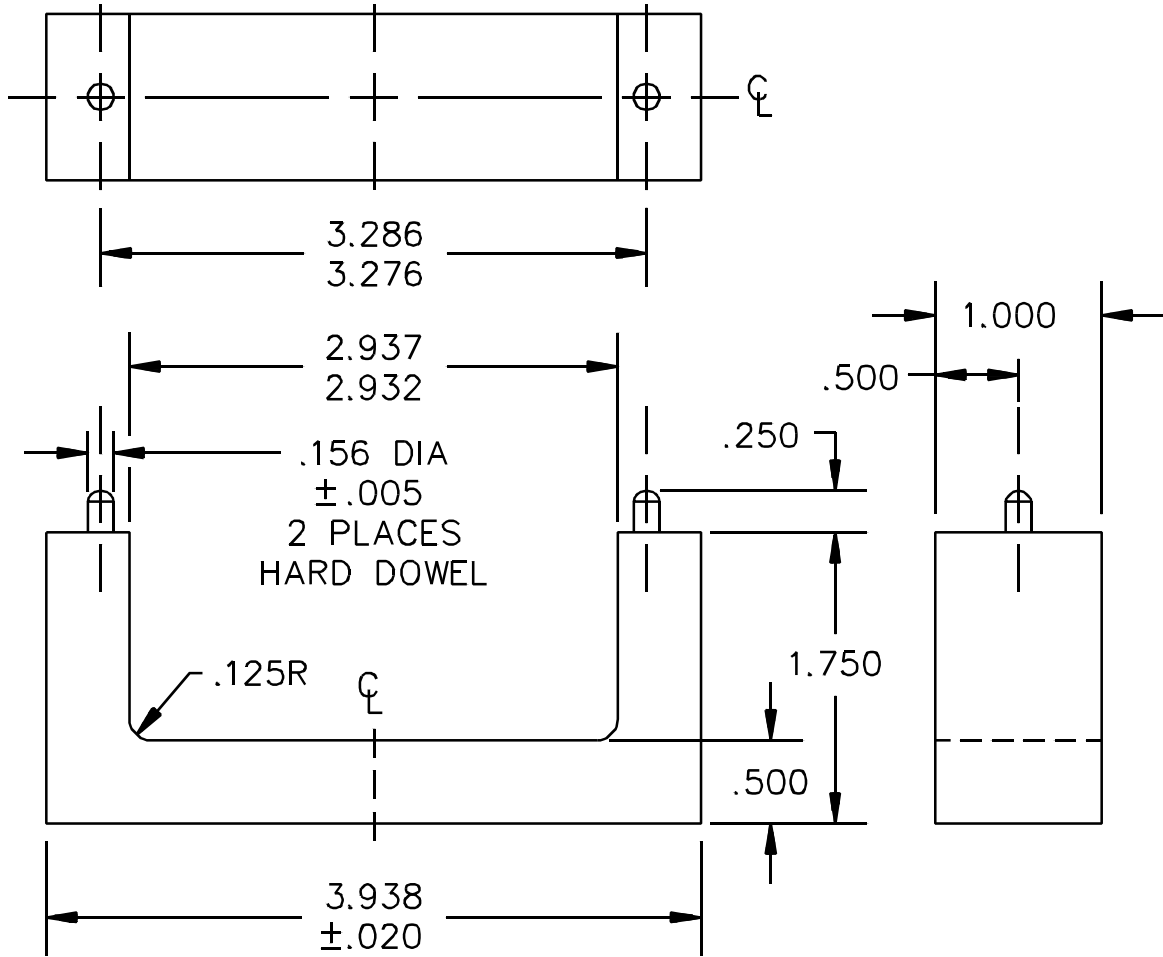
NOTES

- 1) Blades – Steel, Rockwell Hardness C58 to C60. Sharp edges removed to a maximum radius of 0.015 inch (0.38 mm). Fastened to base in rigid manner.
- 2) Base – Cold rolled steel.
- 3) Tolerances – Unless otherwise specified $\pm 1/32$ inch (0.8 mm).

	<u>0.056</u>	<u>0.242</u>		<u>0.501</u>		<u>1.532</u>		
inch	0.055	0.240	0.375	0.499	1-1/2	1.530	1-3/4	3
mm	1.42	6.15	9.53	12.73	38.1	38.91	44.5	76.2
	<u>1.40</u>	<u>6.10</u>		<u>12.68</u>		<u>38.86</u>		

Figure 134.2
Receptacle test fixture

(All dimensions in inches)



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NOTE –

1) Tolerances – Unless otherwise specified ±0.005 inch (0.13 mm) for decimals and ±1/32 inch (0.8 mm) for fractions.

							<u>2.937</u>	<u>3.286</u>	
inch	0.125	0.156	1/4	1/2	1.156	1-3/4	2.932	3.276	3-15/16
mm	3.18	3.96	6.4	12.7	29.36	44.5	<u>74.60</u>	<u>83.46</u>	100.0
							74.47	83.21	

135 Impact Test

135.1 A Hospital Grade 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.

135.2 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.

136 Mold Stress Relief Test

136.1 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.

136.2 The unwired receptacles are to be placed in a circulating air oven for 7 hours at 90EC (194EF). The devices are to be removed from the oven and allowed to cool to room temperature before determining compliance.

Self-Contained Receptacles

137 General

137.1 A self-contained receptacle is to be subjected to the tests described in Sections 60 – 68, 113 – 119, and 138 – 149.

Exception: A self-contained receptacle having one of the configurations illustrated in Figures C1.5, C1.6, C1.9, or C1.10 shall be subjected to the tests described in Sections 60 – 68, 119, 138 – 149 and in Supplement SA.

137.1 revised June 26, 1998

137.2 For self-contained receptacles employing insulation displacement terminals, the Temperature Test, Section 116 is to be performed following the Pullout Test in Section 139.

138 Heat Cycling and Vibration Tests

138.1 General

138.1.1 Following the Heat Cycling and Vibration Tests described in this section each receptacle shall:

- a) Meet the thermal stability criteria described in 138.4.1 and
- b) Not have displayed a temperature rise of more than 100EC (180EF).

Exception: Self-contained receptacles for connection to only copper wire employing crimp, screw-terminal, or pressure-wire connector constructions need not be tested for heat cycling or vibration.

138.1.2 Ten self-contained receptacles rated 15 A are to be assembled onto two conductor No. 14 AWG nonmetallic sheathed cable with ground and copper conductors. Ten devices rated 20 A are to be assembled onto two-conductor No. 12 AWG nonmetallic sheathed cable with ground and copper conductors.

138.1.3 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 138.2.2 and 138.2.3 (mentioning splice and nonsplice connections). See 138.3.2 – 138.3.4 for devices to be vibration tested.

138.2 Heat cycling test

138.2.1 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 No. 12 AWG cable and 40 A for those devices being tested with No. 14 AWG cable.

138.2.2 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).

138.2.3 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 No. 14 AWG (2.1 mm²) copper wire soldered in place or No. 12 AWG (3.3 mm²) 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.

138.2.4 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 40 cycles for a total of three measurements (120 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.

138.2.5 Temperature readings are to be obtained by means of thermocouples consisting of No. 28 – 32 AWG (0.08 – 0.032 mm²) iron and constantan wires. It is a common practice to employ thermocouples consisting of No. 30 AWG (0.05 mm²) iron and constantan wires with a potentiometer type of indicating instrument. This equipment will be used if a referee measurement of temperature is necessary.

138.3 Vibration test

138.3.1 Following approximately 125 cycles of heat cycling (as described in 138.2.1 – 138.2.5), six devices from each group of ten (for a total of 12) are to be disconnected from their circuit and subjected to vibration conditioning.

138.3.2 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.

138.3.3 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 used.

138.3.4 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.

138.3.5 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.

138.3.6 At the conclusion of the Vibration Test in 128.3.1 – 138.3.5, 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).

138.4 Calculations

138.4.1 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 138.2.4) 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 10EC (18EF). There shall not be a temperature rise greater than 100EC (180EF) above the room ambient temperature on any device during the Heat Cycling Test.

139 Cable Pullout Test

139.1 After being subjected to the Cable Pullout Test in 139.2, there shall not be:

- a) Any visible indications of conductor pullout,
- b) Damage to the cable insulation, and
- 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.

139.2 Six receptacles rated 15 A are to be installed onto two-conductor No. 14 AWG copper cable with ground, and six receptacles rated 20 A installed onto No. 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.

140 Conductor Pullout Test

140.1 Following the test pull described in 140.2, no conductor shall be displaced from its connection(s).

140.2 Three devices rated 15 A are to be installed with a single No. 14 AWG (Type TW) copper conductor connected to each terminal. Three devices rated 20 A are to be similarly installed but with a single No. 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.

141 Mounting Strength Test

141.1 General

141.1.1 Following the test in 141.4.1, each receptacle shall not experience;

- 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.

141.2 Receptacles mounted directly in panels

141.2.1 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 141.4.1.

141.3 Receptacles supported by mounting brackets

141.3.1 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 141.4.1.

141.4 Testing

141.4.1 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.

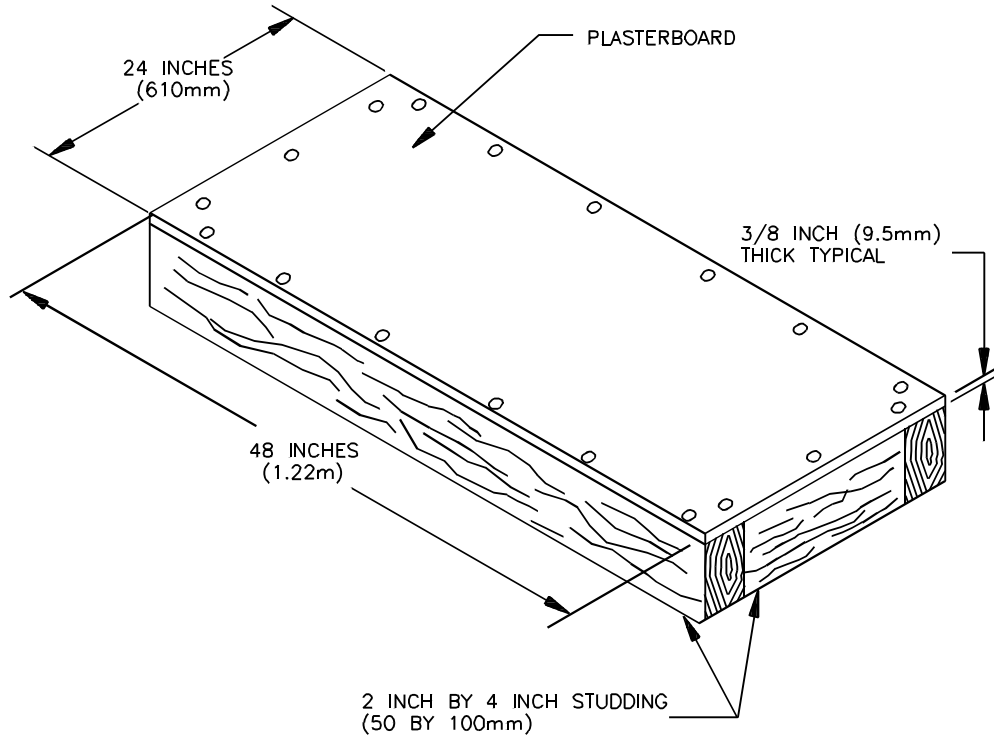
142 Wall-Mounting Secureness Test

142.1 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).

142.2 Three devices are to be tested following their installation, as shown, in the test wall illustrated in Figure 142.1. 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.

Figure 142.1
Test wall

Figure 142.1 revised June 26, 1998



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142.3 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 142.2. 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.

143 Assembly Security Test

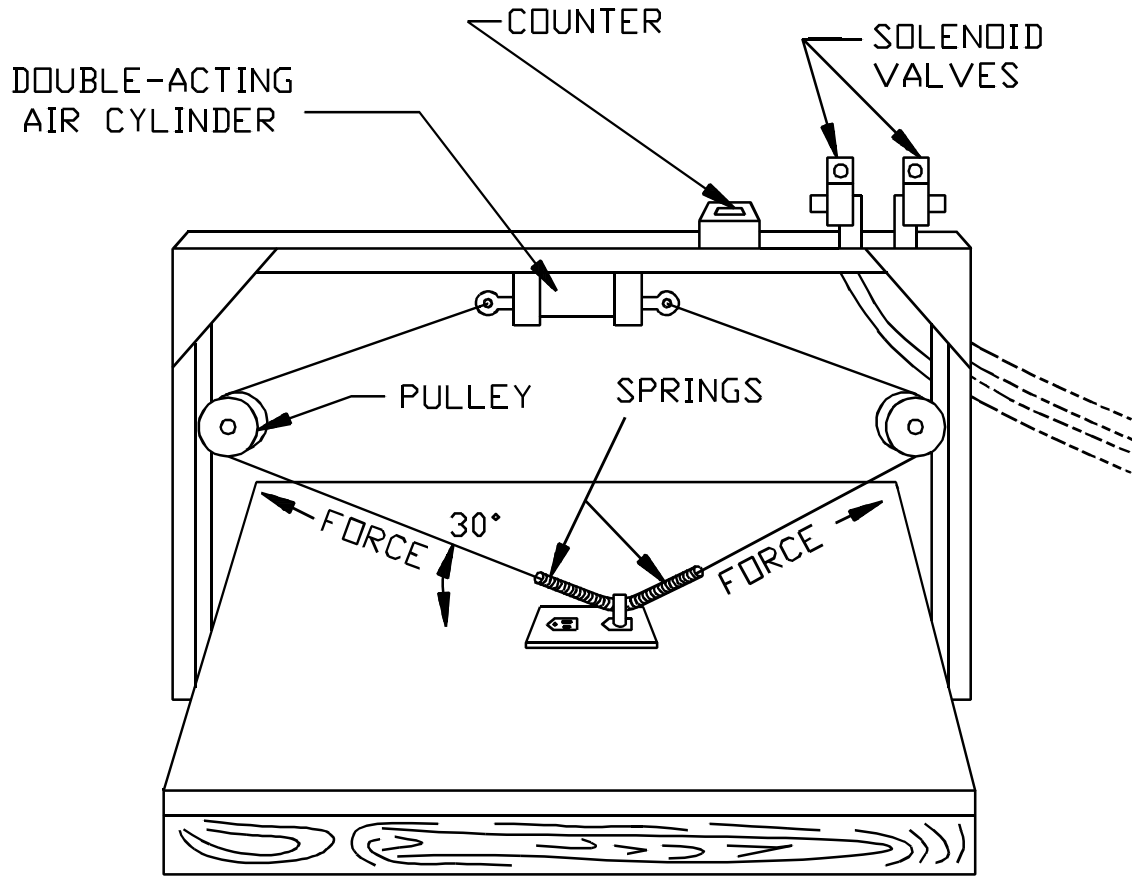
143.1 Method A

143.1.1 Following the Assembly Security Tests in 143.1.1 and 143.2.1 (Methods A and B, respectively) there shall not be any mechanical breakage of the receptacle or separation of the face and rear portions that would interfere with the intended functioning of the device.

143.1.2 Three devices are to be mounted as illustrated in Figure 143.1. A 100 lbf (445 N) is to be applied as shown by means of a rigid steel push-out tool, as illustrated in Figure 143.2, inserted into the slots of the receptacles.

Figure 142.2
Wall mounting secureness test

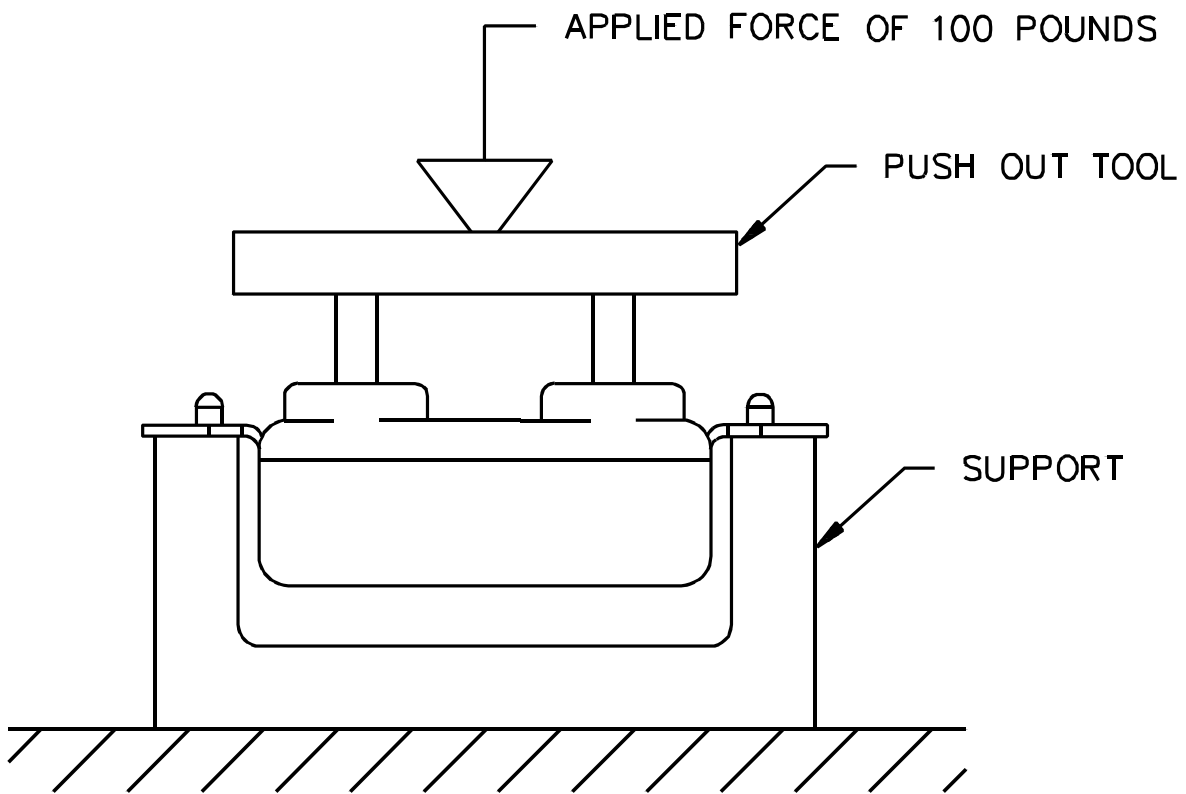
Figure 142.2 revised June 26, 1998



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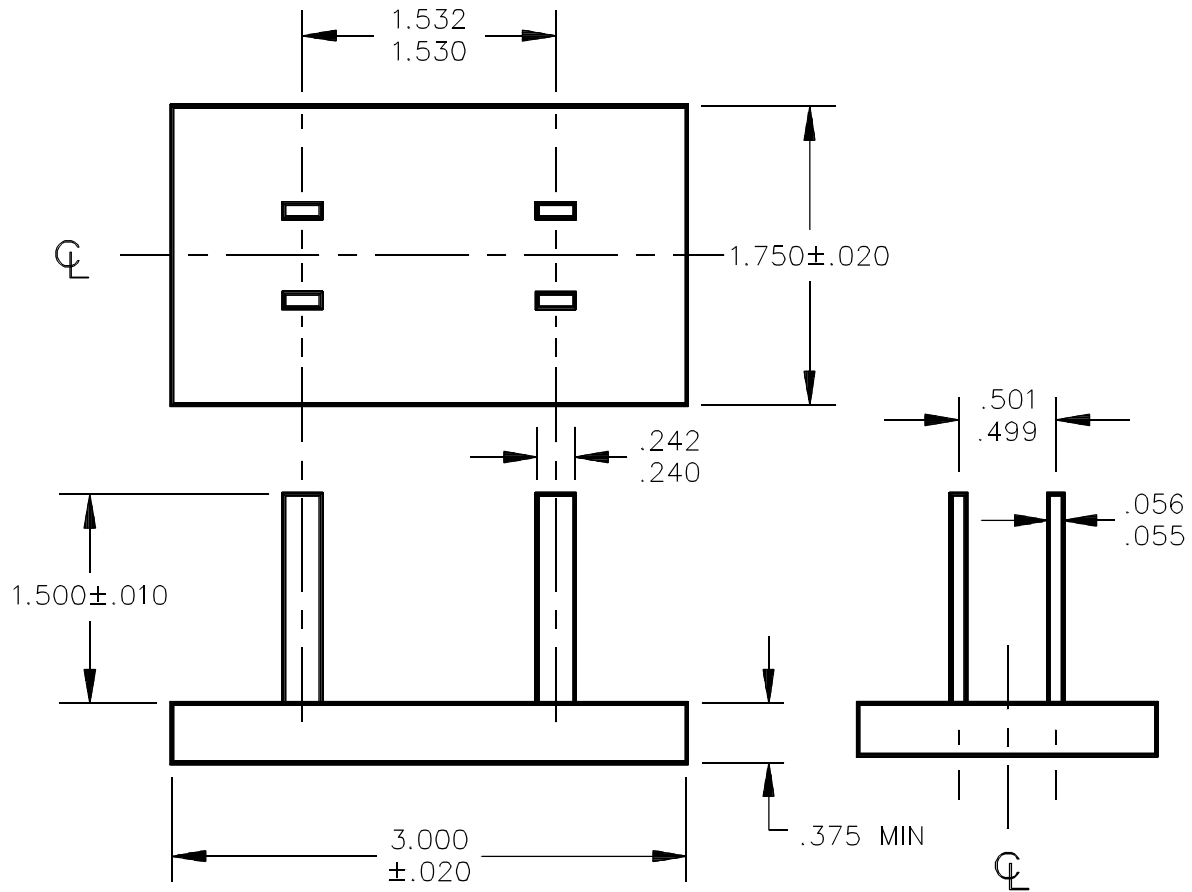
Figure 143.1
Application of assembly security test



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Figure 143.2
Fixture for assembly security test

(All dimensions in inches)



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143.2 Method B

143.2.1 Six receptacles rated 15 A are to be installed on two conductor No. 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 devices rated 20 A are to be similarly tested using two conductor No. 12 AWG copper cables with ground. The force is to be applied for one minute.

143.2.2 The receptacles are to be examined for compliance with 143.1.1 within 5 minutes after the removal of the force.

144 Field Replacement Test

144.1 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.

144.2 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.

145 Fault Current Withstand Test

145.1 When subjected 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.

145.2 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 m) 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.

146 Knockouts Test

146.1 Knockouts 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.

146.2 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.

147 Creep Test

147.1 Self-contained receptacles shall be capable of withstanding the Cable Pullout Test described in Section 139 following the oven conditioning described in 147.2.

147.2 The 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 90EC (194EF).

148 Mold Stress Test

148.1 Following the aging conditioning described in 148.2, there shall not be:

- a) A change in any overall dimension greater than 10 percent and
- b) An opening larger than 1/32 inch (0.8 mm) at any joint

once the device has cooled to room temperature.

148.2 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 90EC (194EF). Upon cooling to room temperature, the joint openings are to be measured after installation on cable as intended.

149 Specimen Flammability Test

149.1 General

149.1.1 Insulating materials of a self-contained receptacle, other than the acceptable materials specified in Table 40.1, 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 $90.0 \pm 1.0\text{EC}$ ($194.0 \pm 1.8\text{EF}$) using Method A, and
- c) Five in the as-received state using Method B.

149.2 Method A

149.2.1 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.

149.2.1 revised (date of publication)

149.3 Method B

149.3.1 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.

149.3.1 revised (date of publication)

CURRENT TAPS AND ADAPTERS

All Devices

150 General

150.1 The performance of a current tap or adapter is to be investigated by means of the tests described in Sections 60 – 68, and 151 – 167.

151 Security of Blades Test

151.1 *Relocated as added 151.5.1 June 26, 1998*

151.2 *Relocated as added 151.5.2 and 151.5.3 June 26, 1998*

151.3 *Relocated as added 151.5.4 June 26, 1998*

151.4 *Relocated as added 151.5.2 June 26, 1998*

151.5 General

151.5.1 The blades and pins of a current tap or adapter rated 15 A or less, and 250 V or less, shall be capable of withstanding a pull of 20 lb (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.

151.5.1 added as relocated from 151.1 June 26, 1998

151.5.2 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 that will permit the blades, pins, or both to pass through it. 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.

151.5.2 added as relocated from 151.2 and 151.4 June 26, 1998

151.5.3 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.

151.5.3 added as relocated from 151.2 June 26, 1998

151.5.4 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.

151.5.4 added as relocated from 151.3 June 26, 1998

151.6 Self-hinged current taps

151.6.1 If the current tap employs a self-hinge that is relied upon to hold the plug face in place, the tests described in 151.5.1 – 151.5.4 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, Section 154A.

151.6.1 added June 26, 1998

152 Secureness-Of-Cover Test

152.1 The disc or separable cover of a current tap or adapter shall remain capable of being mechanically secured after 5 cycles of removal and replacement and after conditioning as described in 152.2.

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

153 Torque Test

153.1 A medium-base screw base that is part of an adapter shall not turn, pull off, or become loose or distorted enough to affect the assembly adversely when a torque of 20 lbf-in (2.3 N•m) is applied to the screw base for 1 minute. A torque of 10 lbf-in (1.1 N•m) is to be used for a body (adapter) of a separable attachment plug.

153.2 The screw base is to be tested by means of a screw shell (threaded receptacle) that can be screwed onto the screw base and to which the prescribed value of torque can be imparted.

154 Integrity of Assembly Test

154.1 *Revised and relocated as added 154.3.1 June 26, 1998*

154.2 *Relocated as added 154.3.3 June 26, 1998*

154.3 General

154.3.1 A current tap intended for use on flexible cord 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 and 13.4 need not 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 need not be subjected to this test.

Exception No. 3: A current tap employing pin-type terminals instead shall be subjected to the Assembly Test, Section 163.

154.3.1 added as revised and relocated from 154.1 June 26, 1998

154.3.2 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 180.2.

154.3.2 added June 26, 1998

154.3.3 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 No. 18 AWG (0.82 mm²) or larger conductors; and
- b) 20 lbf (89 N) for a cord with conductors smaller than No. 18 AWG (0.82 mm²)

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

154.3.3 added as relocated from 154.2 June 26, 1998

154.4 Self-hinged current taps

154.4.1 If the current tap employs a self-hinge that is relied upon to hold the flexible cord in place, the tests described in 154.1.1 – 154.1.3 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 154A.

154.4.1 added June 26, 1998

154A Self-Hinge Flexing Test

Section 154A added June 26, 1998

154A.1 A self-hinge that is relied upon to maintain the integrity of the enclosure or strain relief after a current tap is assembled shall not break, crack or experience other damage as a result of this test.

154A.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 100EC (212EF); and
- c) Group 3 - Cold conditioned for 2 hours at -10EC (14EF) and allowed to return to room temperature.

154A.3 The hinge of each device shall be completely opened and closed for 100 cycles of operation.

155 Contact Security Test

155.1 The female contacts of a current tap shall remain inaccessible to contact after the current tap has been tested as described in this section.

155.2 A current tap having blades for connection to 2-pole, 2-wire outlets rated 15 A, 125 V 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 and/or breakage of the enclosure. 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.

155.3 The same devices are to be retested as described in 155.2 subjecting both blades, in combination, to a single applied force of 40 lbf (178 N) for a period of 1 minute.

156 Temperature Test

Section 156 revised and combined with Section 159 effective January 1, 1998

157 Retention of Plugs Test

157.1 The contacts of the current taps and adapters illustrated in Figures C1.1, C1.5, C1.6, C1.9, and C1.10 shall be capable of holding an attachment plug so that a force of 3 – 15 lbf (13 – 67 N) is required to withdraw the plug when tested as described in this Section.

Exception: A device that has provision for locking the plug in place after the blades have been inserted in the female contacts need not be subjected to this test.

157.2 Each device is to be subjected to ten conditioning cycles of insertion and withdrawal of a standard solid-blade attachment plug of a type with which the device is intended for use and that has American National Standard detent holes in rigidly mounted blades, following which the plug is to be fully reinserted into the device. A pull of 3 lbf (13 N) in a direction perpendicular to the plane of the face of the outlet device and tending to withdraw the plug from the device is then to be applied to the plug for 1 minute. The results are unacceptable if there is any displacement of the plug.

157.3 The current tap or adapter is then to be subjected to the regular overload and temperature tests, following which the entire procedure described above is to be repeated. In the repeated test, the results are unacceptable if the plug is displaced by the 3 lbf (13 N) pull, but it is required that the cap be withdrawn when the pull is increased to 15 lbf (67 N). If the device is intended to accommodate either a 2- or 3-wire plug, the entire procedure described above is to be performed with a 2-wire plug, after which a 3-wire plug inserted into the device is required to be withdrawn by a 15 lbf (67 N) pull.

157.4 For multi-configuration travel adapters, separate sets of six representative adapters are to be tested. The number of sets is to be determined by the number of attachment plug configurations that may be used by the representative travel adapter. Each set of six representative multi-configuration travel adapters is to be tested using a different attachment plug configuration considered representative of those that are identified for use with the adapter.

157.4 added November 5, 1997

158 Overload Test

158.1 *Revised and relocated as added 158.16 June 26, 1998*

158.2 *Revised and relocated as the Exception to added 158.16 June 26, 1998*

158.3 *Revised and separated into added 158.20 and 158.8.23 June 26, 1998*

158.4 *Relocated as added 158.23 June 26, 1998*

158.5 *Relocated as added 158.21 June 26, 1998*

158.6 *Revised and relocated as added 158.22 June 26, 1998*

158.7 *Relocated as added 158.27 June 26, 1998*

158.8 *Relocated as added 158.19 June 26, 1998*

158.9 *Revised and relocated as added 158.25 June 26, 1998*

158.10 *Relocated as the Exception to added 158.25 June 26, 1998*

158.11 *Relocated as added 158.19 June 26, 1998*

158.12 *Revised and relocated as added 158.26 June 26, 1998*

158.13 *Revised and relocated as added 158.17 June 26, 1998*

158.14 *Revised and relocated to added 158.16 and 158.18 June 26, 1998*

158.15 *Revised and relocated as added 158.24 June 26, 1998*

158.16 A current tap or adapter shall be capable of performing acceptably when subjected to the overload test as described in this Section. 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: A current tap or adapter that is intended for disconnecting use only and not for current interruption, need not be subjected to this test. See also 177.7 and 178.6.1.

158.16 added as revised and relocated from 158.1, 158.2, and 158.14 June 26, 1998

158.17 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.

158.17 added as revised and relocated from 158.13 June 26, 1998

158.18 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.

158.18 added as revised and relocated from 158.14 June 26, 1998

158.19 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. Current tap or adapters 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.

158.19 added as revised and relocated from 158.8 and 158.11 June 26, 1998

158.20 Each device 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. If 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 158.18.

158.20 added as revised and relocated from 158.3 June 26, 1998

158.21 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.

158.21 added as relocated from 158.5 June 26, 1998

158.22 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 158.23.

158.22 added as relocated from 158.6 June 26, 1998

158.23 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.

158.23 added as revised and relocated from 158.3 and 158.4 June 26, 1998

158.24 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 UL 1681, 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.

158.24 added as revised and relocated from 158.15 June 26, 1998

158.25 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.

158.25 added as revised and relocated from 158.9 and 158.10 June 26, 1998

158.26 Blades or contacts are not to be adjusted, lubricated, or otherwise conditioned before or during the test. The attachment plug used for the test may be changed after 50 cycles.

158.26 added as revised and relocated from 158.12 June 26, 1998

158.27 In the event that unacceptable results are obtained in the machine testing described in 158.21 or 158.22, referee tests may be conducted manually under conditions similar to those described in 158.21 or 158.22.

158.27 added as relocated from 158.7 June 26, 1998

158.28 For multi-configuration travel adapters separate sets of six representative adapters are to be tested. The number of sets is to be determined by the number of attachment plug configurations that may be used by the representative travel adapter. Each set of six representative multi-configuration travel adapters is to be tested using a different attachment plug configuration considered representative of those that are identified for use with the adapter. The test current used for each set of representative adapters is to be based upon the current rating associated with the configuration of the attachment plug used in the test. The test voltage shall equal the voltage rating associated with the configuration of the male blades of the adapter. See 177.9.

158.28 effective November 5, 1997

159 Temperature Test

159.1 The temperature rise of a current tap or adapter measured at the points described in 159.2 shall not be more than 30EC (54EF) when the device is carrying its maximum rated current.

159.1 effective January 1, 1998

159.2 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 or if the device has no 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.

159.2 effective January 1, 1998

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159.3 The temperature test is to be made following the overload test on the device and is to continue for 4 hours even though stabilized temperatures may be attained in a somewhat shorter interval of time.

159.3 effective January 1, 1998

159.4 The generation of heat from sources other than the female contacts is to be minimized as much as possible. For a current tap or adapter not provided with wiring terminals, Type RH or Type TW lead-in wires no more than 6 inches (150 mm) long are to be soldered to the blades. For a current tap or adapter intended for use with flexible cord, each connection to the device being tested is to be made by means of a 6 inch (150 mm) or shorter 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.

159.4 effective January 1, 1998

159.5 The contacts of the device being tested are to be connected together by means of a mated attachment plug. 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 TW or Type RH wire or the appropriate flexible cord as described in 159.4.

159.5 effective January 1, 1998

159.5.1 For multi-configuration travel adapters, separate sets of six representative adapters are to be tested. The number of sets is to be determined by the number of attachment plug configurations that may be used by the representative travel adapter. Each set of six representative multi-configuration travel adapters is to be tested using a different attachment plug configuration considered representative of those that are identified for use with the adapter. The test current used for each set of representative adapters is to be based upon the current rating associated with the configuration of the attachment plug used in the test. See 177.9.

159.5.1 added November 5, 1997

159.6 Temperature readings are to be obtained by means of thermocouples consisting of Nos. 28 – 32 AWG (0.08 – 0.032mm²) iron and constantan wires. It is a common practice to employ thermocouples consisting of No. 30 AWG (0.05 mm²) iron and constantan wires with a potentiometer type of indicating instrument. This equipment will be used if a referee measurement of temperature is necessary.

160 Resistance to Arcing Test

Effective date for Section 160 changed from January 1, 1995 to January 1, 1998

160.1 If a material is used in the construction of the face of a device having female contacts 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 as described in the Overload Test, Section 158, 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 157.2) 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 plug used for this test may be changed after every 50 operations.

160.2 Alternatively one set of devices may be subjected to the 50 cycles of operation as described in the Overload Test, Section 158, 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.

160.3 For multi-configuration travel adapters, separate sets of six representative adapters are to be tested. The number of sets is to be determined by the number of attachment plug configurations that may be used by the representative travel adapter. Each set of six representative multi-configuration travel adapters is to be tested using a different attachment plug configuration considered representative of those that are identified for use with the adapter. The test current used for each set of representative adapters is to be based upon the current rating associated with the configuration of the attachment plug used in the test. The test voltage shall equal the voltage rating associated with the configuration of the male blades of the adapter. See 177.9.

160.3 added November 5, 1997

161 Fuseholder Temperature Test

Section 161 effective January 1, 1998

161.1 When tested as described in this Section, the temperature rise of a current tap or adapter incorporating a fuseholder shall not exceed the following:

- a) 30EC (54EF) on the fuse clips when tested with a dummy fuse;
- b) 85EC (153EF) on the fuse clips when tested with a live fuse;
- c) 30EC (54EF) at the wiring terminals or cord connections at any time (see 161.7); and
- d) The relative thermal index of the surrounding insulating material, minus an assumed ambient of 25EC (77EF), at any time (see 161.7).

161.2 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 161.6 and 161.7).

Exception: The test may be conducted in conjunction with the Temperature Test, Section 159, if agreeable to all concerned.

161.3 The devices are to be wired in a series circuit as described in the Temperature Test, Section 159.

161.4 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 of the mating attachment plug as close as possible to the face of the device.

161.5 The test is to continue for at least 4 hours even though stabilized temperatures may be attained in a somewhat shorter interval of time. A temperature is considered to be stabilized when three consecutive readings, taken at 5 minute intervals, indicate no further rise above the ambient temperature.

161.6 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.

161.7 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, UL 512. The dummy fuse size for devices employing miscellaneous, miniature and micro fuses is to be as indicated in Table 161.1. To represent the heating of a live fuse, 20EC (36EF) is to be added to the recorded temperature rise on the wiring terminals, cord connections, and surrounding insulating materials.

Table 161.1
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)

161.8 The thermocouples are to consist of Nos. 28 – 32 AWG ($0.08 - 0.032 \text{ mm}^2$) iron and constantan wires. It is a common practice to employ thermocouples consisting of No. 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.

161A Improper Insertion Test

Section 161A added June 26, 1998

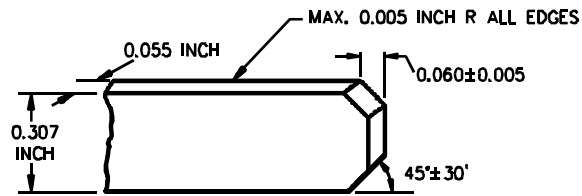
161A.1 To determine compliance with 15.2.3 and 15.2.4, a current tap or adapter shall obstruct the attempted insertion of the test blades illustrated in Figure 161A.1, when tested as described in 161A.2 and 161A.3.

161A.2 Each of 12 devices is to be tested while being supported on a flat steel plate. Rigid spacing materials may be used to support a device that because of its shape does not lie flat on the steel plate, provided that by doing so, pressure is not exerted against the device that will influence test results. The test blades shall be supported and centered above the non-polarized contact slot of the device being tested. Each contact slot of a non-polarized device is to be tested separately.

161A.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 devices 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.

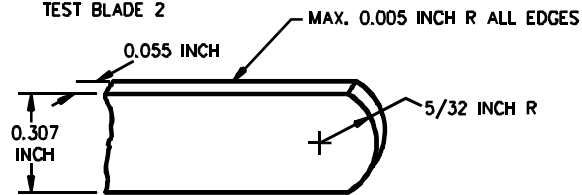
Figure 161A.1
Improper insertion test blades

TEST BLADE 1



MATERIAL: TOOL STEEL

TEST BLADE 2



SB1889

MATERIAL: TOOL STEEL

162 Grounding Contact Tests

162.1 *Revised and relocated as added 162.8.1 effective October 1, 1999*

162.2 *Combined with 162.4 and relocated as added 162.9.2 effective October 1, 1999*

162.3 *Revised and relocated as added 162.9.1 effective October 1, 1999*

162.4 *Revised and relocated as 162.9.2 effective October 1, 1999*

162.5 *Revised and relocated as added 162.9.3 effective October 1, 1999*

162.6 *Revised and relocated as added 162.10.1 effective October 1, 1999*

162.7 *Revised and relocated as added 162.11.1 effective October 1, 1999*

162.8 General

162.8.1 Current taps and adapters that can accommodate a 3-wire grounding attachment plug having one of the configurations indicated in Figures C1.5, C1.6, C1.9, C1.10, C1.13, C1.24, and C1.29 [U-shaped grounding pin clearance opening intended to receive an 0.184 – 0.190 by 0.843 inch (4.67 – 4.83 by 21.41 mm) maximum attachment plug grounding pin] are to be subjected to the tests indicated in this Section.

162.8.1 revised and relocated from 162.1 effective October 1, 1999

162.8.2 Devices that are provided with a means for fixed attachment to a receptacle shall be subjected to the conditioning, continuity check, and grounding pin retention requirements described in 162.9 – 162.11.

162.8.2 added effective October 1, 1999

162.8.3 Devices that are not provided with a means for fixed attachment to a receptacle shall be subjected only to the continuity check and grounding pin retention requirements described in 162.10 and 162.11.

162.8.3 added effective October 1, 1999

162.9 Conditioning

162.9.1 Six previously untested devices are to be used. Each device is to be mounted on a flush receptacle as intended, with its face in a vertical plane. A nonmetallic faceplate is to be installed if intended. A solid No. 14 AWG (2.1 mm²) copper conductor is to be connected to the receptacle grounding terminal.

Exception: A grounding adapter that is provided with a tab for fixed attachment to a receptacle is able to be supported in a test jig or fixture that does not restrict possible deformation of the grounding contact while subjected to the conditioning described in 162.9.2. Upon completion of the conditioning, the adapter is to be assembled onto a flush plate as noted above before conducting the grounding continuity check and grounding pin retention test described in 162.10 and 162.11.

162.9.1 revised and relocated from 162.3 effective October 1, 1999

162.9.2 With the device oriented to create the maximum contact displacement (possible distortion of contact affecting its contact ability), the test pin A, Figure 162.1 is to be fully inserted in the grounding contact of the device under test. A 5 lb (2.27 kg) weight is to be gradually suspended from the test pin 6 inches (152 mm) from the face of the device. 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 device 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. The adapters, current taps, and similar devices are to remain in a vertical plane during each of the 1 minute contact conditioning periods.

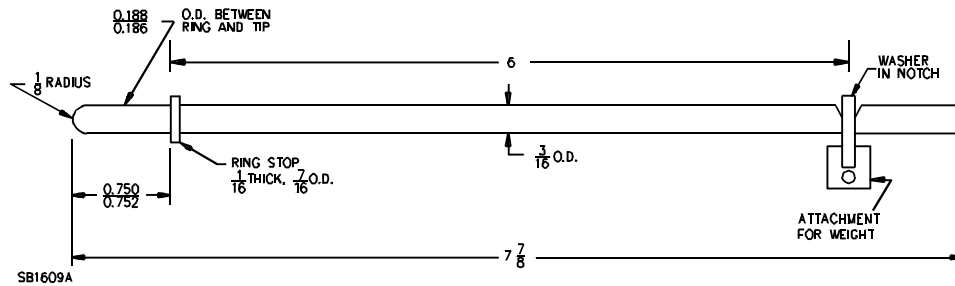
162.9.2 revised and relocated from 162.4 effective October 1, 1999

162.9.3 As a result of this conditioning, there shall not be any breakage of the outlet face of the device 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 device that results in reduction of electrical spacings to values less than those required for the device. The conditioning pin shall remain in place without extraneous support for the required 1 minute in each position.

Exception: A device made of one of the materials described in the Exception to 8.4.1 is not required to support the conditioning pin without extraneous support.

162.9.3 revised and relocated from 162.5 effective October 1, 1999

**Figure 162.1
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

162.10 Continuity

162.10.1 A current tap or adapter that is provided with a means for fixed attachment to a receptacle is to remain assembled to the receptacle and flush plate as described in 162.9.1 during the continuity check. Each device is then to be tested for electrical continuity between the receptacle grounding terminal and the fully inserted test pin B, Figure 162.2. 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 shall remain continuously in contact with the face of the device. An indicating device, such as an ohmmeter, a battery-and-buzzer combination, or similar device, is to be used.

Exception: A grounding adapter that is provided with a tab for fixed attachment to a receptacle that was supported in a test jig or fixture in accordance with the Exception to 162.9.1 is to be assembled onto a receptacle and flush plate as noted in 162.9.1 before conducting the grounding continuity check.

162.10.1 revised and relocated from 162.6 effective October 1, 1999

162.10.2 A current tap or adapter that is not provided with a means for fixed attachment to a receptacle is to be supported in a test jig or fixture that does not restrict possible deformation of the grounding contact while checking continuity. Each device is then to be tested for electrical continuity between the grounding pin and the fully inserted test pin B, Figure 162.2. 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 shall remain continuously in contact with the face of the device. An indicating device, such as an ohmmeter, a battery-and-buzzer combination, or similar device, is to be used.

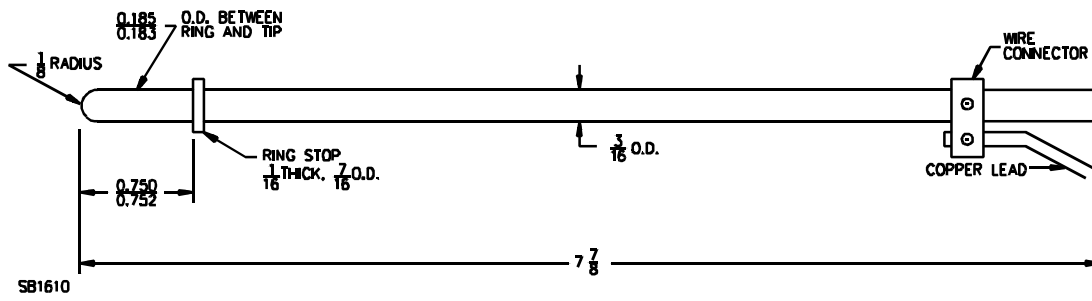
162.10.2 added effective October 1, 1999

162.11 Retention

162.11.1 Each device is then to be positioned facing down in a horizontal position. The device under test shall support the 2 and 4 oz. (57 and 113 g) grounding pin illustrated in Figures 162.3 and 162.4, for 1 minute each when fully inserted in the grounding pin opening. The displacement of the grounding pin shall not be greater than 0.079 inches (2 mm).

162.11.1 revised and relocated from 162.7 effective October 1, 1999

Figure 162.2
Test pin B



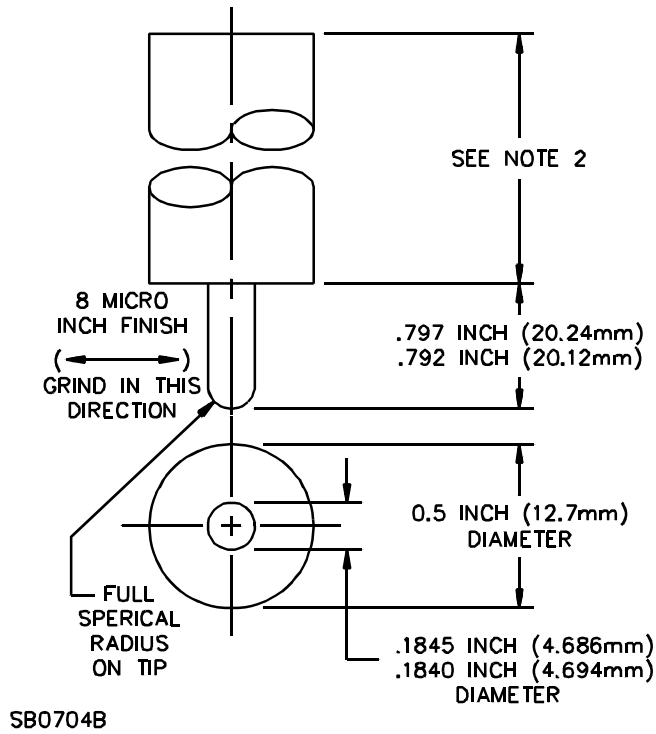
Pin material – solid brass rod

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

Figure 162.3
2 oz (57 g) ground pin

Figure 162.3 revised effective October 1, 1999

(All dimensions in inches)



Material: Pin-Steel, Rockwell Hardness C58 to C60.
Handle – cold rolled steel

NOTES

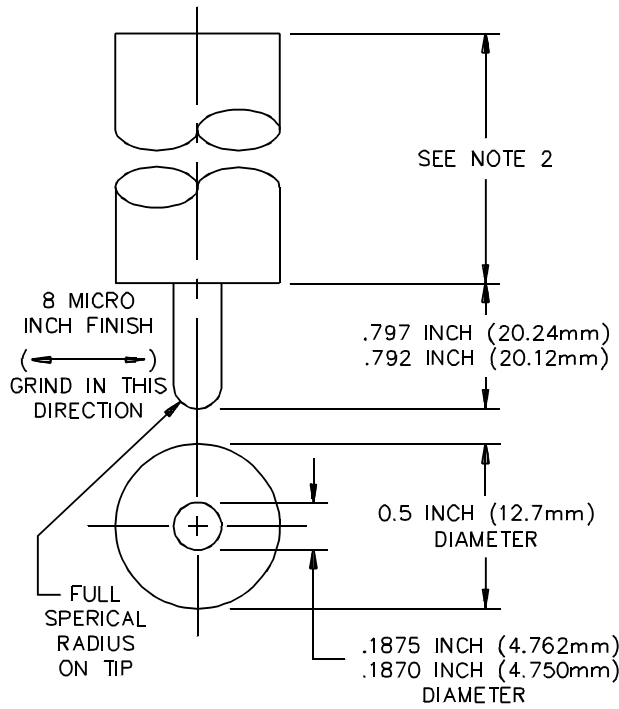
- 1) The ground pin is to be fastened to handle in rigid manner.
- 2) Length not specified. Total tool weight 2 oz (57 g).
- 3) Axis of blade and axis of handle, must have combined concentricity and axial alignment of 0.006 maximum at tip of pin.

inch	0.1840	0.1845	0.792	0.797	0.5
mm	4.694	4.686	20.12	20.24	12.7
microinch	8				
nanometer	200 ±25				

Figure 162.4
4 oz (113 g) ground pin

Figure 162.4 revised effective October 1, 1999

(All dimensions in inches)



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.

inch	0.1870	0.1875	0.792	0.797	0.5
mm	4.750	4.762	20.12	20.24	12.7
microinch	8				
nanometer	200 ±25				

Pin-Type Terminals

163 Assembly Test

163.1 *Revised and separated into added 163.2 and 163.3 (date of publication)*

163.2 A current tap with pin-type terminals shall be able to be readily assembled to the flexible cords with which it is intended to be used.

163.2 added as revised and separated from 163.1 (date of publication)

163.3 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 151 – 167.

Exception: The device is not required to be assembled and tested with those cord types and sizes excluded by the marking specified in 180.3.1 (c).

163.3 added as revised and separated from 163.1 (date of publication)

164 Temperature Test

164.1 *Revised and separated into added 164.3 and 164.5 (date of publication)*

164.2 *Revised and relocated as added 164.4 (date of publication)*

164.3 The temperature rise shall not be more than 30EC (54EF) when the current tap or adapter is carrying the current corresponding to the ampacity of the size cord that the device is intended to accommodate.

164.3 added as revised and separated from 164.1 (date of publication)

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

- a) For a current tap or adapter intended to be used with No. 18 AWG (0.82 mm²) 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 No. 18 AWG (0.82 mm²) 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 No. 18 AWG (0.82 mm²) polyvinyl chloride insulated Type SPT-1 cord having a minimum overall width of 0.210 inch (5.33 mm).
- b) For a current tap or adapter 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 current tap or adapter intended for use with more than one size of flexible cord, the temperature test is to be repeated for each size wire.

164.4 added as revised and relocated from 164.2 (date of publication)

164.5 Each set is to be tested for temperature rise following assembly. Thermocouples are to be attached to the male blades of the current tap or adapter, 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.

164.5 added as revised and separated from 164.1 (date of publication)

164.6 Following the completion of this test, three assemblies using each of the flexible cord sizes and types specified in 164.4 are to be selected and subjected to the Dielectric-Voltage Withstand Test described in Section 101.

164.6 added (date of publication)

165 Strain Relief Test

165.1 *Revised and relocated as added 165.3 (date of publication)*

165.2 *Revised and separated into added 165.4, 165.5, and 165.6 (date of publication)*

165.3 When assembled to the intended flexible cord, a current tap or adapter 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.

165.3 added as revised and relocated from 165.1 (date of publication)

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

- a) For a current tap or adapter intended to be used with No. 18 AWG (0.82 mm²) 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 164.4.
- b) When cords other than No. 18 AWG (0.82 mm²) 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.

165.4 added as revised and separated from 165.2 (date of publication)

165.5 One set of devices for each cord size and type is to be subjected to the test described in 165.6 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 67.0EC (152.6EF).

165.5 added as revised and separated from 165.2 (date of publication)

165.6 While the current tap or adapter 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 No. 18 AWG (0.82 mm²) or larger, or
- b) 20 lbf (89 N) when the conductors are smaller than No. 18 AWG (0.82 mm²).

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

165.6 added as revised and separated from 165.2 (date of publication)

166 Fault Current Test

166.1 *Revised and separated into added 166.2, 166.4, and 166.5 (date of publication)*

166.2 When assembled to the intended flexible cord, a current tap or adapter 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.

166.2 added as revised and separated from 166.1 (date of publication)

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

a) For a current tap or adapter intended to be used with No. 18 AWG (0.82 mm²) 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 164.4.

b) For a current tap or adapter 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.

166.3 added (date of publication)

166.4 The current taps or adapters 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 166.5 following assembly in the as-received condition.

b) The second set is to be subjected to the test described in 166.5 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 166.5 after being conditioned in an oven at 67.0EC (152.6EF) for 30 days.

166.4 added as revised and separated from 166.1 (date of publication)

166.5 A standard screw terminal receptacle of the 5-15 configuration (2-pole, 3-wire, 15A, 125V) is to be wired in a circuit capable of delivering 1000 A rms 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 No. 12 AWG (3.3 mm²) 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 current tap or adapter being tested. The male blades of the current tap 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.

166.5 added as revised and separated from 166.1 (date of publication)

167 Dielectric Voltage-Withstand Test

167.1 The assembly of a cord and current tap 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 devices are to be selected from the temperature test specified in Temperature Test, Section 164.

167.1 revised (date of publication)

167.2 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.

FLATIRON AND APPLIANCE PLUGS

168 General

168.1 The performance of a flatiron or appliance plug is to be evaluated by means of the tests described in Sections 169 – 176 on sets of six representative devices. The test sequence is to be millivolt drop, overload, heating, millivolt drop repeated, crushing, mechanical endurance, and if necessary, the comparison-cord guard test.

168.2 A switching mechanism in a 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.

169 Millivolt Drop Test

169.1 In a switchless plug (as received) 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.

169.2 To determine whether a plug complies with the requirement in 169.1, 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.

170 Overload Test

170.1 A 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.

170.2 Devices which have been subjected to the millivolt-drop test are to be tested as described in this Section.

170.3 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.

170.4 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.

171 Heating Test

171.1 The insulating material used in a flatiron or appliance plug shall be capable of withstanding a temperature of 200EC (392EF) for a period of 72 hours without warping, cracking, blistering, softening, or showing any other indication of serious deterioration.

171.2 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.

172 Millivolt Drop Test Repeated

172.1 The millivolt-drop test is to be repeated following the heating test on devices 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 168.1, 169.1, and 169.2.

173 Crushing Test

173.1 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.

173.2 Plugs are to be employed that have not been previously subjected to any of the tests in Sections 169 – 172. 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.

174 Mechanical Endurance Test

174.1 After a plug that is rated 5 A at 250 V and 10 A at 125 V, and that has been oven conditioned at 200EC (392EF) 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.

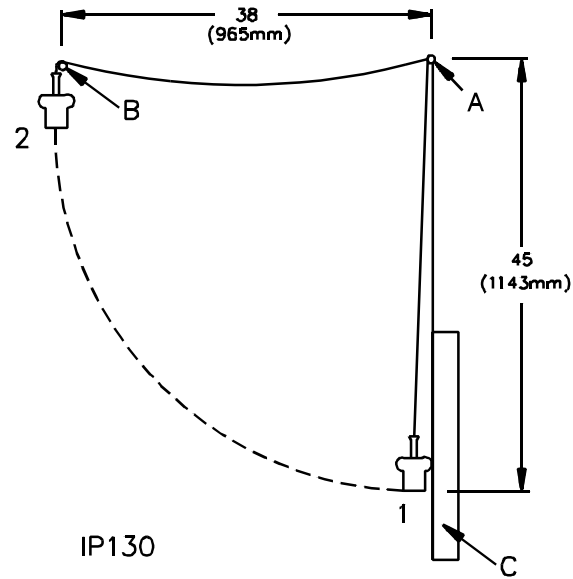
174.2 If an unacceptable result occurs that is attributable directly to a broken switch handle or a release button, the test may be repeated to determine whether the handle or button will break on nonoven-conditioned devices. If the handle or button does not break, and none of the causes for rejection given in 174.1 occur, the mechanical endurance of the plug is acceptable.

174.3 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.

174.4 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 No. 18 AWG (0.82 mm²) 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 174.1. 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 174.1 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 174.1. 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 174.1
Mechanical endurance test

Figure 174.1 revised June 26, 1998



NOTES

A – Supporting bushing

B – Lifting Member

C – Maple block

1 and 2 – See 174.4

174.5 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.

174.6 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.

175 Accelerated Aging Test

175.1 If a rubber guard is employed, 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 $120.0 \pm 1.0^{\circ}\text{C}$ ($248.0 \pm 1.8^{\circ}\text{F}$) in an oven for a period of 96 hours. Following the oven conditioning, the guard shall not show any cracks after being subjected to 5000 cycles of flexing by a machine as described in this section.

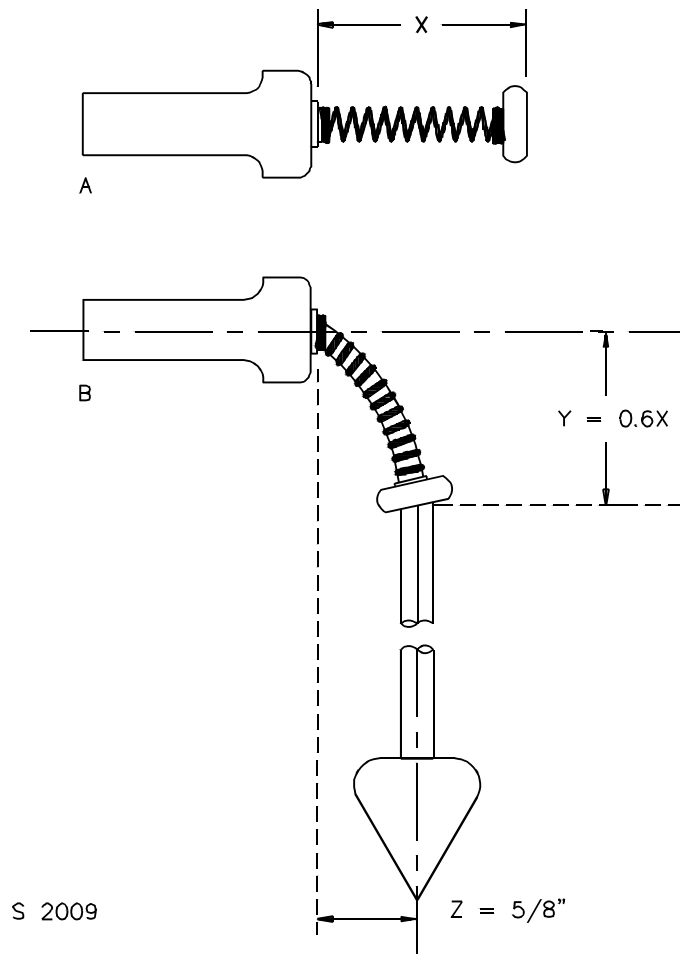
175.2 The guard is to be assembled to the body of the plug, and the assembly wired in the intended manner with a 2 – 3 ft (0.61 – 0.91 m) length of heater cord. With the plug held stationary, the guard is to be flexed by moving the cord back and forth in a plane through an angle of approximately 180 degrees.

176 Cord Guard Test

176.1 Except as noted in 176.2, 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 plug is to be mounted rigidly in a horizontal position as indicated in part A of Figure 176.1. 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 176.1 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).

176.2 A guard that does not comply with 176.1 may be used if, upon investigation, it is found to provide protection equivalent to that provided by a guard that does comply. See also 53.3.

Figure 176.1
Test of cord guard



inch	5/8
mm	15.9

RATINGS

177 Details

177.1 A device that includes either a medium-base lampholder or screw base in combination with either parallel or tandem blades, or slots, shall be rated in accordance with Table 177.1. See also 6.1.

Table 177.1
Ratings of combination devices

Outlet connections	Line connections			
	Terminals or leads	Medium screw base	Parallel blades	Tandem blades
Parallel slots	–	660 W, 125 V	–	–
Tandem slots	–	660 W, 250 V	–	–
Lampholder	a	a	660 W ^b , 125 V ^b	660 W ^b , 250 V ^b
Parallel slots plus lampholder	15 A ^c , 125 V ^b 660 W ^b , 125 V ^{b,d}	660 W ^b , 125 V ^b 660 W ^b , 125 V ^b	15 A ^c , 125 V ^b 660 W ^b , 125 V ^b	–
Tandem slots plus lampholder	15 A ^c , 250 V ^b 660 W ^b , 250 V	660 W ^b , 250 V ^b 660 W ^b , 250 V	–	15 A ^c , 250 V ^b 660 W ^b , 250 V
<p>^a These are lampholders and are covered in the Standard for Edison-Base Lampholders, UL 496.</p> <p>^b If the lampholder portion is switched, the lampholder may be rated either 660 W or 250 W as determined by the action as well as the performance of the switching mechanism when tested, in either case, at 250 V dc.</p> <p>^c If wiring or leads are connected in common, the receptacle portion may be rated for 660 W.</p> <p>^d If separate wiring terminals or leads are provided, the lampholder may be rated for 250 V.</p>				

177.2 A general-use device shall be rated in amperes and volts. If the contact configuration of the device is one of the standard configurations illustrated 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 177.1A. See 6.1, 177.5, and 177.6.

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 in UL 1681.

Exception No. 2: A device that is a combination of special-use devices as described in 177.1 and 177.3 need not comply with this requirement.

177.2 revised January 19, 1998

Table 177.1A
Ratings of general-use devices

Ratings
10 A, 250 V and 15 A, 125 V
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
200 A, 480 V ac
200 A, 600 V ac
200 A, 600 V

Table 177.1A revised and relocated from 177.2 January 19, 1998

177.3 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.

177.4 A receptacle or attachment plug of a configuration specified in Table 177.2 shall have a horsepower rating in accordance with the table. A cord connector of a configuration specified in Table 177.2 and assigned a horsepower rating shall be rated in accordance with the table. See 91.19.1, 91.21.1 – 91.21.3 and 115.19.1, 115.21.1 – 115.21.3.

177.4 revised June 26, 1998

Table 177.2
Horsepower ratings for NEMA configurations

Figure	NEMA config.	AC HP rating ^a	Figure	NEMA config.	AC HP rating ^a
C1.1	1-15	0.5	C1.37	18-50	7.5
C1.2	2-15	1.5	C1.38	18-60	7.5
C1.3	2-20	2			
C1.4	2-30	2	C2.1	L1-15	0.5
C1.5	5-15	0.5	C2.2	L2-20	2
C1.6	5-20	1	C2.3	L5-15	0.5
C1.7	5-30	2	C2.4	L5-20	1
C1.8	5-50	2	C2.5	L5-30	2
C1.9	6-15	1.5	C2.6	L6-15	1.5
C1.10	6-20	2	C2.7	L6-20	2
C1.11	6-30	2	C2.8	L6-30	2
C1.12	6-50	3	C2.9	L7-15	2
			C2.10	L7-20	2
C1.13	7-15	2	C2.11	L7-30	3
C1.14	7-20	2	C2.12	L8-20	3
C1.15	7-30	3	C2.13	L8-30	5
			C2.16	L10-20	2 L-L 1 L-N
C1.16	7-50	5	C2.17	L10-30	2 L-L 2 L-N
C1.17	10-20	2 L-L 1 L-N	C2.18	L11-15	2
C1.18	10-30	2 L-L 2 L-N	C2.19	L11-20	3
C1.19	10-50	3 L-L 2 L-N	C2.20	L11-30	3
			C2.21	L12-20	5
C1.20	11-15	2	C2.22	L12-30	10
C1.21	11-20	3	C2.24	L14-20	2 L-L 1 L-N
C1.22	11-30	3	C2.25	L14-30	2 L-L 2 L-N
C1.23	11-50	7.5			
C1.24	14-15	1.5 L-L 0.5 L-N	C2.26	L15-20	3
			C2.27	L15-30	3
C1.25	14-20	2 L-L 1 L-N	C2.28	L16-20	5
C1.26	14-30	2 L-L 2 L-N	C2.29	L16-30	10
			C2.31	L18-20	2
C1.27	14-50	3 L-L 2 L-N	C2.32	L18-30	3
			C2.33	L19-20	5
C1.28	14-60	3 L-L 2 L-N	C2.34	L19-30	10
			C2.37	L21-20	2
C1.29	15-15	2	C2.38	L21-30	3
C1.30	15-20	3	C2.39	L22-20	5
			C2.40	L22-30	10
C1.31	15-30	3			
C1.32	15-50	7.5			
C1.33	15-60	10			
C1.34	18-15	2			
C1.35	18-20	2			
C1.36	18-30	3			

^a The phase to phase horsepower ratings are noted by "L-L". The phase to neutral ratings are identified by "L-N".

177.5 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.

177.6 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.

177.7 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 91.19.1, 115.19.1 and 178.6.1.

177.7 revised June 26, 1998

177.8 An appliance plug 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.

177.9 A travel adapter shall be rated with the ratings associated with both the male and female configurations provided on the device.

177.9 revised November 5, 1997

MARKINGS

178 Details

178.1 Company name, catalog designation, electrical rating

178.1.1 A device shall be legibly and permanently marked, where readily visible after installation, with:

- a) The manufacturer's name, trade name, or trademark or other descriptive marking by which the organization responsible for the device may be identified. The manufacturer's identification may be in a traceable code if the device is identified by the brand or trademark owned by a private labeler.
- b) Except as stated in 178.1.2 and 178.1.3, the electrical rating.
- c) The catalog number or an equivalent designation, where practicable. See 178.4.1.

178.1.2 A fuseless attachment plug having a configuration illustrated in Figure C1.1 or Figure C1.5 (ANSI 1-15 and 5-15) is not required to be marked with its electrical rating.

178.1.3 An attachment plug or receptacle of a configuration specified in Table 177.2 need not be marked with its horsepower rating.

178.2 Multiple factories

178.2.1 If a manufacturer produces or assembles attachment plugs, receptacles, cord connectors, and the like at more than one factory, each finished device shall have a distinctive marking on the device, that may be in code, by which the device can be identified as the product of a particular factory.

178.3 AC only devices

178.3.1 A wiring device that is intended for use on alternating current circuits only shall be identified as such by means of the letters "AC", or "AC Only", or an acceptable frequency marking (for example, "60 Hertz"), or a phase marking, "N" which shall be a part of the electrical rating. For multiphase devices that are intended for use only on a Wye system, the marking shall include the word "Wye," or the equivalent.

178.4 Catalog designation

178.4.1 If the product is too small, or where the legibility would be difficult to attain to include the complete catalog designation or an equivalent designation, or where several catalog numbers use common parts, the complete designation shall appear on the unit container.

178.5 Fused devices

178.5.1 A device intended to accommodate fuses, other than a plug or cartridge fuse acceptable for branch circuit protection, shall be marked "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.

178.5.2 An attachment plug that is intended to accommodate fuses that can be removed after the attachment plug has been inserted in a receptacle shall be marked "Disconnect power before replacing fuses" or an equivalent wording. See 15.4.1 and 15.4.3.

178.5.2 revised April 26, 1996

178.6 Disconnecting use only

178.6.1 A device intended exclusively for disconnecting use shall be marked "For disconnecting use only," or "Not for current rupturing," or an equivalent statement.

178.7 Locking-type devices

178.7.1 An attachment plug that is required to be given a twisting or turning motion to lock or unlock it after the blades have been inserted into the female contacts and a cord connector intended to accommodate such an attachment plug shall be marked on the device "Turn and pull" or an equivalent wording. The marking shall be visible while the device is in use.

178.8 Recreational vehicle type

178.8.1 A receptacle as illustrated in Figure C3.1 shall be marked on the device "Recreational Vehicle use only" where readily visible after installation.

178.9 Hospital only

178.9.1 A grounding, locking-type device for use in hospitals only shall be clearly marked, where visible after installation, "Hospital only." See Exception No. 1 to 15.3.11.

178.9.1 revised January 19, 1998

178.10 Receptacle marking location

178.10.1 The markings required in 178.1.1, 178.3.1, and 178.18.1 shall appear on the front of the body or mounting yoke of a receptacle intended for use with a separate flush plate, and shall be readily visible on the outside of a receptacle mounted on a metal outlet-box cover, except that the marking of a receptacle having an integral flush plate or outlet-box cover of insulating material may be on the inside of the insulating cover or on the exposed side of the base.

178.11 Plaster ears

178.11.1 Plaster ears, whether the ears are separate pieces or are integral with the mounting means, shall not carry the marking of a receptacle unless the marking also appears elsewhere on the device.

178.12 Cover grounded devices

178.12.1 An armored attachment plug or cord connector in which the armor is conductively connected to the grounding pin, blade, or contact shall be marked on the device "cover grounded" or with an equivalent statement unless the grounding connection is readily visible. However, the marking may be omitted from a device of the type that is described in 11.8.

178.13 Nonconductive mounting means

178.13.1 The receptacle or inlet described in 31.1, 31.3 and 31.5 shall be plainly marked on the device where visible during installation as follows: "CAUTION – Mounting means not grounded. Grounding wire connection required" or an equivalent wording following the word CAUTION.

178.14 Adapters

178.14.1 An adapter having a fixed grounding ear, lug, or similar device described in 51.1 – 51.3 shall be marked on the device "CAUTION – Connect tab to grounded screw" or an equivalent wording following the word CAUTION. This marking shall be plain and legible on each adapter where visible during installation.

178.14.2 An adapter employing a movable grounding member shall be marked with a statement making it clear that the adapter is for use with a portable hand-held, hand-guided, or hand-supported tool or appliance. See 51.1.

178.14A Flush receptacles

178.14A.1 A flush receptacle having one of the configurations illustrated in Figures C1.5, C1.6, C1.9 or C1.10 shall comply with the marking requirements in Supplement SA and with all other applicable requirements in this section.

178.14A.1 added June 26, 1998

178.15 Isolated-ground receptacles

178.15.1 Receptacles provided with an isolated ground contact, as described in 31.4, shall be permanently marked by an orange colored triangle where visible after the receptacle and cover plate are installed. The device shall also be plainly and permanently marked where visible during installation as follows: "Isolated Ground" and "CAUTION – Mounting means not grounded. Grounding wire connection required," or with an equivalent wording following the word "CAUTION."

178.15.2 The orange colored triangle need not be a contrasting shade of orange if the face of the receptacle is orange colored. The triangle shall have sides 5/32 inch (4.0 mm) or more in length.

178.16 Display receptacles

178.16.1 A receptacle intended for use in elevated floors in accordance with the exception to Section 370-27(b) of the National Electrical Code, NFPA-70, shall be marked with the words "Display Receptacle" or equivalent wording where visible during installation. The words "Floor Receptacle" are not considered to be equivalent.

178.16.1 revised September 22, 1997

178.17 Push-in (screwless) terminals

178.17.1 In addition to the markings otherwise required, a device that employs push-in (screwless) terminals shall be marked on the device where readily visible during installation:

- a) With instructions for releasing the wire from the terminal connection, that shall be located where readily visible during wiring and rewiring,
- b) To specify use with "solid wire only" unless the terminal is intended for both solid and stranded wire,
- c) With instructions to strip the insulation from conductors a specific length where readily visible during installation, and
- d) With instructions for connecting acceptably sized wire where readily visible during installation. (properly sized wire.)

178.18 CO/ALR type devices

178.18.1 A receptacle intended for use with aluminum conductors or copper and aluminum conductors, as described in 35.1, shall be marked on the device "CO/ALR" so the marking is visible after installation, see 178.10.1 and "Replace Only With CO/ALR Device" so that the marking is visible during installation.

178.19 Tamper-resistant receptacles

178.19.1 A tamper-resistant receptacle shall be marked with the phrase "Tamper Resistant" or the letters "TR" where they will be visible after installation with the cover plate removed. The letters "TR" shall be a minimum of 3/16 inch (4.8 mm) in height. The 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. A label or sticker bearing these markings, and attached by an adhesive or other means to the device shall not be removable without destroying its significance if reapplied.

178.20 Hospital grade devices

178.20.1 Devices designated Hospital Grade shall additionally be marked in accordance with 178.20.2 – 178.20.6.

178.20.2 An attachment plug shall be marked with the phrase "Hospital Grade" or "Hosp. Grade" 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.

178.20.2 revised (date of publication)

178.20.3 A cord connector shall be marked with the phrase "Hospital Grade" or "Hosp. Grade" 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.

178.20.3 revised (date of publication)

178.20.4 A receptacle shall be marked with the phrase "Hospital Grade" or "Hosp. Grade" where visible during installation and with a green dot that is visible after installation with the cover plate secured as intended.

178.20.4 revised (date of publication)

178.20.5 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.

178.20.6 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.

178.21 Self-contained receptacles

178.21.1 Each self-contained receptacle shall be plainly marked where readily visible after installation with:

- a) The manufacturer's name, trademark, or trade name,
- b) A distinctive catalog number or the equivalent, and
- c) The electrical rating.

178.21.2 Each self-contained receptacle that is not capable of being replaced with a conventional outlet box and receptacle shall be marked with:

- a) The type of receptacle necessary for replacement purposes, and
- b) Instructions for disassembly prior to replacement.

See 180.7.1 and 180.7.2. Receptacles intended for replacement with similar devices without the use of special tools shall be specifically marked to indicate this.

178.22 Travel adapters

178.22.1 A travel adapter that allows an attachment plug to mate with an outlet device having a different voltage rating than that of the plug shall be marked on the device where visible during use "CAUTION" and the following instructions or the equivalent: "For Dual-Voltage Appliances Only – Before Inserting, Set Appliance Switch to ___V Setting. Do Not Use with Products Having a Single ___V Voltage Rating. SEE INSTRUCTIONS BEFORE USING." The first blank shall be filled in with the voltage rating associated with the blade configuration of the adapter. The second blank shall be filled in with the voltage rating associated with the outlet configuration of the adapter.

178.22.1 revised November 5, 1997

178.22.2 A travel adapter with outlet slots that are polarized, and male blades or pins for use in an electrical system that does not have provision for polarization shall be marked on the device where visible during use with the word "CAUTION" and the following statements or their equivalents:

- a) "To reduce the risk of electric shock from exposed live parts, do not use with appliances provided with a lampholder or an electrical outlet," and
- b) "To reduce the risk of fire or electric shock, grasp travel adapter and plug and remove from the receptacle when not in use."

178.22.2 added November 5, 1997

178.22.3 A multi-configuration travel adapter shall be marked with the word "CAUTION" and the following statement or the equivalent: "To reduce risk of fire or electric shock, use only with these plug types," together with an outline drawing of the appropriate plug configurations. The marking shall appear on the device where it will be visible during use.

178.22.3 added November 5, 1997

179 Identification and Marking of Terminals

179.1 Grounded and grounding

179.1.1 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 179.1 or 179.2. 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 179.1 need not comply with this requirement.

No Text on This Page

179.2 Other terminals

179.2.1 Device wiring terminals other than the grounded and grounding terminals described in 179.1.1 need not 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."

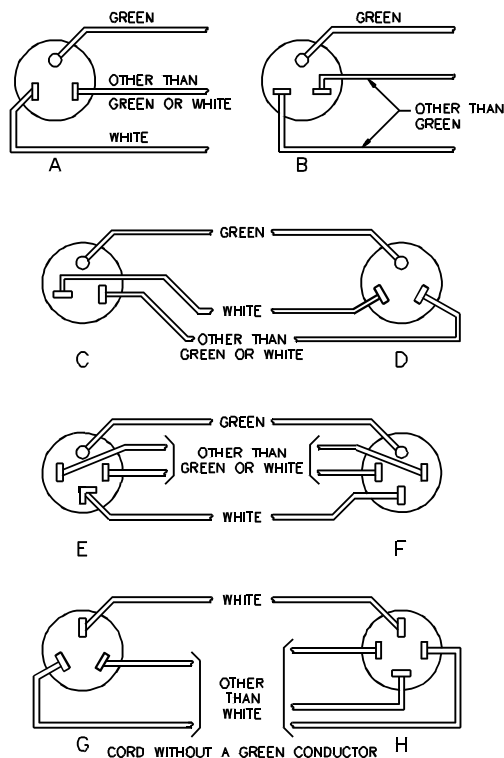
Table 179.1
Identification of wiring terminals

Identification by:	Grounded terminal	Grounding terminal	All other terminals
Wire-binding screw	White metal or plating on circular screw head	Hexagonal, green-colored nut ^b or slotted screw head ^b	Other than white or green circular screw head
Pressure wire connector-visible	White metal or plating on connector	Green-colored connector, screw or appendage ^b	Other than white or green colored connector
Pressure wire connector-concealed	Distinct white-colored area adjacent to wire entrance hole or the word "white" distinctively marked adjacent to wire entrance hole	Distinct green-colored area adjacent to wire entrance hole or the word "green" ^c distinctively marked adjacent to wire entrance hole	Other than white or green area adjacent to wire entrance hole
Terminal plate ^a	White metal or plating	–	Other than white or green metal or plating
Insulating enclosure or terminal	The word "White" marked on or directly adjacent to terminal or White metal or plating on terminal	The word "Green" marked on or directly adjacent to terminal or Green colored terminal	– Other than white or green-colored terminal
^a Only if all line-terminal binding screws are of the same color. ^b Not readily removable. See 179.3.1. ^c In letters at least 1/16 inch (1.6 mm) high.			

Table 179.2
Identification of leads

Identification by:	Grounded conductor	Grounding conductor	All other conductors
Color of braid ^b	Solid white or natural grey (without tracer) Color other than white, natural grey or green, with tracer in braid	Not applicable Not applicable	White or natural grey with tracer in braid or Solid color other than white, ^a natural grey or green ^a (without tracer) Solid color other than white, ^a natural grey or green ^a (without tracer)
Color of insulation ^b	Solid white or natural grey; stripe, white or natural grey, ^a on contrasting color other than green	Green with or without one or more yellow stripes	Solid color other than white, ^a natural grey, or green
Color of separator ^b	Solid white or natural grey	Not applicable	Solid color other than white, ^a natural grey 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
<p>^a A green wire, with or without one or more yellow stripes, is to be used only as an equipment grounding conductor</p> <p>^b If color of braid, insulation, or separator is used for identification, all conductors are to be either tinned or not tinned.</p> <p>^c If conductor tinning is used for identification, all braids and/or insulation are to have the same color and shape.</p>			

Figure 179.1
Identifying cord or lead connections



AB110

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 natural grey color or is equivalently identified by (1) a white or natural grey 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.

179.3 Removable parts

179.3.1 A part relied upon to provide the terminal identification required in 179.1.1 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 may be used to mark the terminal identification.

179.3.2 Identification and marking of terminals in general-use devices other than those illustrated in Sections C1 – C3 may be accepted on a basis equivalent to that outlined in 179.1.1 – 179.3.1. See 15.3.1.

INSTALLATION INSTRUCTIONS

180 Details

180.1 Wiring information – field wiring terminals

180.1.1 The value of tightening torque assigned in accordance with 12.18, shall be marked where readily visible;

- a) On the device,
- b) On the smallest unit container, or
- c) On an information sheet packed in the smallest unit container.

180.2 Wiring information – flexible cord

180.2.1 A device intended for use with flexible cord shall be provided with information regarding:

- a) The intended flexible-cord types (such as type S, SJ, SJT, HPN, SPT-1, and the like). The cord identification may refer to the generic (trade) names for each family of cords (such as Hard Service Cord, Vacuum Cleaner Cord, Parallel Cord, and the like) if all types of cords identified in the family can be utilized with the device.
- b) The conductor size or sizes.
- c) The total number of conductors.
- 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.

180.2.2 The information mentioned in 180.2.1 may be combined in an acceptable 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 may be included individually or as a range with the appropriate cord types.

180.3 Pin-type terminals

180.3.1 In addition to the markings otherwise required, a device that is made with pin-type terminals intended for field assembly on a flexible cord shall be provided with an instruction card. The instruction card shall be attached in such a manner that the device cannot be readily removed. The use of a blister pack or equivalent securing of the device to the instruction card is acceptable. However, the friction attachment of a device to the card is not acceptable. The card shall be marked with:

- a) Instructions for assembling the device to the cord. Details shall be provided, including pictorial representation, to enable proper assembly by an inexperienced person.
- 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.
- 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 must be capable of proper use or be physically excluded.
- 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-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.
- 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.

180.3.1 effective January 1, 1998

180.3A Flush receptacles

180.3A.1 A flush receptacle having one of the configurations illustrated in Figures C1.5, C1.6, C1.9 or C1.10 shall comply with the installation instruction requirements in Supplement SA and with all other applicable requirements in this section.

180.3A.1 added June 26, 1998

180.4 Isolated-ground type

180.4.1 A receptacle described in 31.4 shall be marked to indicate its intended use to reduce electrical noise (electromagnetic interference) by purposely insulating the grounding circuit from any metallic wiring system.

180.5 Nongrounding configurations

180.5.1 A receptacle or plug, other than the 2-pole, 2-wire type, for use only in nongrounding circuits shall be marked: "CAUTION: This device is not for grounding use. Connect only to nongrounding circuits."

180.5.2 A device having a configuration illustrated in Figure C3.9, C3.10, C3.11, or C3.12 shall be marked: "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."

180.5.3 A receptacle with a 2-pole, 2-wire, 15 A, 125 V configuration as illustrated in Figure C1.1 which has provisions for mounting to a standard outlet box shall be marked "REPLACEMENT USE ONLY ON EXISTING CIRCUITS WITH NO MEANS FOR GROUNDING," or the equivalent, on the smallest unit container.

180.5.3 effective January 1, 1998

180.6 Non CO/ALR receptacle

180.6.1 A receptacle rated 15 or 20 A that is not marked "CO/ALR" and that has provisions for mounting to a standard outlet box shall be marked as indicated in 180.6.2. This requirement applies only to devices for installation in a fixed wiring system (branch circuit) employing one or more of the following means for wire securement:

- a) Wire-binding screws,
- b) Back-wired pressure plates (clamp terminals), or
- c) Push-in terminals.

180.6.2 The devices mentioned in 180.6.1 shall be marked with one of the following, or its equivalent:

- a) "Notice – Use only copper or copper-clad wire with this device",
- b) "Notice – Connect only copper or copper-clad wire to this device", or
- c) "Notice – Use only devices marked CO/ALR with aluminum wire".

Exception: When the device itself carries the marking, one of the abbreviated markings in 180.6.4 or the symbol shown in Figure 180.1 meets the intent of the requirement.

180.6.2 revised September 15, 1998

180.6.3 The marking in 180.6.2 shall be located as follows:

- a) For individually packaged devices, the marking shall appear on one of the following:
 - 1) The device,
 - 2) A stuffer sheet, or
 - 3) The device carton.
- b) For bulk-shipped devices, the marking shall be on the device. For the purpose of this requirement, bulk-shipped is defined as any carton having more than one device except for individual packages containing two device intended for sale directly to the user.

180.6.4 If the marking required in 180.6.2 appears on the device, one of the abbreviated markings shown below may be used to indicate that the receptacle is for use with either copper or copper-clad wire. The marking shall be legible with letters at least 1/16 inch (1.6 mm) high.

- a) "Use copper wire only",
- b) "Cu wire only",
- c) "Use copper or copper-clad wire only", or
- d) "Cu and Cu-clad wire only".

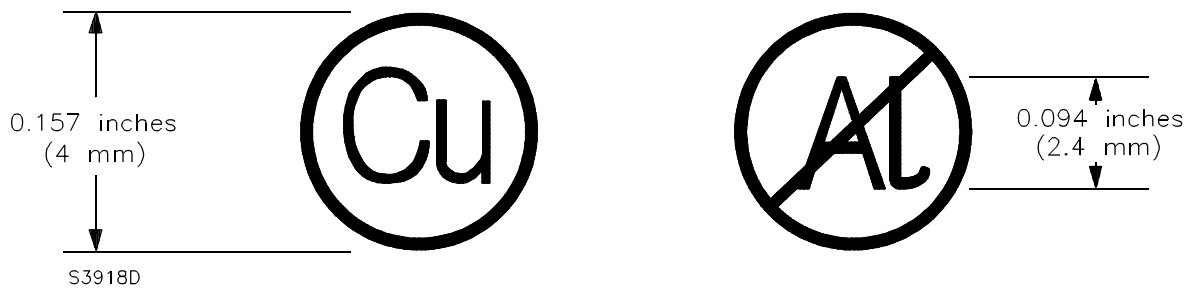
180.6.4 revised August 30, 1996

180.6.5 The symbol shown in Figure 180.1 is an alternate marking to the abbreviated markings noted in 180.6.4.

180.6.5 added September 15, 1998

Figure 180.1
Non-CO/ALR marking

Figure 180.1 added September 15, 1998



180.6.6 When molded, the circles and bar of the marking described in Figure 180.1 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. Alternate methods of marking include die stamping, labeling, or other contrasting method, provided an equivalent prominence is achieved.

180.6.6 added September 15, 1998

180.7 Self-contained receptacles

180.7.1 The following information shall be provided on the outer surface of the smallest unit package or on a tag or stuffer sheet (or its equivalent) or included therein.

- a) Manufacturer's name and complete address.
- b) Catalog number or its equivalent.
- c) Intended conductor material, cable type, and cable size.
- d) Limitations for use – for example, "mobile homes".
- e) Necessary installation instructions such as:
 - 1) Wall or ceiling limitations (material, thicknesses, and the like,
 - 2) Cable preparation (required slack, tools, and the like),
 - 3) Selection of wiring material, and
 - 4) Bracket references, and the like.

180.7.2 With regard to 180.7.1, the installation instructions shall specifically state that the maximum slit length of nonmetallic sheathed cable being prepared for installation on a self-contained receptacle shall be 2.125 inch (54 mm).

180.8 Travel adapters

180.8.1 An instruction sheet, booklet or the equivalent shall be provided with each travel adapter. The instructions shall specifically warn the user of reasonably foreseeable risks and state the precautions that should be taken to reduce such risks. The letters and text in 180.8.3 shall not be less than 5/64 inch (2.0 mm) high for upper-case letters and 1/16 inch (1.6 mm) high for lower-case letters. "IMPORTANT SAFETY INSTRUCTIONS" and "SAVE THESE INSTRUCTIONS" shall be in letters not less than 3/16 inch (4.8 mm) high.

180.8.1 added November 5, 1997

180.8.2 The text of the instructions shall be verbatim to, or in equally definitive terminology as, 180.8.3, except where specific conflict of the application to a product exists. The items may be numbered, and the phrases "IMPORTANT SAFETY INSTRUCTIONS" and "SAVE THESE INSTRUCTIONS" shall be first and last, respectively, in a list of items. Other important safety instructions considered appropriate by the manufacturer may be included.

180.8.2 added November 5, 1997

180.8.3 The following instructions shall be provided with a travel adapter:

"IMPORTANT SAFETY INSTRUCTIONS"

"When using your travel adapter, basic precautions should always be followed, including the following:"

- a) "READ ALL INSTRUCTIONS BEFORE USING."
- b) "DO NOT use this adapter with products containing screw-base lampholders (sockets) or convenience receptacles."

Exception: This instruction need only be provided for a travel adapter that has polarized outlet slots and non-polarized blades or pins.
- c) "THIS PRODUCT IS NOT A VOLTAGE CONVERTER. Check the markings on each appliance and use this adapter only with appliances rated for both 120 and 240 volts. Using appliances rated only 120 volts with this adapter may result in a risk of fire, electric shock, injury to persons, or damage to the appliance."
- d) "Be sure the dual-voltage selector switch, if provided, is in the correct voltage position before operating. Before plugging in, read the information about dual-voltage operation contained in these instructions and in the instructions provided with each appliance to be used with this adapter."
- e) "Always attach the adapter to the plug of the appliance first, then insert the adapter into the outlet."
- f) "Always disconnect the adapter and appliance from the electrical outlet when not in use."
- g) **"SAVE THESE INSTRUCTIONS"**

180.8.3 added November 5, 1997

180.8.4 The instructions for a travel adapter shall include information about dual-voltage operation, including the following:

- a) The statement "For use in the U.S.A., the appliance's voltage selector switch should be placed in the 120-volt position. For use in countries overseas, the voltage selector may need to be placed in the 240-volt position. Confirm the voltage available at each overseas location before using this adapter with an appliance", or the equivalent.
- b) A tabulation including the following information:
 - 1) A diagram of each male blade or pin configuration that the adapter will accept. This column shall be headed "WHEN APPLIANCE HAS THIS PLUG", or the equivalent.
 - 2) A list of countries which employ the female outlet configuration that corresponds to the male blade or pin configuration used by each adapter. This column shall be headed "TO USE IN", or the equivalent.
 - 3) The voltage rating associated with the male configuration in each country. This column shall be headed "SET SELECTOR AT", or the equivalent.

180.8.4 added November 5, 1997

180.9 Angle and shroud housing adapters for attachment plugs and cord connectors

180.9.1 An angle or shroud housing adapter for an attachment plug or cord connector shall be provided with installation instructions that include the following:

- a) The wiring and flexible cord information described in 180.2, and
- b) 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.

180.9.1 added (date of publication)

SUPPLEMENT SA

INTRODUCTION

SA1 Scope

SA1.1 The requirements of this supplement cover 15 and 20 A, 125 and 250 V flush, hospital grade, and self-contained receptacles of NEMA configurations 5–15, 5–20, 6–15 and 6–20 illustrated in Figures C1.5, C1.6, C1.9 and C1.10.

SA1.1 revised June 26, 1998

SA1.2 The receptacles mentioned in SA1.1 shall comply with the applicable requirements of this Standard, UL 498, except as modified by the requirements contained in this supplement.

SA1.3 The requirements of this supplement do not apply to cord connectors, appliance outlets, fixture outlets, current taps, adapters, surface mounted receptacles or similar female contact devices.

SA2 Glossary

SA2.1 For the purposes of this supplement, the following definitions apply.

SA2.2 BULK SHIPMENT – Any packaging container having more than one receptacle not provided with a unit container.

SA2.3 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 without the use of screws.

SA2.4 THROUGH-WIRING – A wiring method which permits a group of receptacles to be wired in parallel to a common branch circuit.

SA2.5 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.

CONSTRUCTION

SA3 General

SA3.1 A "Push-In" terminal may be accepted for a current-carrying connection in a receptacle of configurations 5-15, and 6-15 only.

SA3.2 "Push-In" grounding terminations shall not be used.

SA3.3 A receptacle employing "Push-In" line terminations shall accept a No. 14 AWG (2.1 mm²) solid conductor and shall reject a No. 12 AWG (3.3 mm²) 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 SA19.3.

SA3.4 A "Push-In" terminal shall not be used with stranded wire.

SA3.5 A receptacle employing "Push-In" terminations may be provided with a means to release the conductors. Where an opening in the insulating body is provided for such purpose, behind the plane of the mounting means, it shall not permit entry of a No. 14 AWG (2.1 mm^2) or larger solid conductor. The wire release means, if provided, shall be subjected to the tests in Temperature Test, Push-In Terminals, Section SA18.

SA3.6 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.

PERFORMANCE

ALL DEVICES

SA4 General

SA4.1 The test sequence and number of receptacles required are to be as shown in Table SA4.1.

SA4.2 Standard test conditions are to be as shown in the body of the standard. Temperature readings are to be obtained by means of type J thermocouples consisting of No. 28 – 32 AWG ($0.08 - 0.032 \text{ mm}^2$) iron and constantan wires. It is a common practice to employ thermocouples consisting of No. 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.

Table SA4.1
Summary of tests^a
Supplement SA receptacles

Section	Test sequences	No. of devices ^b	Details
SA5	Retention of Blades	6	Supersedes Retention of Plugs Test, Section 114.
SA6	Overload		Supersedes Overload Test as described in 115.19.1 – 115.19.10, 115.20.1, and 115.20.2.
SA7	Temperature		Supersedes Temperature Test, Section 116.
SA8	Retention of Blades Repeated		Supersedes Retention of Plugs Test, Section 114.
SA9	Resistance to Arcing		Supersedes Resistance to Arcing Test, Section 117.
SA7	Terminal Temperature	6	Conducted when a 15 A receptacle is not represented by a 20 A receptacle. Supersedes Temperature Test, Section 116.
SA10	Fault Current	2	Represented by the Fault Current Test, Section 131, for Hospital Grade receptacles and the Fault Current Withstand Test, Section 145, for self-contained receptacles.
SA11	Terminal Strength	3	Supersedes the Terminal Strength Test, Section 133. May be combined with the Assembly Security Test, Section 134, if the device is Hospital Grade. Additional devices may be needed based on the terminal construction; see test description. Neither test required for self-contained devices. Terminal Strength Test not required for receptacles with wire leads or "push-in" terminals only.
SA12	Assembly Security		
SA13	Dielectric Withstand	6	Represented by the Dielectric Voltage Withstand Test, Section 65.
SA15	Conductor Insertion and Retention	6	Devices with push-in terminals with wire release mechanism.
SA16	Conductor Push-In		
SA17	Terminal Abuse		
SA15	Conductor Insertion and Retention	6	Devices with push-in terminals without wire release mechanism.
SA16	Conductor Push-In	6	Devices with push-in terminals without wire release mechanism.
SA17	Terminal Abuse	6	Devices with push-in terminals without wire release mechanism.
SA18	Temperature	8	Devices with push-in terminals.

^a See also Tables 59.5 – 59.7 for other tests required for general grade, Hospital Grade and self-contained receptacles.

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

Table SA4.1 revised June 26, 1998

SA5 Retention of Blades Test

SA5.1 Receptacles having the break-off tab, if 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 SA5.1. 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 SA5.1 but is not to have holes in the outer ends of the blades.

SA5.2 The standard gauge without holes in the blades and with the grounding blade removed is then to be inserted in the receptacle and a static 3 lbf (13.3 N), 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.

SA5.3 The standard gauge with holes in the end of the line blades and complete with the grounding blade is then to be inserted in the receptacle and a force applied in a direction normal to the plane of the face of the receptacle that tends to remove the gauge. The static force required to withdraw the gauge shall not exceed 15 lbf (67 N).

SA5.4 Each of the line contacts of the receptacles is to be tested using the test blade illustrated in Figure SA5.2. 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.

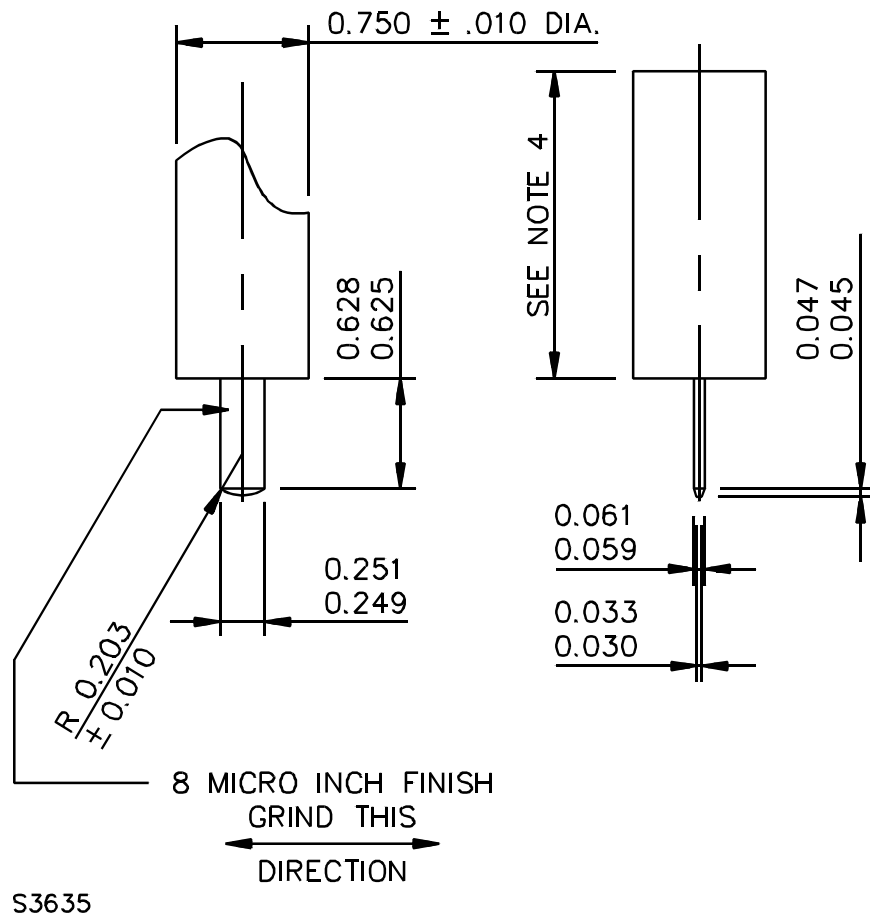
Figure SA5.1 (Cont'd)

inch	mm	inch	mm	inch	mm
0.0002	0.005	0.125	3.18	0.467	11.8
0.001	0.025	0.126	3.20	0.469	11.91
0.002	0.051	0.156	3.96	0.479	12.17
0.010	0.254	0.186	4.72	0.499	12.67
0.016	0.4	0.188	4.78	0.501	12.73
0.020	0.5	0.203	5.156	0.671	17.04
0.031	0.79	0.249	6.33	0.672	17.07
0.045	1.14	0.251	6.37	0.717	18.21
0.047	1.19	0.358	9.09	0.719	18.26
0.059	1.50	0.360	9.14	0.796	20.22
0.061	1.55	0.449	11.40	0.797	20.24
0.124	3.15	0.461	11.7		

microinch	8 ± 1
-----------	-----------

nm	200 ± 25
----	--------------

Figure SA5.2
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

(Continued)

Figure SA5.2 (Cont'd)

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.

SA6 Overload Test

SA6.1 A receptacle shall be capable of performing acceptably when subjected to the overload test described in SA6.2 – SA6.10. 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.

SA6.2 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.

SA6.2 revised January 19, 1998

SA6.3 Each receptacle is to be tested, by machine or manually, as outlined in SA6.4 and SA6.5, by inserting and withdrawing an attachment plug 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% of rated current for 100 cycles of operation at a rate no faster than 10 cycles per minute. The blade of the attachment plug is to mate with the contact of the receptacle for no more than 1 s during each cycle. The attachment plug used for this test may 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.

SA6.4 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.

SA6.5 In the event of failures during machine testing, referee tests may be conducted manually under conditions similar to those described in SA6.4.

SA6.6 The open circuit voltage of the test circuit shall not exceed 105% of the rated voltage and the closed circuit voltage shall not be less than 95% of the rated voltage. At the option of the manufacturer the open circuit voltage may exceed 105% of the rated voltage.

SA6.7 **Deleted January 19, 1998**

SA6.8 Neither the blades nor the contacts are to be adjusted, lubricated, or conditioned, other than as required by Retention of Blades Test, Section SA5, before or during the test.

SA6.9 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.

SA6.10 The fuse in the grounding circuit is to be a 15 A fuse. The fuses in the test circuit are not to exceed the amperage rating of the receptacle. If either the line fuse or the grounding fuse opens during the test, the results are not acceptable.

SA7 Temperature Test

SA7.1 The contact temperature rise of a receptacle shall not be more than 30EC (54EF) when the receptacle is carrying its maximum rated current.

SA7.2 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 30EC (54EF), except as noted in SA7.9.

Exception No. 1: Self-contained receptacles need not 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 SA18.

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 SA18. 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. See SA19.4.

SA7.2 revised April 26, 1996

SA7.3 For receptacles of configurations 5-20 and 6-20 the contact temperature and terminal temperature tests are to be combined. The receptacle is to be wired with No. 12 AWG (3.3 mm²) solid or stranded copper building wire.

SA7.4 For receptacles of configuration 5-15 or 6-15 intended for through-wiring and not represented by otherwise similar receptacles of configuration 5-20 or 6-20, the contact temperature and terminal temperature tests are to be conducted separately. These 15 A configuration receptacles are to be wired with No. 14 AWG (2.1 mm²) 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 No. 12 AWG (3.3 mm²) solid or stranded copper building wire for the terminal temperature test.

SA7.5 For receptacles of configurations 5-15 and 6-15 not intended for through-wiring, the contact temperature and terminal temperature tests are to be combined. The receptacle is to be wired with No. 14 AWG (2.1 mm²) solid or stranded copper building wire.

SA7.6 The temperature measurement mentioned in SA7.1 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 SA7.2 is to be made on the wiring terminals of the receptacle if they are accessible for the mounting of thermocouples.

SA7.7 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.

SA7.8 When testing receptacles with wire binding screws or screw actuated clamp type terminations, the terminal temperature is to be measured on the terminations in a manner such that the thermocouple does not interfere with the termination.

SA7.9 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 40EC (72EF).

SA7.10 The temperature test(s) are to be conducted following the overload test on the receptacle and are to continue for 4 h although stabilized temperatures may be obtained in a somewhat shorter interval of time. The contact temperatures are to be measured at the contacts previously subjected to the overload test.

SA7.11 The overloaded contacts of individual receptacles are to be connected together by means of a shorted attachment plug. 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 may be soldered to the plug terminals in order to minimize the generation of heat from sources other than the contacts.

SA7.12 The receptacles under test are to be connected in series in the test circuit with building wire as specified in SA7.4 or SA7.5 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.

SA7.13 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 No. 14 AWG (2.1 mm²) conductor and 14 in-lbf (1.6 N•m) for receptacles wired with No. 12 AWG (3.3 mm²) conductor.

SA8 Repeated Retention of Blades Test

SA8.1 Following the temperature test(s) the overloaded contacts of the receptacles are to be subjected to a repeated Retention of Blades Test in accordance with Section SA5.

SA9 Resistance to Arcing Test

SA9.1 If an insulating 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 outlets that were subjected to 100 cycles of operation in the Overload Test described in Section SA6 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.

SA9.2 Alternatively, one set of receptacles may be subjected to the 100 cycles of operation in the Overload Test described in Section SA6, 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.

SA9.3 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.

SA10 Fault Current Test

SA10.1 When a receptacle 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.

Exception: A Hospital Grade receptacle tested as described in Fault Current Test, Section 131, need not be subjected to this test.

SA10.1 revised June 26, 1998

SA10.2 Each receptacle is to be tested at rated voltage on a circuit capable of delivering 1000 A rms through shorted bus bars. For receptacles rated 250 V, each phase is to be wired to a circuit having a potential of 125 V to ground. 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 No. 12 AWG (3.3 mm²) 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 No. 14 AWG (2.1 mm²) 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 m²) of No. 14 AWG (2.1 mm²) solid copper wire and a 15 A circuit breaker is to be employed.

SA11 Terminal Strength Test

SA11.1 When tested as described in this section, there shall not be:

- 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 SA11.6;
- 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 SA11.1.2 or during the plug retention and withdrawal evaluations described in SA11.7 and SA11.8;
- e) Displacement of the standard gauge of more than 0.079 inches (2 mm) during the plug retention evaluation described in SA11.7; or
- f) Inability to release the standard gauge during the plug release evaluation described in SA11.8.

Revised SA11.1 effective December 1, 1997

SA11.1.1 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.

Added SA11.1.1 effective December 1, 1997

SA11.1.2 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 SA5.1. 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 SA11.1 (a), (c), and (d) upon completion of this conditioning.

Added SA11.1.2 effective December 1, 1997

SA11.2 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 SA11.2 for single receptacles or in Table SA11.3 for duplex receptacles.

Revised SA11.2 effective December 1, 1997

SA11.3 Each terminal is to be wired with No. 12 AWG (3.3 mm^2) solid copper conductor by applying the tightening torque as specified in Table SA11.4 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 SA11.1 (a) upon completion of this procedure.

SA11.3 revised and separated into SA11.3 and SA11.5.1 effective December 1, 1997

Table SA11.1
Tightening torque for slotted head screws

Table SA11.1 revised and relocated as Table SA11.4 effective December 1, 1997

Table SA11.2
Terminal testing configurations single receptacles

Terminal type	No. of devices	Terminals to be wired on each device (see SA11.2)
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 SA11.1.

Added Table SA11.2 effective December 1, 1997

Table SA11.3
Terminal testing configurations duplex receptacles

Terminal type	No. of devices	Outlet tested	Terminals to be wired on each device (see SA11.2)
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
Pressure-wire terminal only, 2 wire entries per terminal	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, 1 wire entry per terminal	3	Upper Lower	Two wire-binding screw terminals Two pressure-wire terminals
	3	Upper Lower	Two pressure-wire terminals Two wire-binding screw terminals
Combination wire-binding screw and pressure-wire terminal, 2 wire entries per terminal	1	Upper Lower	Two wire-binding screw terminals Two pressure-wire terminals wired using Configuration No. 1 ^a
	1	Upper Lower	Two wire-binding screw terminals Two pressure-wire terminals wired using Configuration No. 2 ^a
	1	Upper Lower	Two wire-binding screw terminals 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 Lower	Two pressure-wire terminals wired using Configuration No. 3 ^a Two wire-binding screw terminals

^a The wiring configurations for pressure-wire terminals with two wire entries per terminal are shown in Figure SA11.1.

Added Table SA11.3 effective December 1, 1997

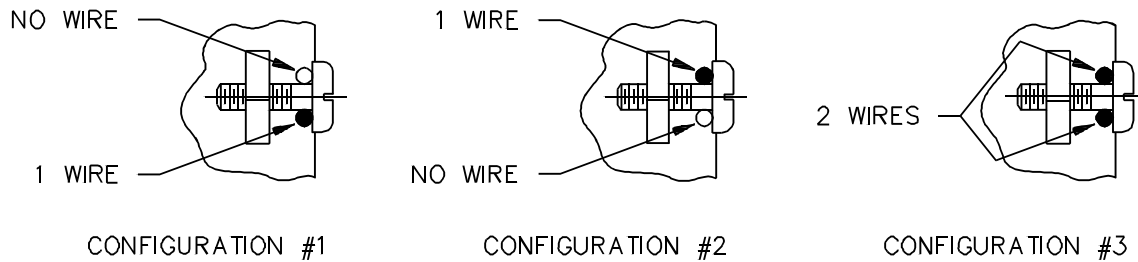
Table SA11.4
Terminal screw tightening torque

Screw size	Tightening torque pound-inches (N•m)
No. 6 or less	12 (1.4)
No. 8 or greater	14 (1.6)

Table SA11.4 revised and relocated from Table SA11.1 effective December 1, 1997

SA11.4 Deleted effective December 1, 1997

Figure SA11.1
Wiring configurations for back-wired terminals



No Text on This Page

SA11.5 *Deleted effective December 1, 1997*

SA11.5.1 Each termination is then to be disassembled and the assembly and torquing repeated once using newly stripped wire. The terminals of a Hospital Grade receptacle are to be disassembled, assembled, and torqued three additional times following the method described in SA11.3 except that the maximum tightening torque is to be 14 lbf-in (1.6 Nm). The receptacle shall comply with SA11.1 (a) upon completion of this procedure.

SA11.5.1 revised and relocated from SA11.3 effective December 1, 1997

SA11.6 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 SA11.1 (a) and (b) upon completion of this procedure.

Revised SA11.6 effective December 1, 1997

SA11.7 The standard gauge shown in Figure SA5.1 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 SA11.1 (a), (c), (d), and (e) upon completion of this procedure.

Added SA11.7 effective December 1, 1997

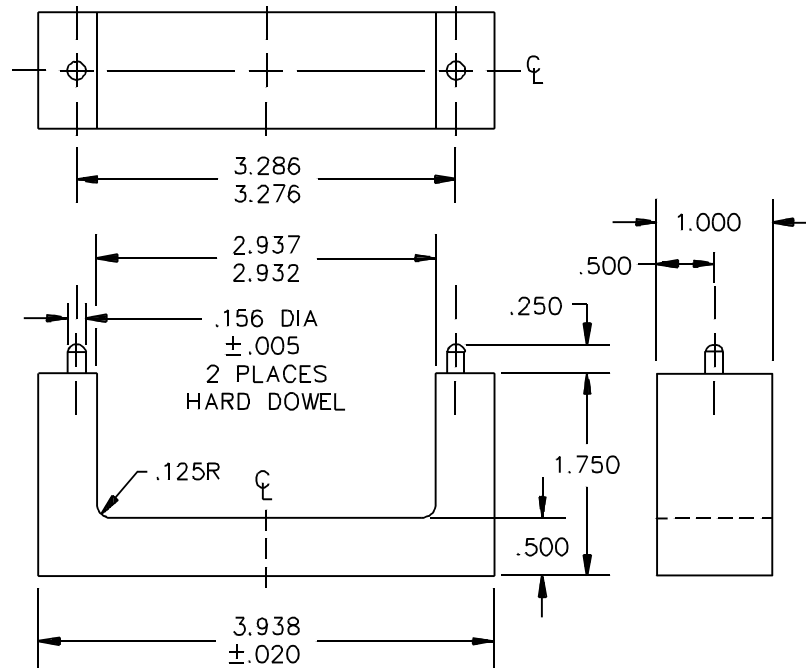
SA11.8 The standard gauge is then to be reconfigured with the grounding pin and with line blades with holes in the outer ends of the blades and inserted into each outlet of the receptacle. A receptacle rated 20 A with the "T" slot contact is to be tested with the gauge assembled in the 15 A configuration. 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 SA11.1 (a), (c), (d), and (f) upon completion of this procedure.

Added SA11.8 effective December 1, 1997

SA12 Assembly Security Test

SA12.1 A receptacle is to be mounted in the fixture described in Figure SA12.1, and 50 lbf (220 N) is to be applied, as shown in Figure SA12.2, 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 SA12.3. 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 SA12.3) is to be modified to have a single set of blades.

Figure SA12.1
Receptacle test fixture



SB1276A

(Continued)

Figure SA12.1 (Cont'd)

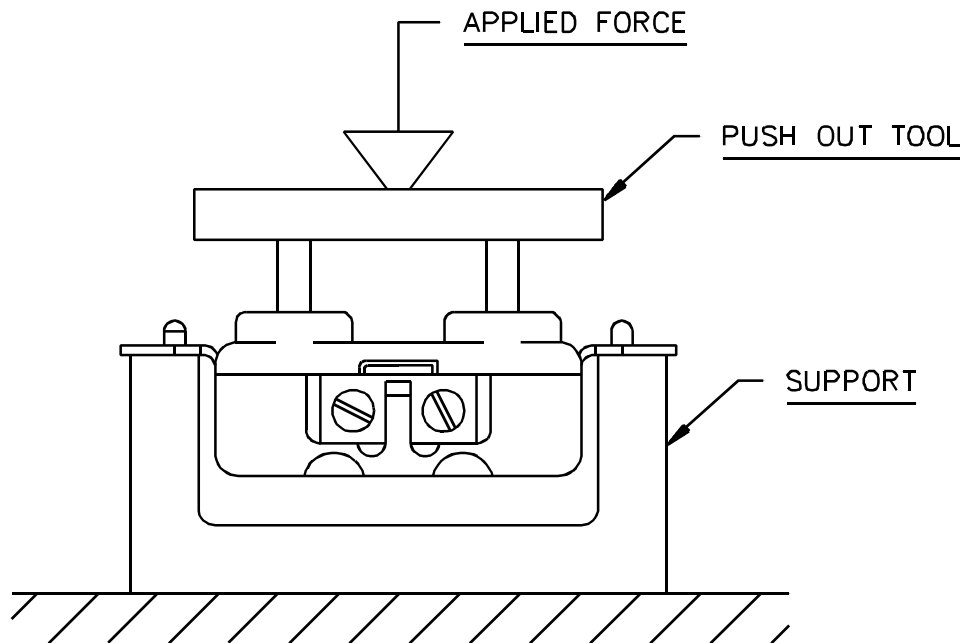
inches	mm
0.005	0.13
0.020	0.51
0.125	3.18
0.156	3.96
0.250	6.35
0.500	12.70
1.000	25.40
1.750	44.45
2.932	74.47
2.937	74.60
3.276	83.21
3.286	83.46
3.938	100.03

NOTES

- 1) Dimensions are in inches.
- 2) Metric equivalents are given for 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.

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Figure SA12.2
Assembly security test method



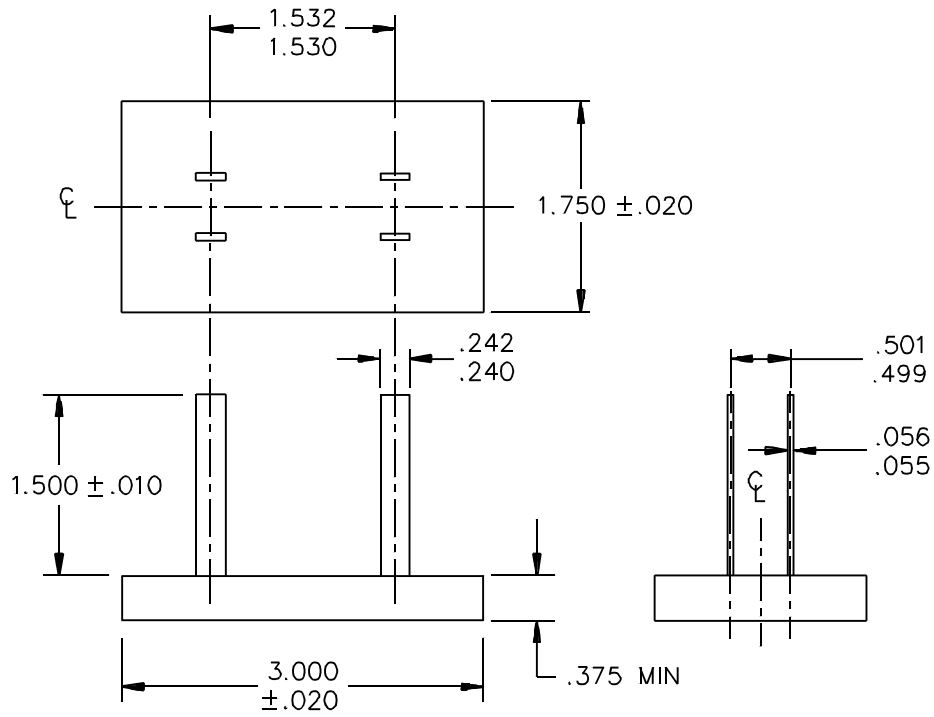
S3637

SA12.2 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.

SA12.3 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 SA12.4, for a period of 10 s by means of a bridge as shown in Figure SA12.5. The criteria of SA12.2 shall apply.

SA12.4 The receptacle shall maintain grounding continuity between the grounding terminal and ground pin. Any acceptable indicating device, such as an ohmmeter, a battery-and-buzzer combination, or the like, may 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 119.3. 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 SA12.3
Pushout tool**



SB1277A

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

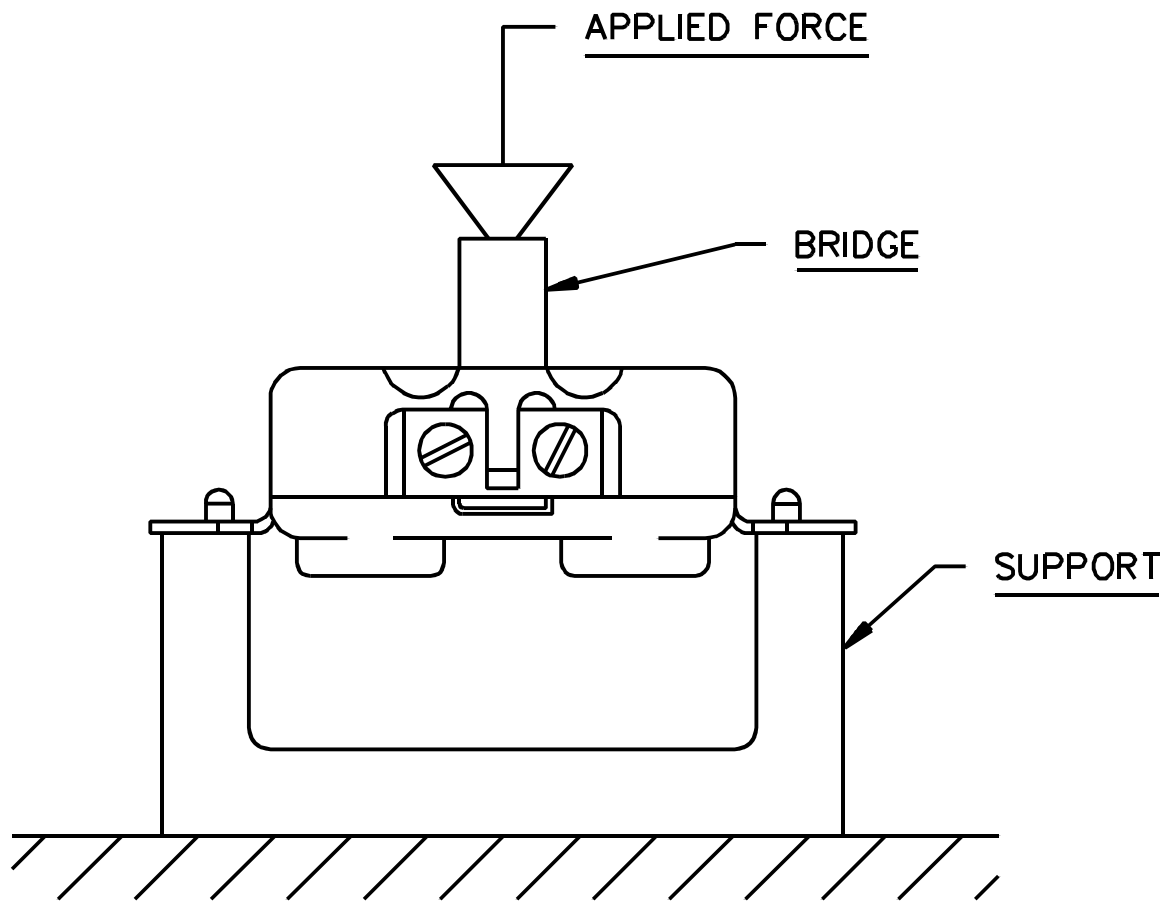
(Continued)

Figure SA12.3 (Cont'd)

NOTES

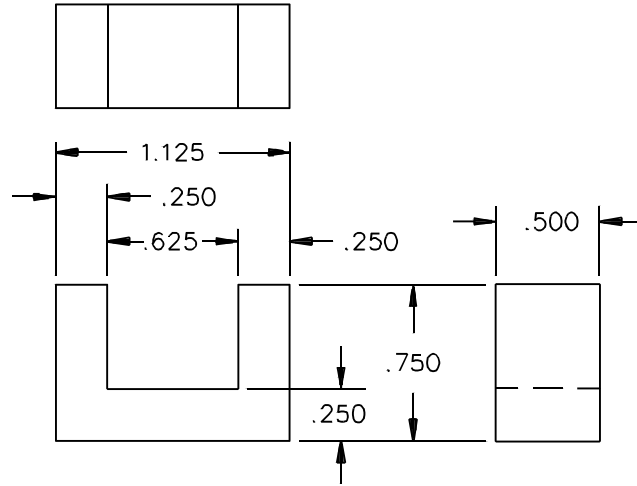
- 1) Dimensions are in inches.
- 2) Metric equivalents are given for general information only and are based upon 1.00 inch = 25.4 mm.
- 3) Blades to be parallel to each other and perpendicular to the base within 0.006 inch (0.15 mm) T.I.R..
- 4) Blades are to be fastened to the base in a rigid manner.
- 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.

Figure SA12.4
Assembly security test method (inverted)



S3637A

**Figure SA12.5
Bridge**



S3638

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) may be varied so that the tool clears the strap of the receptacle.
- 5) The shape of the bridge may be varied to suit the back of the device being tested.

SA13 Dielectric Withstand Test

SA13.1 Receptacles shall withstand without breakdown a 50 – 60 Hz essentially sinusoidal potential applied as described in SA13.3 for one minute between live parts of opposite polarity and between live parts and grounded or dead metal parts immediately following the humidity conditioning described in SA13.2.

Exception: Receptacles employing insulating materials consisting wholly of ceramic, thermoset, thermoplastic or elastomeric materials need not be subjected to the humidity conditioning.

SA13.2 Previously untested receptacles are to be used for this test. Mating 3-wire attachment plugs with solid blades are to be inserted into the contact openings of three of the six receptacles. The receptacles are to be placed into an environmental chamber and subjected to the following conditions:

- a) 4 hours at a temperature of $75 \pm 1\text{EC}$ ($167 \pm 1.8\text{EF}$) at a relative humidity of 92 ± 3 percent.
- b) 16 hours at a temperature of $75 \pm 1\text{EC}$ ($167 \pm 1.8\text{EF}$) at a relative humidity of 40 ± 3 percent.
- c) 4 hours at a temperature of $30 \pm 1\text{EC}$ ($86 \pm 1.8\text{EF}$) at a relative humidity of 60 ± 3 percent.

SA13.3 Upon completion of the humidity conditioning, each receptacle 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 of 2000 V 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.

SA13.4 The mating attachment plugs used in SA13.2 shall be capable of withstanding the application of a 2500 V potential.

SA13.5 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.

SA13.6 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 SA13.3. A test potential of 2000 V is to be reapplied across adjacent line terminals. No smoothing of any remaining jagged terminal plate edges is to be performed.

PUSH-IN TERMINALS

SA14 General

SA14.1 Receptacles employing push-in terminals are to be tested as described in Sections SA15 – SA18.

SA14.2 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.

SA15 Conductor Insertion and Retention Test, Push-In Terminals

SA15.1 A receptacle provided with push-in terminals, when tested as outlined in SA15.2 – SA15.7 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.

SA15.2 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.

SA15.3 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.

SA15.4 To determine compliance with SA15.1 each tested terminal and wire combination is to be examined after the last wire insertion. The receptacles are to be subjected to a Dielectric Withstand Test, as described in Section SA13, except that the receptacles need not be subjected to the humidity conditioning described in SA13.2. 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.

SA15.5 Each tested terminal and wire combination shall then withstand the application of a straight pull for 1 minute of the force in SA15.6 without:

- a) Pullout or breakage of the conductor, or
- b) Any reduction in the electrical spacings at wiring terminals or within the device.

SA15.6 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.

SA15.7 At the completion of the test described in SA15.6 there shall not be dielectric breakdown when each terminal is again tested as described in SA15.4.

SA16 Conductor Push-In Test, Push-In Terminals

SA16.1 The same receptacles used for the conductor insertion and retention test, but with the original test wires removed, are to be tested for conductor push-in as described in SA16.3, using newly stripped conductors as described in SA16.2.

Exception: For receptacles without a wire release mechanism, previously untested receptacles are to be used.

SA16.1 revised April 26, 1996

SA16.2 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.

SA16.3 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 SA15.4 and SA15.5.

SA17 Terminal Abuse Test, Push-In Terminals

SA17.1 The same receptacles 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.

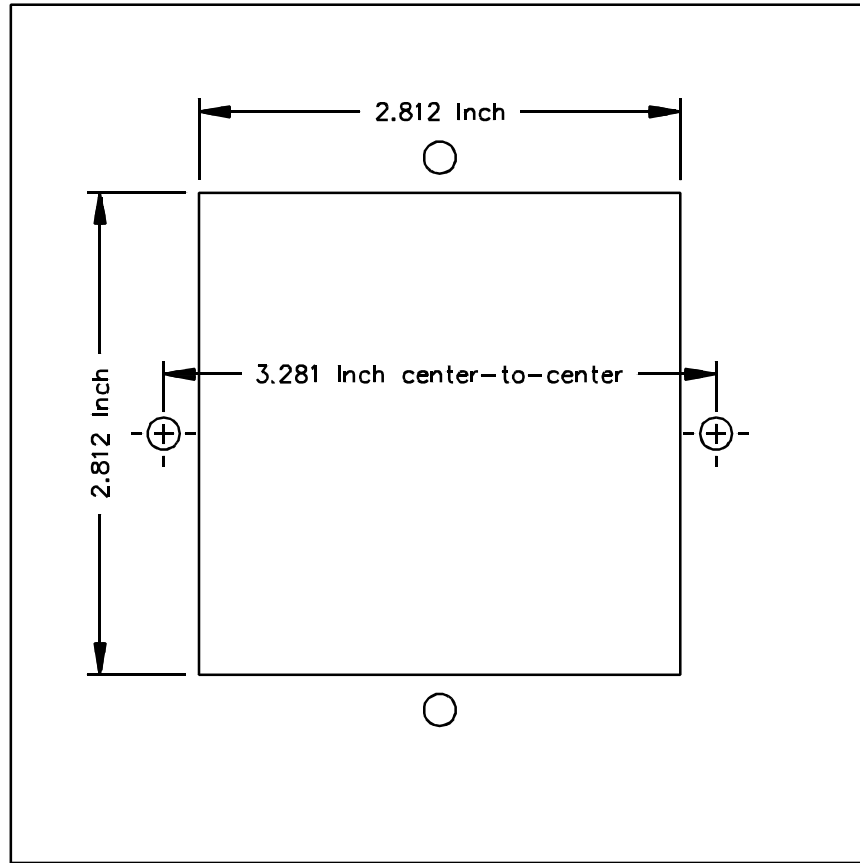
Exception: For receptacles without a wire release mechanism, previously untested receptacles are to be used.

SA17.2 Each receptacle is to be mounted in the test fixture shown in Figure SA17.1 with its face in a vertical plane. The test pin shown in Figure SA17.2 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.

SA17.3 As a result of the test described in SA17.2, 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.

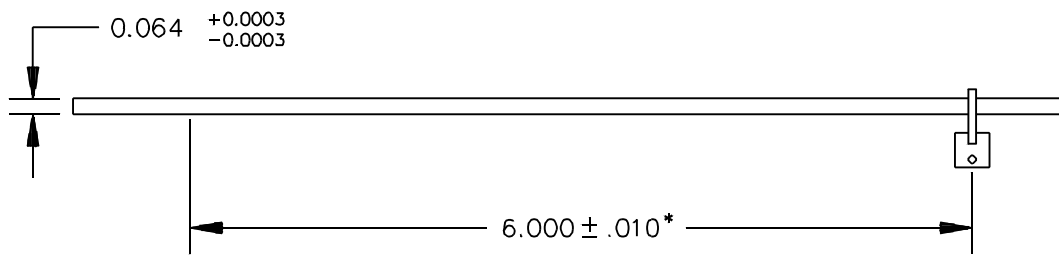
Figure SA17.1
Test fixture



S3631

NOTE – Holes are tapped for No. 6-32 Device Mounting Screws

Figure SA17.2
No. 14 AWG test pin



*Measured from plane of opening in device

NOTE – Pin material – tool steel, nominal 1/16 drill rod

SA18 Temperature Test, Push-In Terminals

SA18.1 A push-in terminal shall not have a temperature rise exceeding 30EC (54EF) based on an ambient temperature of 25EC (77EF) for each test described in this Section.

SA18.2 Separate sets of previously unused receptacles are to be assembled with the conductor sizes and types described in Temperature Test, Section SA7.

SA18.3 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.

SA18.4 Each terminal assembly is to be conditioned by inserting and releasing a solid No. 14 AWG (2.1 mm²) 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 SA18.1, 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 SA18.5.

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.

SA18.5 A fourth insertion of a newly-stripped, previously unused length of solid No. 14 AWG (2.1 mm²) 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.

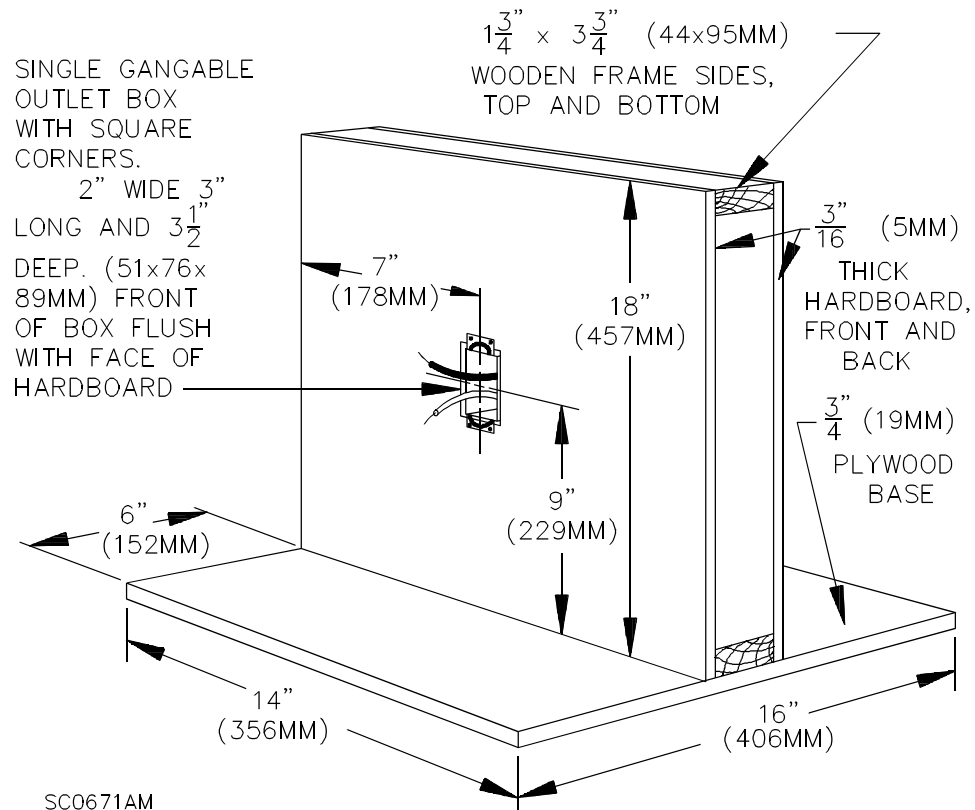
SA18.6 Following the pull test described in SA18.5, the receptacles are to be mounted to the test frame shown in Figure SA18.2 and wired in a series circuit as described in SA18.7.

SA18.7 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.

Figure SA18.1
Outlet box support fixture

Figure SA18.1 revised June 26, 1998

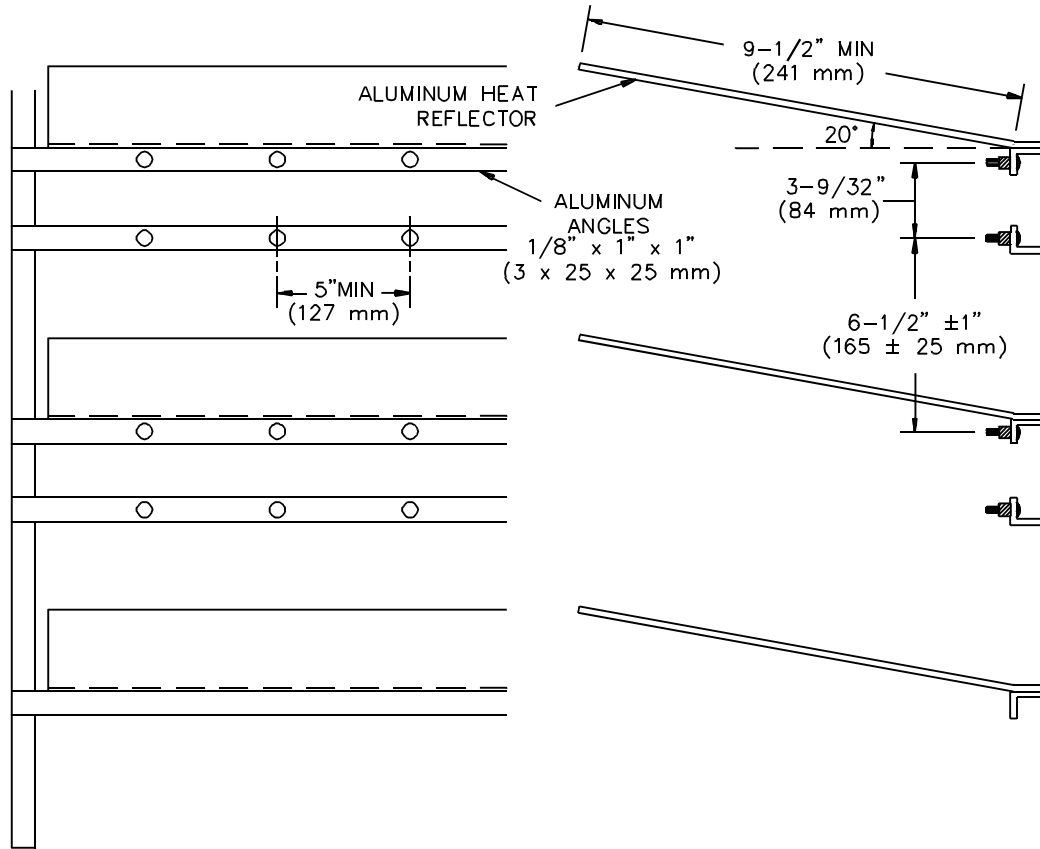


NOTES

- 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.

Figure SA18.2
Test fixture

Figure SA18.2 revised June 26, 1998



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SA18.8 The temperature test sequence is to consist of:

- a) The temperature rise test described in SA18.9 – SA18.10,
- b) The current cycling conditioning described in SA18.11,
- c) The wire disturbance conditioning described in SA18.12, and
- d) The temperature rise test repeated again.

Each tested receptacle is to be subjected to the tests in the order described.

SA18.9 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 SA7.7. Temperatures are also to be measured on the break-off tabs, if provided. See SA7.9.

SA18.10 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.

SA18.11 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.

SA18.12 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.

MARKINGS

SA19 General

SA19.1 Each receptacle shall be marked with the date or other dating period of manufacture not exceeding any three consecutive months. The date of manufacture may be abbreviated; or may be in a nationally accepted conventional code or in a code affirmed by the manufacturer, provided that the code:

- a) Does not repeat in less than 20 years, and
- b) Does not require reference to the production records of the manufacturer to determine when the receptacle was manufactured.

SA19.2 A receptacle employing push-in terminals that are not provided with a wire release mechanism shall be marked "Push-in terminals not for reuse", or with an equivalent wording, where visible during installation.

SA19.3 A receptacle employing only push-in terminals shall be marked "15 ampere branch circuits only" and "No. 14 AWG solid copper conductors only", or equivalent wording where visible during installation. The smallest unit container shall also be marked "For use on 15 ampere branch circuits only and with No. 14 AWG solid copper conductors only", or equivalent wording.

SA19.4 A receptacle employing combination push-in terminals and wire-binding screw terminals shall be marked "Push-in terminals for use on 15 ampere branch circuits only and with No. 14 AWG solid copper conductors only" or equivalent wording where visible during installation. The smallest unit container shall be marked with the following or equivalent wording: "Push-in terminals for use on 15 ampere branch circuits only and with No. 14 AWG solid copper conductor only. Do not use push-in terminals on a 20 ampere branch circuit."

SA20 Installation Instructions

SA20.1 General

SA20.1.1 A receptacle shall be provided with instructions that contain all of the information needed for installation and use as intended. Such instructions may consist of wording, pictorial representation or a combination of both. The instructions shall be located as described in SA20.3.1 – SA20.3.3 and shall include the following:

- a) The manufacturer's name or trademark.
- b) The words "To Install", "Installation Instructions", or the equivalent.
- 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 is acceptable if the instructions also contain a cautionary marking restricting installation to a qualified person. This information need not be provided for a receptacle employing wire leads.
- d) Branch circuit conductor strip length. A strip gauge marked on the device is acceptable; however, if 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 need not be provided for a receptacle employing wire leads.
- e) Wire lead strip length, if the receptacle is provided with wire leads. This information need not be provided if the wire leads are pre-stripped.
- f) Directions for attaching the line, grounded (neutral) and grounding conductors to the appropriate terminals or leads of the receptacle. The words "White Wire", "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 are considered acceptable.

SA20.2 Push-in terminals

SA20.2.1 The installation instructions described in SA20.1.1 shall include reference to the maximum 15 A branch circuit overcurrent protector rating and limitation to No. 14 AWG solid copper branch circuit conductors for a receptacle employing push-in terminals.

SA20.2.2 The installation instructions described in SA20.1.1 shall include instructions regarding reuse or rewiring for a receptacle employing push-in terminals with a wire-release mechanism.

SA20.2.3 The installation instructions described in SA20.1.1 shall 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.

SA20.3 Location

SA20.3.1 The installation instructions required in SA20.1.1 – SA20.2.3 shall be provided 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. See 20.3.2.
- 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.

SA20.3.2 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.

SA20.3.3 If any of the required markings or instructions are placed on:

- a) The unit container or display card, or
- b) The 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.

SUPPLEMENT SB – ENCLOSURE TYPES FOR ENVIRONMENTAL PROTECTION

SB1 Scope

Section SB1 added (date of publication)

SB1.1 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.

SB1.2 A device with an environmental enclosure shall comply with the applicable requirements of this Standard, UL 498, and Supplement SA, except as modified by the requirements in this supplement.

SB1.3 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.

SB2 Glossary

Section SB2 added (date of publication)

SB2.1 For the purposes of this supplement, the following definitions apply.

SB2.2 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.

SB2.3 GASKET – A deformable material clamped between stationary faces to provide a degree of protection as specified in Table SB6.1. This may include surfaces or features formed integrally from parts of the environmental enclosure made of deformable material.

SB2.4 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

SB3 General

SB3.1 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, UL 50, as appropriate.

SB3.1 added (date of publication)

SB3.2 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 UL 514A or UL 514C, as appropriate.

SB3.2 added (date of publication)

SB3.3 The enclosure of an attachment plug, receptacle, inlet, or cord connector marked with an enclosure type designation in accordance with SB7.1 shall comply with the construction requirements in the Standard for Enclosures for Electrical Equipment, UL 50, 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 need not be the same as the enclosure type designation of that device when it is fully connected to its intended mating device.

SB3.3 added (date of publication)

SB3.4 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 SB7.1 is marked only on the removable part.

SB3.4 added (date of publication)

SB3.5 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.

SB3.5 added (date of publication)

SB3.6 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.

SB3.6 added (date of publication)

SB3.7 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.

SB3.7 added (date of publication)

SB3.8 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.

SB3.8 added (date of publication)

SB3.9 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 SB7.7.

Added SB3.9 effective (24 months after the date of publication)

SB3.10 The Type 6 or 6P environmental enclosure designation shall be limited to grounding-type attachment plugs, receptacles, cord connectors, and inlets.

SB3.10 added (date of publication)

SB4 Polymeric Enclosures

Section SB4 added (date of publication)

SB4.1 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 SB6.

Exception No. 2: A part fully internal to the environmental enclosure is not required to comply with this requirement.

SB4.2 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 SB6.

Exception No. 2: A part fully internal to the environmental enclosure is not required to comply with this requirement.

SB5 Gaskets

Section SB5 added (date of publication)

SB5.1 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.

SB5.2 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.

SB5.3 The gasket material shall comply with the Standard for Gaskets and Seals, UL 157.

PERFORMANCE

SB6 General

Section SB6 added (date of publication)

SB6.1 The enclosure of a device shall comply with the requirements and tests specified in Table SB6.1 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, UL 50, 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.

SB6.2 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.

SB6.3 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 UL 50, 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 SB6.1
Environmental enclosure types**

Type	Intended use and description	Requirements or qualification tests from UL 50
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, Drip Test, Gaskets, 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, Dust Test or the hose test described in the Hose and Hosedown Tests, Icing Test, Outdoor Enclosures, Indoor Enclosures, Corrosion Resistant Enclosures, Gaskets, Gasket Tests
3R	Outdoor use primarily to provide a degree of protection against rain, sleet, and damage from external ice formation.	Rain Test, Icing Test, Outdoor Enclosures, Indoor Enclosures, Corrosion Resistant Enclosures, Gaskets, 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, Outdoor method of the Dust Test or the hose test described in the Hose and Hosedown Tests, Icing Test, Outdoor Enclosures, Indoor Enclosures, Corrosion Resistant Enclosures, Gaskets, 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, Outdoor Enclosures, Indoor Enclosures, Corrosion Resistant Enclosures, Icing Test, Gaskets, 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, Outdoor Enclosures, Indoor Enclosures, Corrosion Resistant Enclosures, Corrosion Resistance Test, Icing Test, Gaskets, Gasket Test

(Continued)

Table SB6.1 (Cont'd)

Type	Intended use and description	Requirements or qualification tests from UL 50
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, Drip Test, Indoor settling airborne dust method of the Dust Test or the Atomized water test - method B of the Atomized Water Test, Gaskets, 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, Icing Test, Submersion Test, Outdoor Enclosures, Indoor Enclosures, Corrosion Resistant Enclosures, Gaskets, 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, Icing Test, Outdoor Enclosures, Indoor Enclosures, Corrosion Resistant Enclosures, Air Pressure Test, Gaskets, 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, Drip Test, Indoor circulating airborne method of the Dust Test or the Atomized water test - method A of the Atomized Water Test, Gaskets 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, Oil Test, Gaskets, Gasket Tests

SB6.4 When conducting the Rain Test, the Drip Test, the Hose and Hosedown Tests, and the Submersion Test in UL 50, 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.

SB6.5 The Rain Test and the Drip Test are not required to be conducted when the enclosure complies with the Hose and Hosedown Tests. Table SB6.2 lists other acceptable substitutes for specific qualification tests from UL 50.

Table SB6.2
Acceptable test substitutes

Qualification test from UL 50	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 the 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

SB6.6 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.

SB6.7 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.

SB6.8 The ball impact test mentioned in SB6.7 is to be conducted:

- a) At room temperature for all devices,
- b) Immediately after being conditioned for three hours in a cold chamber at -35EC (-31EF) 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 0EC (32EF) 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

SB7 General

SB7.1 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 SB6.1. 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 SB3.4). 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.

SB7.1 added (date of publication)

SB7.2 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.

SB7.2 added (date of publication)

SB7.3 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 SB7.1.

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 SB7.1 is able to be used when it is demonstrated that the temperature is not exceeded in service.

SB7.3 added (date of publication)

SB7.4 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.

SB7.4 added (date of publication)

SB7.5 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 SB7.4, 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.

SB7.5 added (date of publication)

SB7.6 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 SB3.2.

SB7.6 added (date of publication)

SB7.7 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."

Added SB7.7 effective (24 months after the date of publication)

SB7.8 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.

SB7.8 added (date of publication)

Table SB7.1
Label exposure conditions

Table SB7.1 added (date of publication)

Enclosure type number	Label exposure conditions	Maximum surface temperature EC (EF)	Minimum surface temperature EC (EF)
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 SC – MARINE SHORE POWER INLETS

INTRODUCTION

SC1 Scope

Section SC1 added June 26, 1998

SC1.1 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.

SC2 Glossary

Section SC2 added June 26, 1998

SC2.1 For the purpose of this supplement, the following definitions apply.

SC2.2 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.

SC2.3 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.

SC2.4 SHORE POWER INLET – A boat-mounted inlet (motor attachment plug) intended to provide connection for a shore power cable set.

SC3 General

Section SC3 added June 26, 1998

SC3.1 A marine shore power inlet shall comply with the requirements for inlets this standard and the requirements for wet-location cover plates in the Standard for Metallic Outlet Boxes, UL 514A, or the Standard for Nonmetallic Outlet Boxes, Flush Device Boxes, and Covers, UL 514C, as applicable, except as modified by the requirements in this Supplement.

CONSTRUCTION

SC4 General

Section SC4 added June 26, 1998

SC4.1 A shore power inlet shall employ one of the configurations shown in Figures C2.4, C2.5, C2.7, C2.8, C2.24 – C2.27, C2.37, C2.38, C2.43 or C2.44 of the Standard for Wiring Device Configurations, UL 1681.

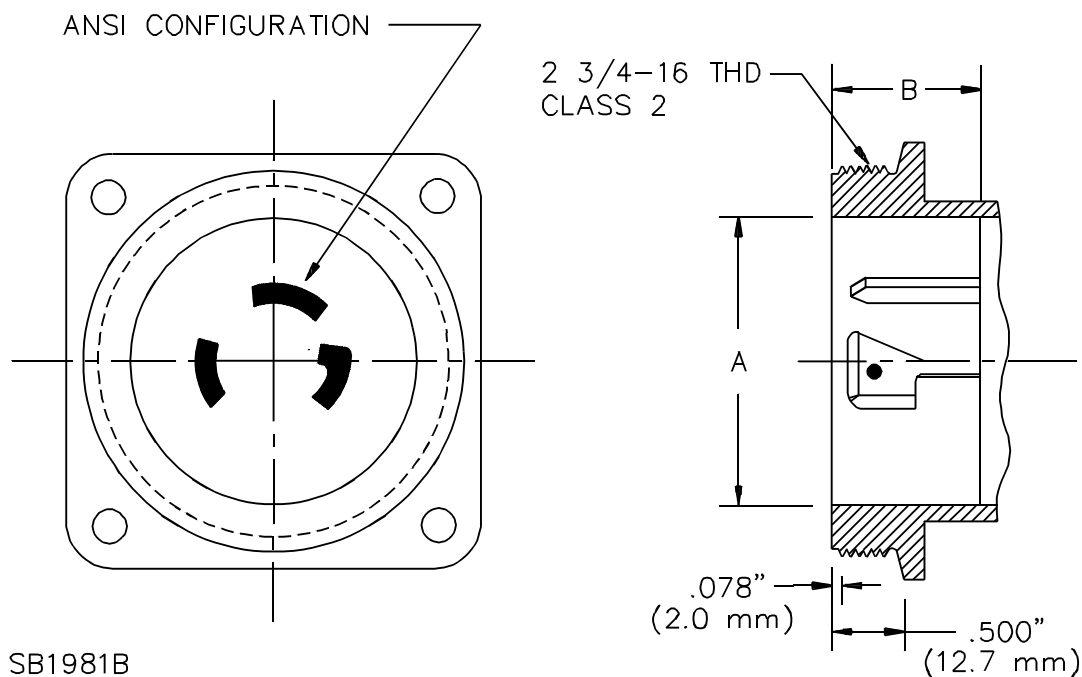
SC4.2 A shore power inlet shall be provided with a threaded hub and a threaded or hinged face cover. The hub and the face cover, if threaded, shall have a 2-3/4 – 16, Class 2 thread having at least three full threads. A shore power inlet shall be dimensioned to couple with a shore power cable set load fitting of a corresponding configuration. The face cover shall be positively retained in place on the shore power inlet. See Table SC4.1 and Figure SC4.1 for the required dimensions.

Table SC4.1
Dimensions for a shore power inlet as shown in Figure SC4.1

ANSI Standard designation	Rating	Shore power inlet, inches (mm)		Figure in UL 1681
		A ^a	B	
C73-72	20A, 125 V, 1 Phase, 2 Pole, 3 Wire	1.880 (47.75)	0.921 ^b (23.39)	C2.4
C73-73	30 A, 125 V, 1 Phase, 2 Pole, 3 Wire	1.880 (47.75)	1.000 ^b (25.40)	C2.5
C73-75	20 A, 250 V, 1 Phase, 2 Pole, 3 Wire	1.880 (47.75)	0.921 ^b (23.39)	C2.7
C73-76	30 A, 250 V, 1 Phase, 2 Pole, 3 Wire	1.880 (47.75)	1.000 ^b (25.40)	C2.8
C73-83	20 A, 125/250 V, 1 Phase, 3 Pole, 4 Wire	2.000 (50.80)	0.921 ^b (23.39)	C2.24
C73-84	30 A, 125/250 V, 1 Phase, 3 Pole, 4 Wire	2.000 (50.80)	1.000 ^b (25.40)	C2.25
C73-85	20 A, 250 V, 3 Phase, 3 Pole, 4 Wire	2.000 (50.80)	0.921 ^b (23.39)	C2.26
C73-86	30 A, 250 V, 3 Phase, 3 Pole, 4 Wire	2.000 (50.80)	1.000 ^b (25.40)	C2.27
C73-90	20 A, 208Y/120 V, 3 Phase, 4 Pole, 5 Wire	2.000 (50.80)	0.921 ^b (23.39)	C2.37
C73-91	30 A, 208Y/120 V, 3 Phase, 4 Pole, 5 Wire	2.000 (50.80)	1.000 ^b (25.40)	C2.38
C73-110 ^d	50 A, 125 V, 1 Phase, 2 Pole, 3 Wire	2.015 (51.18)	1.163 ^c (29.54)	C2.43
C72-111 ^d	50 A, 125/250 V, 1 Phase, 3 Pole, 4 Wire	2.015 (51.18)	1.163 ^c (29.54)	C2.44
^a Minimum dimension. ^b Tolerance of minus 0, plus 0.031 (plus 0.79 mm). ^c Maximum dimension. ^d Small-craft.				

SC4.3 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 SC11.

Figure SC4.1
Dimensions of a shore power inlet



SC5 Insulating Materials

Section SC5 added June 26, 1998

SC5.1 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 need not be subjected to the Ultraviolet Light Exposure Test.

SC6 Corrosion Resistance

Section SC6 added June 26, 1998

SC6.1 All current-carrying parts shall be copper alloy. The blades of the shore power inlet shall be provided with a corrosion-resistant plating.

SC6.2 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.

SC6.3 If there is any question as to whether the parts are corrosion resistant, the Salt-Spray Test, Section SC8, shall be performed.

PERFORMANCE

SC7 General

Section SC7 added June 26, 1998

SC7.1 A shore power inlet shall be subjected to the Mechanical Strength Test, Section SC10, the Water-Spray Test, Section SC11, and the Shock Test, Section SC12. If necessary to determine compliance with the corrosion resistance requirements in SC6.2, a shore power inlet shall also be subjected to the Salt-Spray Test, Section SC8, and the Dielectric Voltage-Withstand Test, Section SC9.

SC8 Salt-Spray Test

Section SC8 added June 26, 1998

SC8.1 If necessary to determine compliance with the corrosion resistance requirement in SC6.2, a shore power inlet shall be exposed to salt spray (fog) as described in SC8.2. Following the exposure, the shore power inlet shall comply with the Dielectric Voltage-Withstand Test, Section SC9, the Mechanical Strength Test, Section SC10, and the Water-Spray Test, Section SC11.

SC8.2 The salt spray exposure is to be conducted for a period of 750 hours in accordance with the Standard Method of Salt Spray (Fog) Testing, ASTM B117-73 (1979).

SC9 Dielectric Voltage-Withstand Test

Section SC9 added June 26, 1998

SC9.1 After being subjected to the Salt-Spray Test, Section SC8, 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.

SC9.2 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.

SC10 Mechanical Strength Test

Section SC10 added June 26, 1998

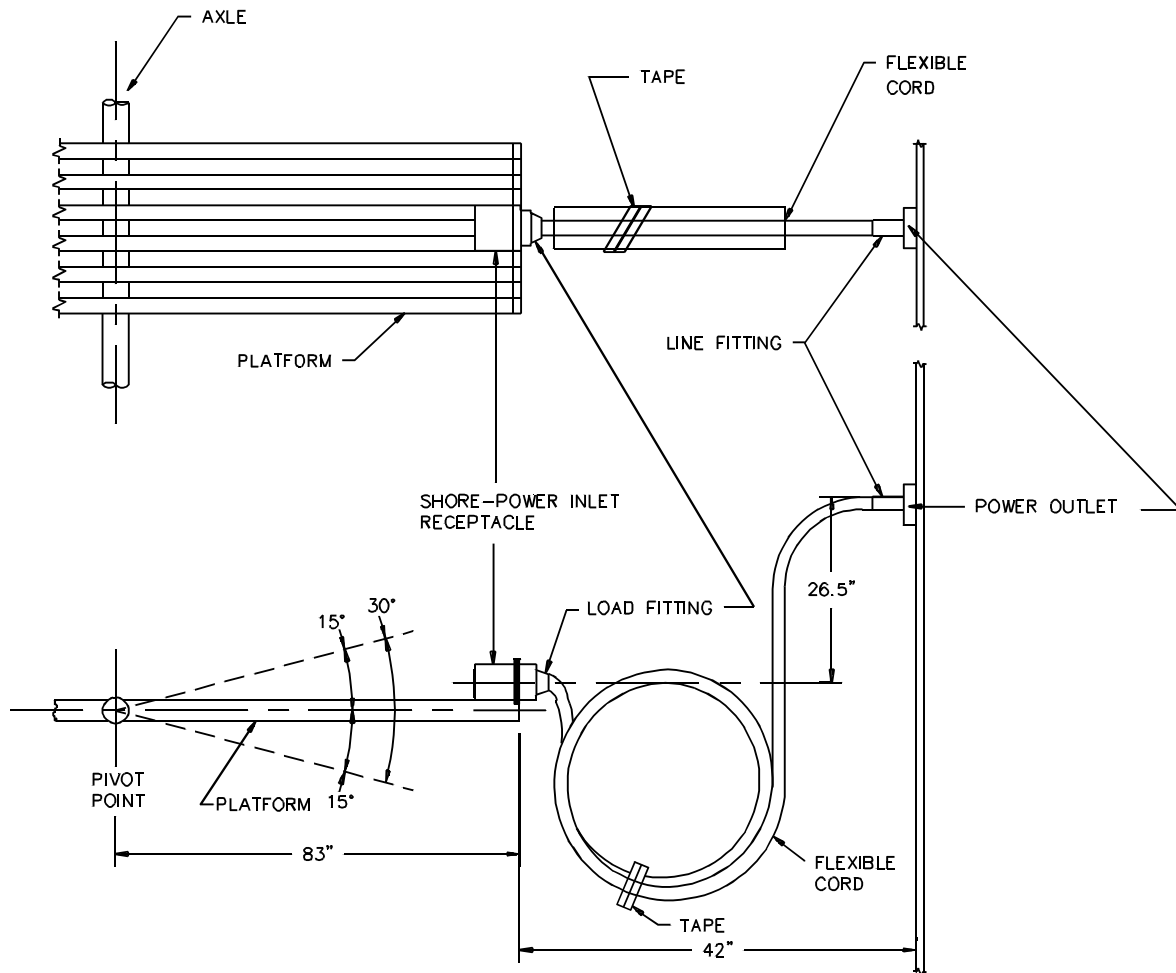
SC10.1 As a result of the test described in SC10.2 – SC10.4, there shall not be any cracking, breaking, or other physical deterioration of the shore power inlet.

SC10.2 One shore power inlet is to be installed on a platform as shown in Figure SC10.1. 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.

SC10.3 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.

SC10.4 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 SC10.1
Mechanical strength test apparatus



SB1968

Inch	26.5	42	83
mm	0.67	1.07	2.11

SC11 Water-Spray Test

Section SC11 added June 26, 1998

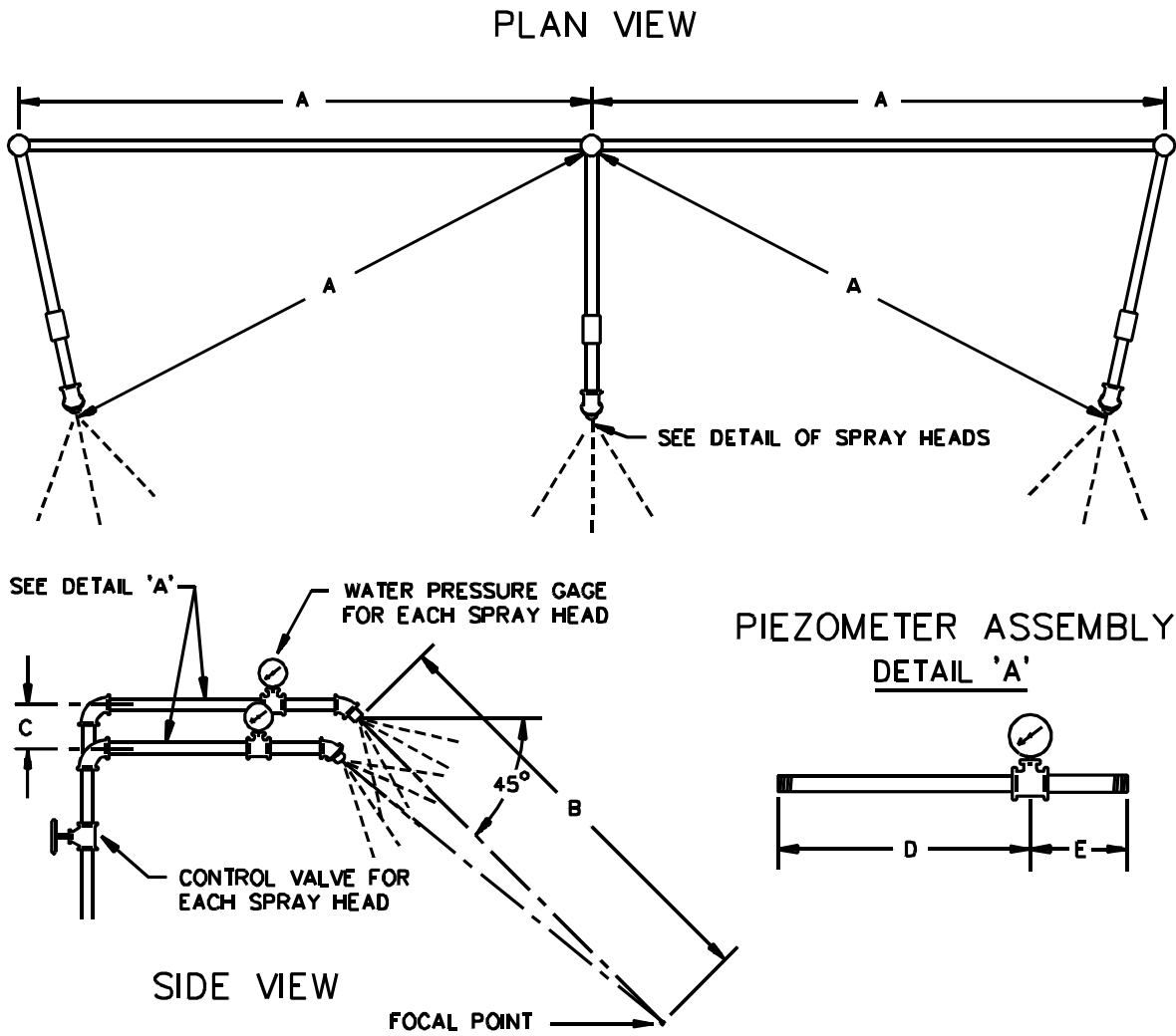
SC11.1 As a result of the test described in SC11.2 – SC11.4, water shall not contact the current-carrying parts of a shore power inlet.

SC11.2 One shore power inlet is to be mounted to a vertical wall section with its face cover in the closed position.

SC11.3 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 SC11.1. The spray heads are to be constructed in accordance with Figure SC11.2. 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/in² (34 kPa) at each spray head.

SC11.4 After being subjected to the water spray described in SC11.3, 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.

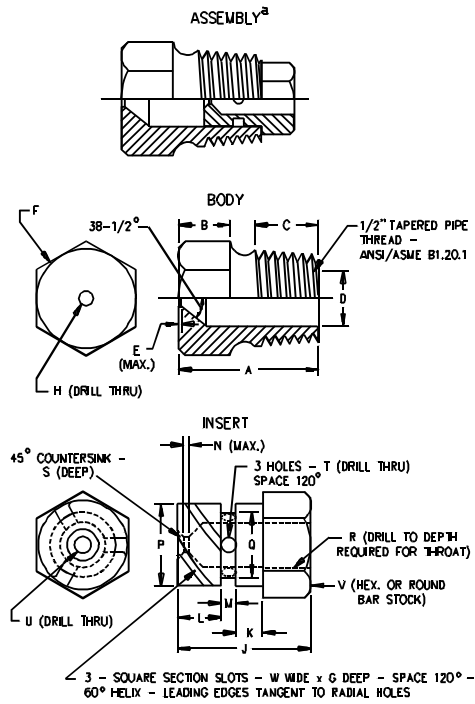
Figure SC11.1
Water-spray-head piping



RT101B

Item	Inch	mm
A	28	710
B	55	1400
C	2-1/4	55
D	9	230
E	3	75

Figure SC11.2
Water-spray head



RT100C

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 Inc.

^b ANSI B94.11M Drill Size

^c Optional – To serve as wrench grip.

SC12 Shock Test

Section SC12 added June 26, 1998

SC12.1 As a result of the test described in SC12.2 – SC12.4:

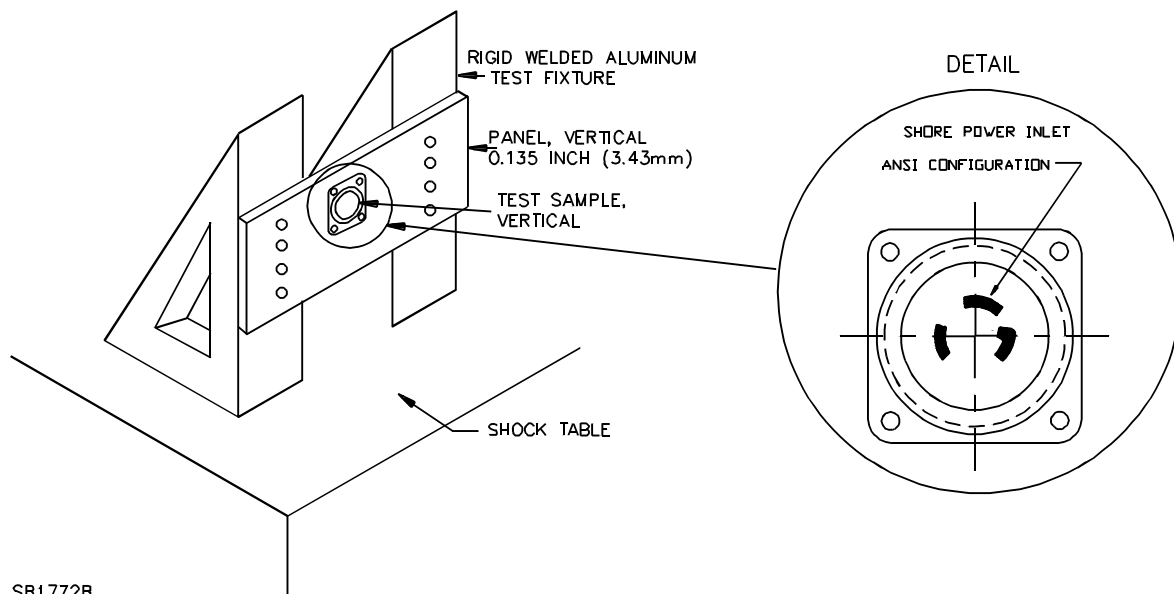
- a) There shall not be any cracking, breaking, or physical deterioration of the shore power inlet, and
- b) No portion of the flexible cord attached to the wiring terminals of the shore power inlet shall pull out of the device.

SC12.2 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 SC12.1.

SC12.3 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.

SC12.4 The assembly (device, fixture, and cord) is to be subjected to 1000 shock impacts of 10 g [322 ft/s² (98 m/s²)] 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 SC12.1
Shock test



SB1772B

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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

Configurations, Wiring Device – UL 1681
Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors – UL 486E
Fuseholders – UL 512
Marking and Labeling Systems – UL 969
Outlet Boxes, Flush-Device Boxes, and Covers, Nonmetallic – UL 514C
Outlet Boxes, Metallic – UL 514A
Plastic Materials for Parts in Devices and Appliances, Tests for Flammability of – UL 94
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
Switches, Enclosed and Dead-Front – UL 98
Switches, General-Use Snap – UL 20
Wire Connectors and Soldering Lugs for Use with Copper Conductors – UL 486A
Wire Connectors for Use with Aluminum Conductors – UL 486B

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Superseded requirements for

the Standard for

Attachment Plugs and Receptacles

UL 498, Thirteenth Edition

The requirements shown are the current requirements that have been superseded by requirements in revisions issued for this Standard. To retain the current requirements, do not discard the following requirements until the future effective dates are reached.

162.1 Current taps and adapters:

- a) That can accommodate a 3-wire grounding attachment plug having one of the configurations indicated in Figures C1.5, C1.6, C1.9, C1.10, C1.13, C1.24, and C1.29 [U-shaped grounding pin clearance opening intended to receive an 0.184 – 0.190 by 0.843 inch (4.67 – 4.83 by 21.41 mm) maximum attachment plug grounding pin] and
- b) That are provided with a means for fixed attachment to a receptacle

are to be subjected to the tests indicated in this Section.

162.2 The adapters, current taps, and similar devices will remain in a vertical plane during each of the 1 minute contact conditioning periods.

162.3 Previously untested devices are to be used. Each device is to be mounted on a flush receptacle as intended, with its face in a vertical plane. A nonmetallic faceplate is to be installed if intended. A solid No. 14 AWG (2.1 mm²) copper conductor is to be connected to the receptacle grounding terminal.

162.4 With the device oriented to create the maximum contact displacement (possible distortion of contact affecting its contact ability), the test pin A, Figure 162.1 is to be fully inserted in the grounding contact of the current tap or adapter under test. A 5 lb (2.27 kg) weight is to be gradually suspended from the test pin 6 inches (152 mm) from the face of the current tap or adapter. 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 current tap or adapter 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.

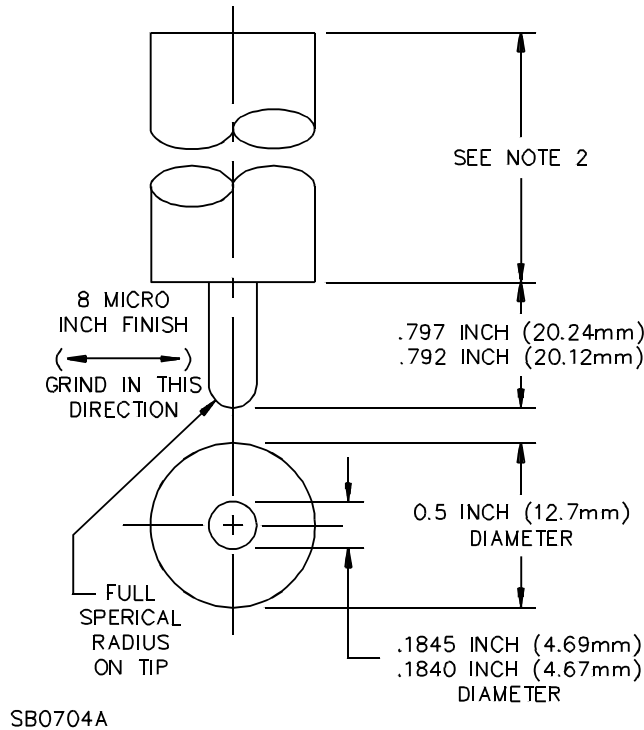
162.5 As a result of the test described in 162.3, there shall not be any breakage of the outlet face of the current tap or adapter that would expose live parts to contact by 1/16 inch (1.6 mm) diameter rod. In addition, there shall not be any breakage or distortion of the insulating body of the current tap or adapter that results in reduction of electrical spacings to values less than those required for the device. The conditioning pin shall remain in place without extraneous support for the required 1 minute in each position.

162.6 Each device is then to be tested for electrical continuity between the outlet grounding contact and the fully inserted test pin B, Figure 162.2. 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 shall remain continuously in contact with the face of the current tap or adapter. An indicating device, such as an ohmmeter, a battery-and-buzzer combination, or the like, is to be used.

162.7 Each device is then to be positioned with the current tap or adapter facing down in a horizontal position. The device under test shall support the 2 and 4 oz. (57 and 113 g) grounding pin illustrated in Figures 162.3 and 162.4, for 1 minute each when fully inserted in the grounding pin opening.

Figure 162.3
2 oz (57 g) ground pin

(All dimensions in inches)



Material: Pin-Steel, Rockwell Hardness C58 to C60.
Handle – cold rolled steel

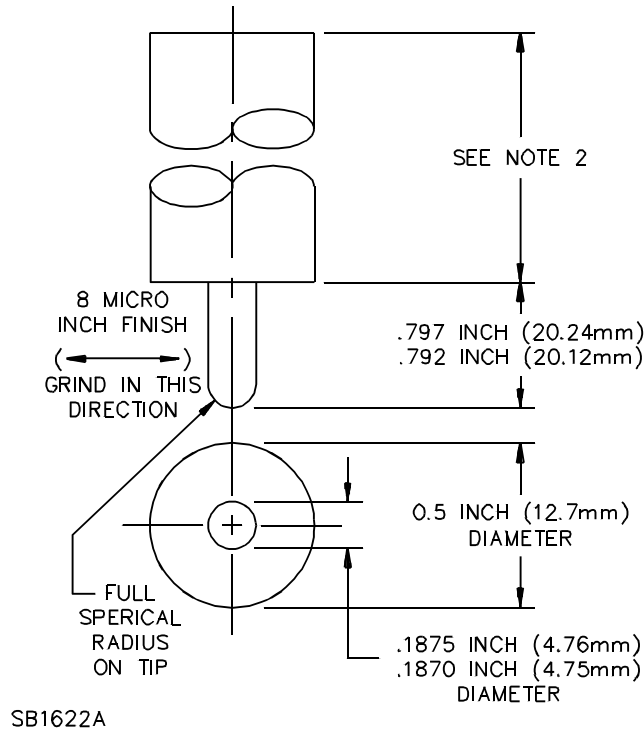
NOTES

- 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.

inch	0.1840	0.1845	0.792	0.797	0.5
mm	4.694	4.686	20.11	20.24	12.7
microinch	8				
micrometer	0.2				

Figure 162.4
4 oz (113 g) ground pin

(All dimensions in inches)



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.

inch	0.1870	0.1875	0.792	0.797	0.5
mm	4.750	4.763	20.11	20.24	12.7
microinch	8				
micrometer	0.2				

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