UL 498F

STANDARD FOR SAFETY

Plugs, Socket-Outlets and Couplers with Arcuate (Locking Type) Contacts

UL Standard for Safety for Plugs, Socket-Outlets and Couplers with Arcuate (Locking Type) Contacts, UL 498F

First Edition, Dated July 29, 2020

SUMMARY OF TOPICS

This revision of ANSI/UL 498F dated September 21, 2021 includes a revision to the Spring Action Terminals requirements; 12.6.1, 12.6.4, 19.3.2, Section 23A, Table 34.1, Table 34.3, Section 49A, Section 62A, Table 89.1, Table 89.3

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

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

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UL 498F

Standard for Plugs, Socket-Outlets and Couplers with Arcuate (Locking Type) Contacts

First Edition

July 29, 2020

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

The most recent designation of ANSI/UL 498F as an American National Standard (ANSI) occurred on September 20, 2021. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

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

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INTRODUCTION

1 Scope

1.1 These requirements cover plugs, socket outlets (receptacles), couplers, cord connectors, and inlets, with arcuate contacts (locking-type configurations), rated 20 or 30 A grounding type only. All intended for connection to a branch circuit for use in accordance with the National Electrical Code, ANSI/NFPA 70.

1.2 These requirements do not cover plugs, socket outlets (receptacles), couplers, cord connectors, and inlets with arcuate contacts (locking-type configurations) rated 20 and 30 A non-grounding type, or devices rated 15, 50 or 60 A grounding or non-grounding type, refer to UL 498D Standard.

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

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

a) Straight-blade attachment plugs, receptacles, cord connectors, and inlets, covered by the Standard for Attachment Plugs and Receptacles, UL 498;

b) Attachment plugs, receptacles, cord connectors, and inlets with arcuate contacts (locking-type configurations) – Enclosure Types for Environmental Protection, UL 498E;

c) Inlets with arcuate contacts (locking-type configurations) – Marine Shore Power Inlets, UL 498M;

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

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

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

g) 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;

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

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

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

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

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

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

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

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

2 Components

2.1 A component of a product covered by this Standard shall:

a) Comply with the requirements for that component as specified in this Standard;

b) Be used in accordance with its rating(s) established for the intended conditions of use; and

c) Be used within its established use limitations or conditions of acceptability.

2.2 A component of a product covered by this Standard is not required to comply with a specific component requirement that:

a) Involves a feature or characteristic not required in the application of the component in the product;

b) Is superseded by a requirement in this Standard; or

c) Is separately investigated when forming part of another component, provided the component is used within its established ratings and limitations.

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

2.4 A component that is also intended to perform other functions such as overcurrent protection, ground-fault circuit-interruption, surge suppression, any other similar functions, or any combination thereof, shall comply additionally with the requirements of the applicable UL standard(s) that cover devices that provide those functions.

3 Units of Measurement

3.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

4 Referenced Publications

4.1 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.

4.2 The following publications are referenced in this Standard:

ANSI/NEMA WD6, *Wiring Devices – Dimensional Specifications*
ANSI/NFPA 70, *National Electrical Code*
ASTM D 570, *Test Method for Water Absorption of Plastics*

ASTM E28, *Standard Test Methods for Softening Point of Resins Derived from Naval Stores by Ring-and-Ball Apparatus*
UL 20, *Standard for General-Use Snap Switches*
UL 94, *Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances*
UL 98, *Standard for Enclosed and Dead-Front Switches*
UL 486A-486B, *Standard for Wire Connectors*
UL 486E, *Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors*
UL 496, *Standard for Lampholders*
UL 498, *Standard for Attachment Plugs and Receptacles*
UL 498A, *Standard for Current Taps and Adapters*
UL 498D, *Standard for Attachment Plugs, Cord Connectors and Receptacles with Arcuate (Locking Type) Contacts*
UL 498E, *Standard for Attachment Plugs, Cord Connectors and Receptacles – Enclosure Types for Environmental Protection*
UL 498M, *Standard for Marine Shore Power Inlets*
UL 514A, *Standard for Metallic Outlet Boxes*
UL 514B, *Standard for Conduit, Tubing, and Cable Fittings*
UL 514C, *Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers*
UL 746A, *Standard for Polymeric Materials – Short Term Property Evaluations*
UL 746B, *Standard for Polymeric Materials – Long Term Property Evaluations*
UL 746C, *Standard for Polymeric Materials – Use in Electrical Equipment Evaluations*
UL 746D, *Standard for Polymeric Materials – Fabricated Parts*
UL 796, *Standard for Printed-Wiring Boards*
UL 817, *Standard for Cord Sets and Power-Supply Cords*
UL 943, *Standard for Ground-Fault Circuit Interrupters*
UL 969, *Standard for Marking and Labeling Systems*
UL 1203, *Standard for Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations*
UL 1283, *Standard for Electromagnetic Interference Filters*
UL 1363, *Standard for Relocatable Power Taps*
UL 1449, *Standard for Surge Protective Devices*
UL 1681, *Standard for Wiring Device Configurations*
UL 1682, *Standard for Plugs, Receptacles and Cable Connectors of the Pin-and-Sleeve Type*
UL 1691, *Standard for Single Pole Locking-Type Separable Connectors*
UL 1863, *Standard for Communications Circuit Accessories*
UL 1977, *Standard for Component Connectors for Use in Data, Signal, Control and Power Applications*
UL 4248-1, *Standard for Fuseholders – Part 1: General Requirements*
UL 4248-4, *Standard for Fuseholders – Part 4: Class CC*
UL 4248-5, *Standard for Fuseholders – Part 5: Class G*
UL 4248-6, *Standard for Fuseholders – Part 6: Class H*
UL 4248-8, *Standard for Fuseholders – Part 8: Class J*
UL 4248-9, *Standard for Fuseholders – Part 9: Class K*
UL 4248-11, *Standard for Fuseholders – Part 11: Type C (Edison Base) and Type S Plug Fuse*
UL 4248-12, *Standard for Fuseholders – Part 12: Class R*
UL 4248-15, *Standard for Fuseholders – Part 15: Class T*
UL 60950-1, *Standard for Information Technology Equipment – Safety – Part 1: General Requirements*
UL 61058-1, *Standard for Switches for Appliances – Part 1: General Requirements*

5 Glossary

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

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

5.3 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.

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

5.5 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.

5.6 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.

5.7 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.

5.8 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.

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

5.10 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.

5.11 GROUNDING DEVICE – A device having a L5-15, L6-15, TT-R, or ML-2R configuration, the standard configuration illustrated in the Hospital Use Only 2-Pole, 3-Wire Grounding-Type Locking Devices Rated 20 A, 125 V, Figure C1.1 of UL 1681, or a nonstandard configuration that employs one blade, pin, or contact exclusively for grounding.

5.12 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.

5.13 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.

5.14 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.

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

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

5.17 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.

5.18 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.

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

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

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

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

5.21 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.

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

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

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

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

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

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

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

5.26 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.

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

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

5.29 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

6 All Devices

6.1 The ratings mentioned throughout this Standard including those mentioned in Table 88.1 represent maximum ampacity and maximum operating potential in volts for receptacles and other outlet devices such as cord connectors or current taps.

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

7 Configurations

7.1 The NEMA configurations of various attachment plug and receptacle combinations referenced in this Standard are in accordance with ANSI/NEMA WD6, and are included in Annex A for ease of reference. The figures referenced as Section C1 contain non-NEMA configurations and are found in UL 1681.

8 Insulating Materials

8.1 General

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

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

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

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

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

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

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

8.1.2 A polymeric material used for electrical insulation or enclosure of live parts shall be fabricated in accordance with UL 746D.

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

8.2 Flammability

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

Exception: A polymeric material that complies with either the 3/4-inch (12 mm or 20 mm) flame flammability test described in UL 746C, need not have a flammability class rating.

8.3 Electrical properties

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

Exception No. 1: A polymeric material used for electrical insulation or enclosure of live parts is not required to comply with this requirement if it complies with the Comparative Tracking Index Test, Section 35.

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

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

Exception No. 1: A polymeric material used for electrical insulation or enclosure of live parts is not required to comply with the HWI requirements if it complies with the Glow Wire Test, Section 36.

Exception No. 2: A polymeric material used for electrical insulation or enclosure of live parts is not required to comply with the HAI requirements if it complies with the High-Current Arc Resistance to Ignition Test, Section 37.

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

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

Table 8.1
Hot Wire Ignition (HWI) and High-Current Arc Resistance to Ignition (HAI) Ratings of Insulating Materials

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

[a] Flammability classification – Described in UL 94.

[b] Hot Wire Resistance to Ignition – Described in UL 746A.

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

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

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

8.4 Thermal properties

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

Exception: The following generic materials having readings of 65 or less on the Shore Durometer D scale (when measured for 5 seconds at an ambient temperature of 73.4 ±3.6°F (23.0 ±2.0°C) are acceptable for use at 140°F (60°C) based on their successful completion of the appropriate accelerated aging test described in Accelerated Aging Tests, Section 41:

a) Ethylene/Propylene/Diene (EPDM)

b) Natural Rubber (NR)

c) Neoprene (Chloroprene Butadiene) Rubber (CBR)

d) Nitrile Rubber (NBR)

e) Polyvinyl Chloride (PVC) and its copolymers

f) Silicone Rubber (SIR)

g) Styrene (Butadiene) Rubber (SBR)

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

Table 8.2
Minimum Relative Thermal Indices of Insulating Materials Used in Insulation and Enclosure Applications

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

[a] Relative Thermal Index – Described in 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 50, 53, 62 and 71.

8.5 Vulcanized fiber

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

8.5.2 Vulcanized fiber shall comply with the requirements in 8.2.1 – 8.4.1 and shall be moisture-resistant in accordance with 39.1 and 39.2.

8.6 Sealing compounds

8.6.1 A sealing compound shall be insulating, waterproof, and shall not soften at a temperature of 65°C (149°F). The softening point is to be determined using ASTM E28.

8.6.2 Sulphur shall not be employed as a sealing compound.

8.7 Fuse enclosures

8.7.1 A fuse enclosure shall be of a moisture-resistant material in accordance with 39.1 and 39.2. Fiber and similar absorptive materials shall not be used for the enclosure of a fuse.

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

9 Enclosure

9.1 General

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

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

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

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

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

9.1.3 Accessible dead-metal parts of a non-grounding device shall be electrically insulated from live parts and wiring other than the complete flexible cord so that they are unable to be energized by stray strands, failure of wiring terminals (such as loosening of screws), or damaged or broken wiring. When the stray strand length affects whether a device complies with this requirement, the device shall be marked in accordance with Reference No. 3 to Table 89.1. See 9.1.7.

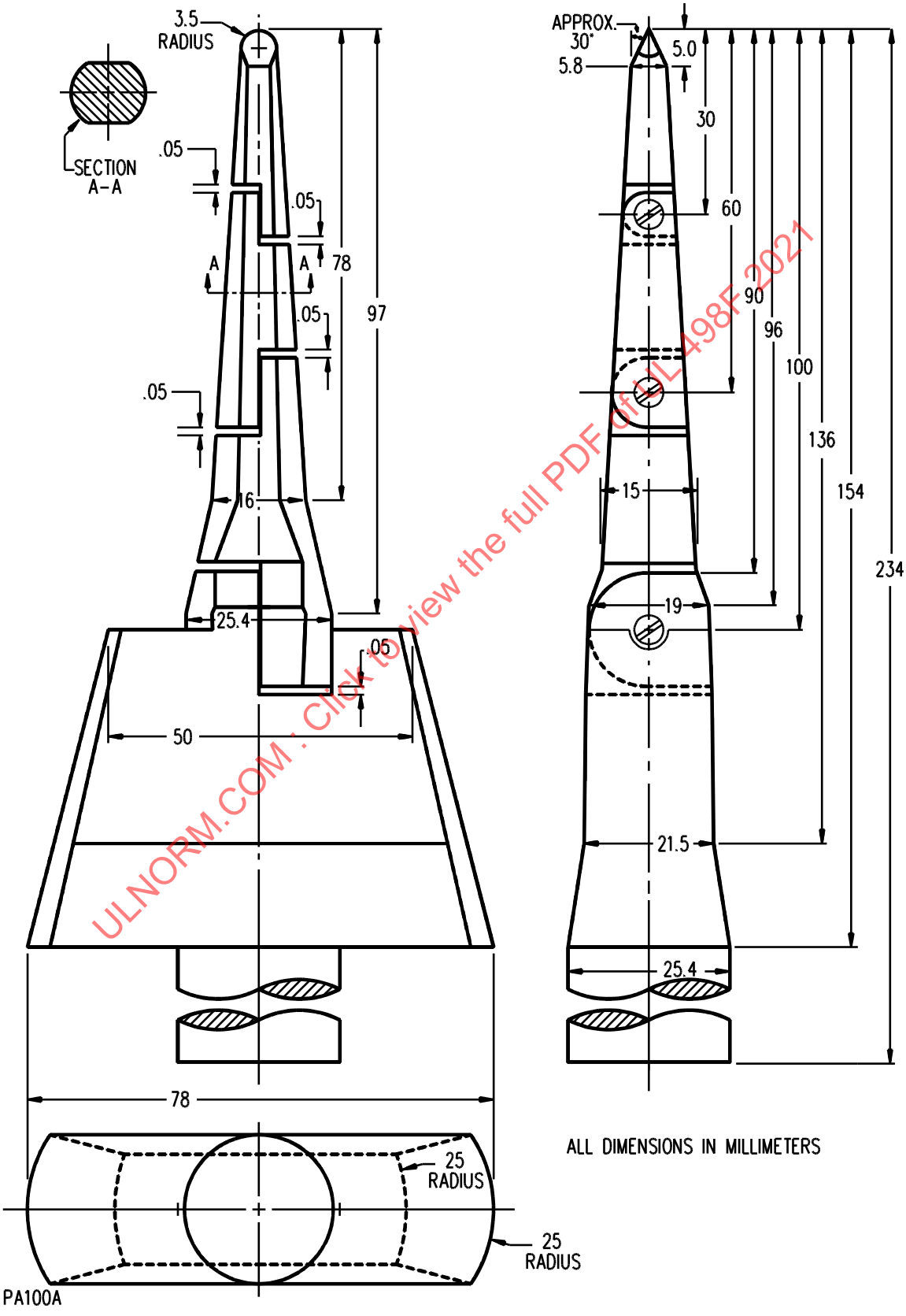
9.1.4 In order to judge the accessibility of a live or dead-metal part, the device is to be wired and assembled in accordance with the manufacturer's instructions, except that any nonessential parts (described in 9.1.6) that are able to be opened or removed by the user without using a tool are to be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

a) The part is contacted by the probe, or

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

Figure 9.1

Articulate Probe with Web Stop



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

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

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

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

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

a) Provides strain relief;

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

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

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

9.2 Male faces and wire terminations

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

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

9.2.3 An insulating disc or face cover intended to be opened or removed to provide access to the wiring terminals shall be mechanically secured after wiring by one or more screws, latches, or detents that cannot be unintentionally opened or removed. A cover that is held in place by only friction without any positive detent action is not considered mechanically secured and is to be subjected to the Secureness-Of-Cover Test described in Section 47.

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

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

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

b) It shall not be wider than 3/8 inch (9.5 mm) along the periphery of the cover; and

c) It shall not be located within 3/8 inch (9.5 mm) of the binding screw head as measured from the closest point in the notch periphery.

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

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

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

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

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

10 Current-Carrying Parts

10.1 General

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

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

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

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

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

10.2 Contacts

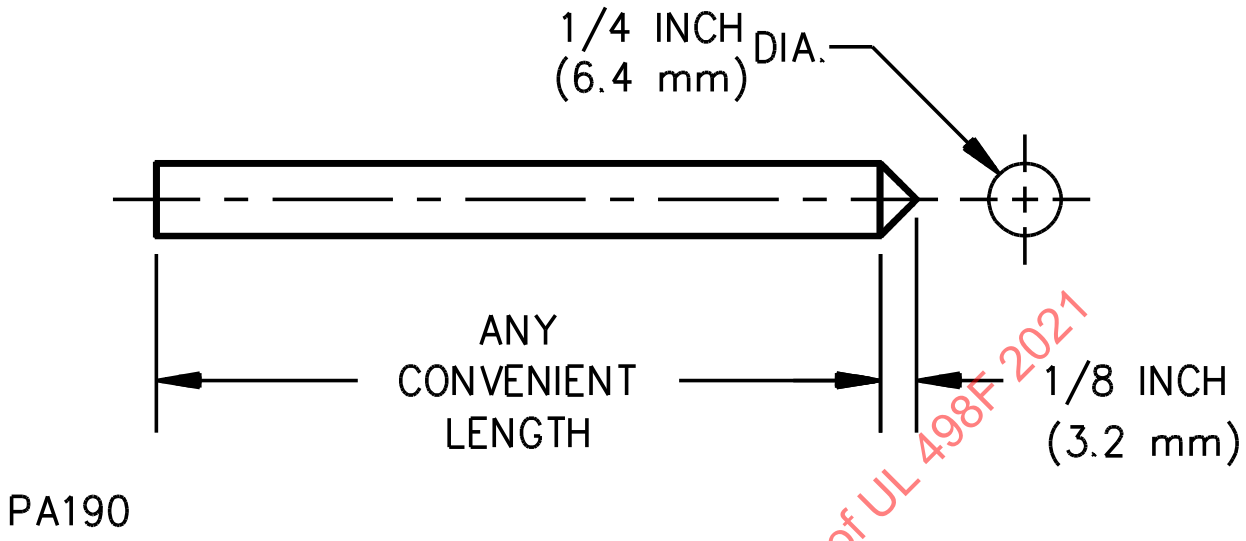
10.2.1 Female contacts and associated live parts in the contact opening of an outlet device that can be touched by the probe illustrated in Figure 10.1 shall be recessed from the plane of the opening a distance not less than 1/4 of the maximum straight-line dimension of the opening, or 3/64 inch (1.2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

Exception No. 1: Devices having openings that close upon removal of the attachment plug are not required to comply with this requirement.

Exception No. 2: Specific-purpose devices intended only for disconnecting use (see 88.5), are not required to comply with this requirement.

Figure 10.1

Probe



11 Grounding and Dead Metal Parts

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

a) The grounding pin, blade, or contact,

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

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

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

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

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

Exception: Another form of connection employed in a cord connector is not prohibited when the connection complies with the requirement in Potential Drop in Grounding Connections Test, Section 63.

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

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

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

11.6 The grounding terminal of a grounding device shall be connected to the contact that is intended for use for equipment grounding. For devices having one of the standard grounding configurations, the grounding contact is identified by the letter "G" in the corresponding figure in ANSI/NEMA WD6, and in UL 1681. The grounding terminal shall be permanently identified in accordance with 91.1.1 in a manner that is readily recognizable during installation. See also 18.1, 22.1, 26.1.2, and Section 91, Identification and Marking of Terminals.

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

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

11.8 A conductive connection between a blade, pin, or contact, and an exposed dead-metal part capable of being grounded in service, such as the mounting strap, yoke, or body armor, shall be provided only in a grounding device. A non-grounding device with exposed dead-metal parts shall not be provided with a wiring terminal identified for an equipment grounding conductor. See also 18.3 and 22.2.

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

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

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

Exception: Parts determined to comply with 28.2.4 are not required to comply with this requirement.

12 Terminals

12.1 General

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

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

12.2 Wire-binding screw terminals

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

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

12.2.3 A wire-binding screw shall thread into metal.

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

Table 12.1
Sizes of Terminal Screws

Rating of device in amperes	Minimum size of screw	Maximum number of threads per inch (per 25.4 mm)
20	8[a]	32[b]
30	8	32

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

[b] No. 8 or larger screws having more than the number of threads per inch (per 25.4 mm) indicated may be used for terminals when the assembly complies with the Tightening Torque Test, Section 44.

12.2.5 A receptacle or inlet rated 30 A or less and employing wire-binding screw terminals for connection to copper branch circuit conductors only, shall comply with the general performance requirements for receptacles, Section 67 or the general performance requirements for inlets, Section 51 as applicable.

12.2.6 The tightening torque for the wire-binding screw terminals shall be specified by the device manufacturer and shall be marked as described in Reference No. 4 of Table 89.2 for inlets and Reference No. 18 of Table 89.4 for receptacles.

12.3 Soldering lugs

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

12.4 Pressure-wire terminals

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

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

Table 12.2
Pressure-wire Terminals Used in Receptacles and Inlets

Use	Current rating	Pressure-wire terminal type	Reference paragraphs
Copper wire only	<30A	Clamp	54.4, 72.5
		Setscrew	12.4.3, 54.1, 72.2

12.4.3 The tightening torque for the pressure-wire terminals designated in Table 12.2 shall be specified by the device manufacturer and shall be marked as described in Reference No. 4 of Table 89.2 for inlets and Reference No. 18 of Table 89.4 for receptacles. 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.

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

12.5 Combination wire binding/pressure-wire terminals

12.5.1 A receptacle or inlet employing a combination wire binding/pressure-type terminal shall be limited to 10, or 12 AWG conductors. The terminals shall comply with the applicable performance requirements as specified in UL 486E.

12.5.2 A receptacle or inlet employing a combination wire binding/pressure-wire terminal for connection to copper branch circuit conductors only, shall comply with the general performance requirements for receptacles, as specified in Section 67, Combination Wire Binding/Pressure Wire-Type Terminals, or the general performance requirements for inlets, Section 51 as applicable.

12.6 Spring action clamp terminals

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

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

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

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

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 48 or 64.

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, Section 46, but is not required to restrict

a pull on the flexible cord from being transmitted directly to the wiring terminations when the conductors are terminated as described in 13.2(a).

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

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

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

13.3 The diameter of a round cord-entry hole shall not be longer than 1/4 inch (6.4 mm).

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

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

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

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

14 Spacings

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

a) Uninsulated live parts of opposite polarity;

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

Exception No. 1: The grounding terminal of a flush receptacle shall instead comply with the spacing requirements in 28.2.1.

Exception No. 2: A dead-metal screw head, rivet, or the like, which is located in a hole not larger than 9/32 inch (7.1 mm) in diameter and recessed not less than 3/16 inch (4.8 mm) is not considered to be exposed to contact by persons after the device is installed in the intended manner.

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

15 Assembly

15.1 General

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

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

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

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

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

15.2 Grounding and polarization

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

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

15.3 Mating and interchangeability

15.3.1 A general-use device, including any configuration illustrated in ANSI/NEMA WD6, UL 1681, 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: A special-purpose device for use in equipment where intermixed connections do not increase the risk of fire, electric shock, injury to persons, or damage to equipment, is not required to comply with this requirement.

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

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

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

b) Any of the configurations outlined in UL 1681;

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

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

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

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

a) ANSI/NEMA WD6;

b) UL 1681;

c) Other American National Standard.

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

Exception No. 1: 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. 2: Plugs, and cord connectors for use on flexible cords, or that are provided with fuses, that have a lower current rating, as described in Exception No. 1 to 88.1, are not prohibited from mating with corresponding devices with the standard current rating and the identical voltage rating.

15.4 Fuseholders

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

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

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

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

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

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

Exception: A fusible attachment plug having a configuration that is not illustrated in ANSI/NEMA WD6, or in UL 1681, may be provided with a fuse or fuses which is removable when the pins or blades are in a receptacle when the attachment plug is marked in accordance with Reference No. 12 of Table 89.1.

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

15.5 Switches

15.5.1 A switch provided as a part of a wiring device shall comply with UL 20. A switch provided as part of a device intended for factory assembly as a component of end-use equipment shall comply with UL 61058-1.

ATTACHMENT PLUGS AND INLETS

16 Insulating Materials

16.1 An insulating plate employed for the backing of an inlet shall not be less than 1/32 inch (0.8 mm) thick and shall be moisture-resistant in accordance with 39.1 and 39.2. Phenolic composition or a similar material is acceptable for the insulating plate. Fiber may be employed if it is not less than 1/16 inch (1.6 mm) thick, is impregnated to resist the absorption of moisture in accordance with 39.1 and 39.2, and is not depended upon (by itself) to hold contacts or other live parts in place.

17 Enclosure

17.1 General

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

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

a) Properly position individual conductor; and

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

17.2 Configurable plug

17.2.1 A configurable attachment plug may only be of the ANSI/NEMA WD6 configurations as shown in Table 17.1.

Table 17.1
Configurable Attachment Plug Configurations

ANSI/NEMA WD6 Configuration	No. of poles	No. of wires	Ampere, A	Voltage, V
L5-20P/L5-30P	2	3	20/30	125
L25-30P	2	3	30	240
L6-20P/L6-30P	2	3	20/30	250
L7-20P/L7-30P	2	3	20/30	277
L24-20P	2	3	20	347
L8-20P/L8-30P	2	3	20/30	480
L9-20P/L9-30P	2	3	20/30	600
L14-20P/L14-30P	3	4	20/30	125/250
L15-20P/L15-30P	3	4	20/30	250 3 ph
L16-20P/L16-30P	3	4	20/30	480 3 ph

Table 17.1 Continued on Next Page

Table 17.1 Continued

ANSI/NEMA WD6 Configuration	No. of poles	No. of wires	Ampere, A	Voltage, V
L17-30P	3	4	30	600 3 ph
L21-20P/L21-30P	4	5	20/30	120/208 3 ph
L26-30P	4	5	30	240/415 3 ph
L22-20P/L22-30P	4	5	20/30	277/480 3 ph
L23-20P/L23-30P	4	5	20/30	347/600 3 ph

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

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

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

17.2.5 A configurable attachment plug identified by the manufacturer shall include all necessary terminals and blade and pin construction for the identified configuration(s).

18 Grounding and Dead Metal Parts

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

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

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

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

c) The device is plainly marked in accordance with Reference No. 3 of Table 89.2.

18.2 For a grounding device, the blade to be used for grounding (G in the figures) shall be longer (see respective figures) than the other blades.

18.3 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.

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

19 Terminals and Leads

19.1 Terminals

19.1.1 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.

19.2 Leads

19.2.1 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 19.1.

Table 19.1
Smallest Acceptable Sizes of Inlet Leads

Current rating of inlet	Copper circuit leads – AWG (mm^2)	Copper grounding leads – AWG (mm^2)
20	12 (3.3)	12 (3.3)
30	10 (5.3)	10 (5.3)

19.2.2 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.

19.3 Attachment plug and inlet with spring action clamp terminal

19.3.1 An inlet that is provided with spring action clamp terminal shall be provided with a positive means to prevent unintentional separation of the conductor from the terminal and shall comply with the Spring Action Clamp Terminal Pull Test described in Section 57.

19.3.2 An attachment plug that is provided with spring action clamp terminal shall be provided with a positive means to prevent unintentional separation of the conductor from the terminal and shall comply with the Spring Action Clamp Terminal Pull Test described in Section 49A.

20 Assembly

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

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

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

c) Acceptably secured in the plug.

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

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

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

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

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

21 Weatherproof Type

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

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

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

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

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

CORD CONNECTORS

22 Grounding and Dead Metal Parts

22.1 The grounding terminal mentioned in 11.6 and 22.2 and its corresponding contact shall be conductively connected to the armor of an armored cord connector.

22.2 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.

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

23 Assembly

23.1 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).

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

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

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

23.5 A cord connector shall comply with the requirements in 13.1 – 13.4 for strain relief, bushings, and cord grips.

23A Cord Connector with Spring Action Clamp Terminal

23A.1 A cord connector that is provided with spring action clamp terminal shall be provided with a positive means to prevent unintentional separation of the conductor from the terminal and shall comply with the Spring Action Clamp Terminal Pull Test described in Section 62A.

RECEPTACLES

24 Insulating Materials

24.1 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 39.1 and 39.2. Fiber may be employed in an insulating plate if it is not less than 1/16 inch (1.6 mm) thick, is impregnated to resist the absorption of moisture in accordance with 39.1 and 39.2 and is not depended upon (by itself) to hold contacts or other live parts in place.

25 Enclosure

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

a) Properly position individual conductor; and

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

26 Grounding and Dead Metal Parts

26.1 General

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

26.1.2 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.

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

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

26.2 Flush receptacles

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

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

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

27 Terminals and Leads

27.1 General

27.1.1 The line wiring terminals of a receptacle intended for mounting in an outlet box shall be located or protected so that, upon installation, they will not be forced against the wiring in the box. See also 26.2.1.

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

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

27.2 Leads

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

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

b) Not smaller in size than indicated in Table 27.1 for a receptacle that employs other than a separable terminal assembly and not smaller than 12 AWG for a receptacle that employs a separable terminal assembly.

Table 27.1
Smallest Acceptable Sizes of Receptacle Leads

Current rating of receptacle	Copper supply leads – AWG (mm^2)	Copper grounding leads – AWG (mm^2)
20	12 (3.3)	12 (3.3)
30	10 (5.3)	10 (5.3)

27.2.2 For a general-use receptacle:

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

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

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

27.3 Separable terminal assembly

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

27.3.2 A separable terminal assembly shall:

a) Be provided with a mechanical means such as a lock, latch or similar means, which prohibits unintentional separation when in the mated condition, and shall comply with the Latching Mechanism Test described in Section 85,

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

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

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

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

27.4 Receptacle with spring action clamp terminal

27.4.1 A receptacle that is provided with spring action clamp terminal shall be provided with a positive means to prevent unintentional separation of the conductor from the terminal and shall comply with the Spring Action Clamp Terminal Pull Test described in Section 75.

28 Assembly

28.1 General

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

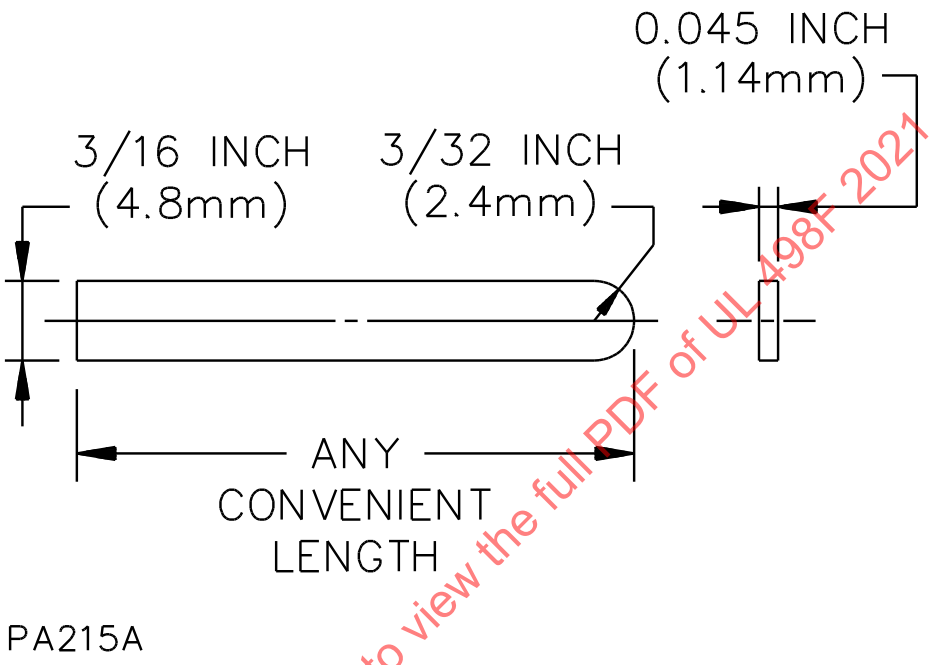
28.2 Flush receptacles

28.2.1 The grounding terminal of a grounding-type flush receptacle shall be spaced at least 1/4 inch (6.4 mm) from any ungrounded live part (associated with other than a white grounded terminal) exposed to contact by a grounding conductor in the outlet box. Live parts accessible from within the cavity of an outlet box are considered exposed to contact by a grounding conductor if they can be contacted by the probe illustrated in Figure 28.1. The spacings shall be measured through air and over both insulating and

conductive surfaces with the receptacle wired as intended with the maximum anticipated conductor size. They shall be measured from any point on the grounding terminal that may contact the clamped grounding conductor as in the case of a wire-binding screw terminal, or from any point on the perimeter of an opening to receive a grounding conductor in the case of an enclosed terminal.

Figure 28.1

Flat Probe



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

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

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

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

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

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

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

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

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

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

28.3 Surface-mount receptacles

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

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

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

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

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

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

29 Flush Plates

29.1 A flush plate provided as an integral part of a receptacle shall comply with the requirements for flush plates in UL 514A or UL 514C.

30 Self-Grounding Receptacles

30.1 A self-grounding receptacle shall not be rated greater than 30 A or 150 V to ground and shall comply with the Fault Current Test, Section 77.

31 Isolated-Ground Receptacles

31.1 An isolated-ground receptacle shall be identified in accordance with the marking and instruction requirements for isolated-ground receptacles specified in Reference No. 9 of Table 89.4.

32 Pendant Receptacles

32.1 The enclosure and cover plate of a pendent receptacle shall be non-metallic only and comply with the requirements of UL 514C, in addition to the applicable requirements in this Standard.

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

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

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

33 Lighted Receptacle

33.1 A lighted receptacle shall additionally comply with 33.2 through 33.4.

33.2 The lens (jewel) of a lighted receptacle shall comply with UL 746C, Resistance to Impact testing, conditioned to minus 31°F (minus 35 °C), followed by the Dielectric Voltage Withstand test.

Exception No. 1: A lighted receptacle when conditioned to a temperature of 0°C shall be marked as described in Table 89.4 Reference No. 39 ("Indoor Use Only").

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

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

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

33.5 When a printed wiring board is used, shall comply with UL 796, having a maximum operating temperature of at least 221°F (105°C) and a minimum flammability rating of HB as determined by the applicable tests in UL 94.

PERFORMANCE

34 Representative Devices

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

34.2 Attachment plugs are to be subjected to the appropriate tests outlined in Table 34.1.

34.3 Inlets (motor attachment plugs) are to be subjected to the appropriate tests outlined in Table 34.2.

34.4 Cord connectors are to be subject to the appropriate tests outlined in Table 34.3.

34.5 Receptacles are to be subjected to the appropriate tests outlined in Table 34.4.

Table 34.1
Summary of Tests: General Grade Attachment Plugs

Section	Test Sequences	No. of devices[a]	Details
35	Comparative Tracking Index	5	Materials to be evaluated in accordance with Exception No. 1 to 8.3.1.
36	Glow Wire	3	Materials to be evaluated in accordance with Exception No. 1 to 8.3.2.
37	High-Current Arc Resistance to Ignition	3	Materials to be evaluated in accordance with Exception No. 2 to 8.3.2.
40	Dielectric Voltage-Withstand	6	All plugs.
38	Mold Stress Relief		Plugs employing thermoplastic material.
40	Dielectric Voltage-Withstand (Repeated)		Plugs subjected to Mold Stress Relief Test.
39	Moisture Absorption Resistance	3	Conducted on vulcanized fibre, fuseholders and insulating backplates. Use insulating material portion of device only.
41	Accelerated Aging	6	Materials to be evaluated in accordance with the Exception to 8.4.1.
42	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.
43	Conductor Secureness	6	Plugs employing wire leads only.
44	Tightening Torque	6	Plugs with wire-binding screws with pitch greater than that specified in Table 12.1.
47	Secureness of Cover	6	Plugs with separable face covers as described in Enclosure, Section 9.
48	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.
48.3	Self-Hinge Flexing	18	Plugs employing self-hinges in the enclosure.
49	Terminal Temperature	6	Not conducted on plugs with soldered, brazed. or welded cord connections or with wire-binding, pressure-wire or solder terminals.
49A	Spring Action Clamp Terminal Pull	6	Conducted on attachment plugs with spring action clamp terminals only.
50.1	Fuseholder Temperature	6	Plugs with fuseholders only.

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

Table 34.2
Summary of Tests: Inlets (Motor Attachment Plugs)

Section	Test sequences	No. of devices[a]	Details
35	Comparative Tracking Index	5	Materials to be evaluated in accordance with Exception No. 1 to 8.3.1.
36	Glow Wire	3	Materials to be evaluated in accordance with Exception No. 1 to 8.3.2.
37	High-Current Arc Resistance to Ignition	3	Materials to be evaluated in accordance with Exception No. 2 to 8.3.2
40	Dielectric Voltage-Withstand	6	All inlets.
38	Mold Stress Relief	6	Inlets employing thermoplastic materials.
40	Dielectric Voltage-Withstand (Repeated)	6	Inlets subjected to Mold Stress Relief Test.
39	Moisture Absorption Resistance	6	Conducted on vulcanized fibre, fuseholders and insulating backplates. Use insulating material portion of device only.
41	Accelerated Aging	6	Materials to be evaluated in accordance with the Exception to 8.4.1.
42	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.
43	Conductor Secureness	6	Inlets employing wire leads only.
44	Tightening Torque	6	Inlets with wire-binding screws with pitch greater than that specified in Table 12.1.
52	Terminal Temperature	6	Not conducted on inlets with soldered, brazed, or welded cord connections or with wire-binding or solder terminals.
53	Fuseholder Temperature	6	Inlets with fuseholders only.
54	Pressure-Wire Terminals – General	6	Inlets with pressure wire terminals only.
56	Strength of Insulating Base	6	Inlets with pressure wire terminals only.
57	Spring Action Clamp Terminal Pull	6	Inlets with spring action clamp terminals only.

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

Table 34.3
Summary of Tests: Cord Connectors

Section	Test sequences	No. of devices[a]	Details
35	Comparative Tracking Index	5	Materials to be evaluated in accordance with Exception No. 1 to 8.3.1.
36	Glow Wire	3	Materials to be evaluated in accordance with Exception No. 1 to 8.3.2.
37	High-Current Arc Resistance to Ignition	3	Materials to be evaluated in accordance with Exception No. 2 to 8.3.2.
40	Dielectric Voltage-Withstand	6	All cord connectors.
38	Mold Stress Relief	Same 6	Cord connectors employing thermoplastic materials.
40	Dielectric Voltage-Withstand (Repeated)	Same 6	Cord Connectors subjected to Mold Stress Relief Test.

Table 34.3 Continued on Next Page

Table 34.3 Continued

Section	Test sequences	No. of devices[a]	Details
39	Moisture Absorption Resistance	3	Conducted on vulcanized fibre, fuseholders and insulating backplates. Use insulating material portion of device only.
41	Accelerated Aging	6	Materials to be evaluated in accordance with the Exception to 8.4.1.
42	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.
43	Conductor Secureness	6	Cord connectors employing wire leads only.
44	Tightening Torque	6	Cord connectors with wire-binding screws with pitch greater than that specified in Table 12.1.
59	Overload	6	Test based on current rating.
60	Temperature	Same 6	
61	Resistance to Arcing	6	Not required for devices employing phenolic, urea or melamine in the outlet face.
59	Overload (horsepower)	6	Conducted only on cord connectors with horsepower ratings.
62	Fuseholder Temperature	6	Cord connectors with fuseholders only.
62A	Spring Action Clamp Terminal Pull	6	Conducted on cord connectors with spring action clamp terminals only
63	Potential Drop in Grounding Connections	6	Cord connectors with grounding connections secured by means other than riveting, bolting, welding or equivalent.
64	Integrity of Assembly	6	Not conducted on connectors employing pin terminals, strain relief knots, or certain strain relief constructions. Refer to test description.
66	Self-Hinge Flexing	12	Cord connectors employing self-hinges in the enclosure.

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

[b] For a cord connector with a spring-activated latching mechanism, see 58.2.

Table 34.4
Summary of Tests: Receptacles

Section	Test sequences	No. of devices[a]	Details
35	Comparative Tracking Index	5	Materials to be evaluated in accordance with Exception No. 1 to 8.3.1.
36	Glow Wire	3	Materials to be evaluated in accordance with Exception No. 1 to 8.3.2.
37	High-Current Arc Resistance to Ignition	3	Materials to be evaluated in accordance with Exception No. 2 to 8.3.2.
40	Dielectric Voltage-Withstand	6	All receptacles.
38	Mold Stress Relief	Same 6	Receptacles employing thermoplastic materials.
40	Dielectric Voltage-Withstand (Repeated)	Same 6	Receptacles subjected to Mold Stress Relief Test.

Table 34.4 Continued on Next Page

Table 34.4 Continued

Section	Test sequences	No. of devices[a]	Details
39	Moisture Absorption Resistance	3	Conducted on vulcanized fibre, fuseholders and insulating backplates. Use insulating material portion of device only.
41	Accelerated Aging	6	Materials to be evaluated in accordance with the Exception to 8.4.1.
42	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.
43	Conductor Secureness	6	Receptacles employing wire leads only.
44	Tightening Torque	6	Receptacles with wire-binding screws with pitch greater than that specified in Table 12.1.
68	Overload	6	Test based on current rating.
69	Temperature	Same 6	
70	Resistance to Arcing	Same 6 or 6 new samples. See 70.2.	Not required for devices employing phenolic, urea or melamine in the outlet face.
69	Temperature (Terminal)	6	Flush and self-contained receptacles having a 5-15R, 5-20R, 6-15R, or 6-20R configuration. Conducted when a 15 A receptacle is not represented by a 20 A receptacle.
68	Overload (horsepower)	6	Conducted only on receptacles with horsepower ratings and receptacles having the NEMA configurations specified in Table 88.2.
71	Fuseholder Temperature	6	Receptacles with fuseholder only.
72	Pressure-Wire Terminals (General)	6	Receptacles with pressure-wire terminals only.
74	Strength of Insulating Base and Support	6	Receptacles with pressure-wire terminals only.
75	Spring Action Clamp Terminal Pull	6	Receptacles with spring action clamp terminals only.
77	Fault Current	6	Self-grounding receptacles only.
79	Retention of Tab Connection Test	6	Flush receptacle provided with separable terminal assembly.
80	Separable Connector Pull Test	6	Flush receptacle provided with separable terminal assembly.
81	Mold Stress Relief Test	6	Flush receptacle provided with separable terminal assembly.
82	Dielectric Voltage-Withstand Test	Same 6	Flush receptacle provided with separable terminal assembly.
83	Grounding Contact Temperature Test	Same 6	Flush receptacle provided with separable terminal assembly.
84	Resistance Test	Same 6	Flush receptacle provided with separable terminal assembly.
85	Latching Mechanism Test	6	Flush receptacle provided with separable terminal assembly.
86	Short Circuit Test	1	Flush receptacle provided with separable terminal assembly.
87	Continuity Impedance Test	1	Flush receptacle provided with separable terminal assembly.

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

ALL DEVICES

35 Comparative Tracking Index Test

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

36 Glow Wire Test

36.1 A polymeric material used for electrical insulation or enclosure of live parts and evaluated in accordance with Exception No. 1 of 8.3.2, shall be tested in accordance with the requirements of 36.2 in order to determine its resistance to ignition from overheated conductors caused by circuit overloads.

36.2 Devices are to be subjected to the Glow-Wire End-Product Test described in UL 746C. As a result of this test, there shall not be ignition of the insulating material during 30 seconds of application of the probe at a glow-wire temperature of 1202°F (650°C) for all devices.

37 High-Current Arc Resistance to Ignition Test

37.1 A polymeric material used for electrical insulation or enclosure of live parts and evaluated in accordance with Exception No. 2 to 8.3.2, when tested as described in 37.2 – 37.6, shall not ignite within the number of arcs specified in Table 37.1 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 61 or 70, as appropriate, is not required to be subjected to this test.

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

Table 37.1
High-Current Arc Resistance to Ignition Test Arcing Criteria

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

37.2 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.

37.3 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.

37.4 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 37.5 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.

37.5 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.

37.6 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.

38 Mold Stress Relief Test

38.1 As a result of temperature conditioning specified in 38.2, there shall not be any warpage, shrinkage or other distortion that results in any of the following:

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

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

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

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

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

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

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

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

38.3 Immediately following the completion of this test, the devices are to be subjected to a repeated Dielectric Voltage-Withstand Test as described in Section 40. The devices are not required to be subjected to the humidity conditioning described in 40.1.2.

39 Moisture Absorption Resistance Test

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

39.2 The material is to be:

a) Dried at 105 ±5°C for 1 hour;

b) Weighed (W_1);

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

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

e) Reweighed (W_2).

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

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

Exception: A material tested in accordance with Test Method for Water Absorption of Plastics (ASTM D 570) described in UL 746A, is not required to be tested.

40 Dielectric Voltage-Withstand Test

40.1 Devices for fixed or permanent installation

40.1.1 Devices intended for fixed or permanent installation including appliance, fixture or equipment outlets, inlets, and receptacles, shall withstand without breakdown a 50 – 60 Hz essentially sinusoidal potential applied as described in 40.1.3 for one minute, immediately following the humidity conditioning described in 40.1.2, between the following:

a) Live parts of opposite polarity, and

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

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

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

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

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

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

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

40.1.4 The mating attachment plugs used in 40.1.2 are to be capable of withstanding the application of a 2500 V potential for devices rated 300 V or less and a 3500 V potential for devices rated greater than 300 V.

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

40.1.6 If the receptacle is provided with break-off tabs for feed-through wiring, the tabs are to be removed immediately following the completion of the test described in 40.1.3. A test potential of 2000 V is then to be applied again across the two adjacent line terminals.

40.2 Cord-connected devices

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

41 Accelerated Aging Tests

41.1 General

41.1.1 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.

41.2 Rubber, EPDM, and TEE compounds

41.2.1 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 41.2.2 – 41.2.3.

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

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

41.2.3 The accelerated-aging tests described in 41.2.1 – 41.2.3 are to be made on each color of material and on each basic rubber, EPDM, or TEE material employed for the device.

41.3 PVC compounds and copolymers

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

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

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

42 Insulation Resistance Test

42.1 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.

42.2 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.

42.3 To determine compliance with the requirement in 42.1, the insulation resistance is to be measured by a magneto megohmmeter that has an open-circuit output of 500 V or by equivalent equipment.

42.4 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 42.5.

42.5 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.

42.6 All rubber parts are to be kept for at least 48 hours at room temperature before being subjected to the test mentioned in 42.3.

43 Conductor Secureness Test

43.1 If a conductor or lead is connected to an element (male blade or female contact) of a device before the element has been assembled into the device, the connection shall not break under a pull applied for 1

minute between the element and the conductor before the element has been assembled into the device. A force of 20 lbf (89 N) is to be applied if the conductor is 18 AWG (0.82 mm^2) or larger in size. If a smaller conductor is used, the force is to be 8 lbf (36 N).

43.2 While the test mentioned in 43.1 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.

44 Tightening Torque Test

44.1 A No. 8 or larger wire-binding screw having more than 32 threads per inch (per 25.4 mm) shall be capable of withstanding the torque application described in 44.2 without stripping either the screw threads or the terminal plate threads or damaging the slot in the head of the screw.

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

ATTACHMENT PLUGS

45 All Devices

45.1 The performance of an attachment plug is to be investigated by means of the applicable tests described in Sections 35 – 44, and 46.

46 Self-Hinged Plugs

46.1 If the attachment plug employs a self-hinge that is relied upon to hold the plug face in place, the tests described in 48.2.1 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 48.3.

47 Secureness-Of-Cover Test

47.1 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 47.2.

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

48 Integrity of Assembly Test

48.1 General

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

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

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

48.1.2 A field-wired device is to be wired in accordance with the manufacturer's instructions using 12 inch (305 mm) lengths of the sizes and types of flexible cord chosen to represent the range of cords intended for use with the device. See Reference No. 4 of Table 89.1.

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

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

b) 20 lbf (89 N) for a cord with conductors smaller than 18 AWG (0.82 mm^2), for 1 minute in the direction perpendicular to the plane of the cord entrance.

48.2 Self-hinged plugs

48.2.1 If the attachment plug employs a self-hinge that is relied upon to hold the flexible cord in place, the tests described in 48.1.1 – 48.1.3 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 48.3.

48.3 Self-hinge flexing test

48.3.1 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.

48.3.2 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 212°F (100°C); and

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

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

49 Terminal Temperature Test

49.1 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 54°F (30°C).

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

49.2 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.

49.3 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.

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

49A Spring Action Clamp Terminal Pull Test

49A.1 An attachment plug employing spring action clamp terminals shall be subjected to the test conditions as specified in 49A.2 – 49A.6.

49A.2 Upon completion of this test, there shall not be any damage to the terminal or its securement mechanism. The spring action clamp shall remain capable of functioning as intended. There shall not be any damage, arcing or dielectric breakdown during application of the test potential. The conductor shall not pull free from the terminal during application of the test force.

49A.3 Each terminal of each device (three terminals minimum) shall be tested. Each terminal shall be wired with the smallest AWG conductor size of the intended flexible cord and wired with the largest conductor size of the intended flexible cord, as specified by the manufacturer. The attachment plug enclosure housing and strain relief clamp shall not be used.

49A.4 The conductor insulation shall be prepared by removing the insulation from the conductor according to manufacturer's instructions (strip length) and then inserted into the spring action clamp terminal as intended. The lever of the spring action clamp shall then be operated to the fully latched and locked position and back to the unlatched and unlocked position. This sequence of operation shall be repeated for a total of 100 cycles.

49A.5 Following the 100 cycles, the conductor shall be reattached to the spring action clamp terminal and the lever placed in the latched and locked position as intended. A static pull force as specified in Table 49A.1Table 49A.1 shall be applied to the conductor for 1 minute in a direction perpendicular to the plane of the device under test, tending to remove the conductor.

Table 49A.1
Test values for spring action clamp terminal pull test

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

49A.6 Each device is then to be subjected to a 50 – 60 Hz essentially sinusoidal potential equal to twice the rated voltage plus 1000 V applied between live parts of opposite polarity and between live parts and grounding or dead metal parts. The test voltage is to be increased at a uniform rate and as rapidly as is consistent with its value being correctly indicated by a voltmeter and maintained at the test potential for 1 minute.

50 Fuseholder Temperature Test

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

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

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

c) 54°F (30°C) at the wiring terminals or cord connections at any time (see 53.7); and

d) The relative thermal index of the surrounding insulating material, minus an assumed ambient of 77°F (25°C), at any time (see 53.7).

50.2 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 50.6 and 53.7).

Exception: The test may be conducted in conjunction with the Terminal Temperature Test, Section 49, if agreeable to all concerned.

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

50.4 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.

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

50.6 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.

50.7 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 UL 4248-1, UL 4248-4, UL 4248-5, UL 4248-6, UL 4248-8, UL 4248-9, UL 4248-11, UL 4248-12, and UL 4248-15. The dummy fuse size for devices employing miscellaneous, miniature and micro fuses is to be as indicated in Table 50.1. To represent the heating of a live fuse, 36°F (20°C) is to be added to the recorded temperature rise on the wiring terminals, cord connections, and surrounding insulating materials.

Table 50.1
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)

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

INLETS

51 All Devices

51.1 The performance of an inlet is to be investigated by means of the applicable tests described in Sections 35 – 44, and 51 – 56.

52 Terminal Temperature Test

52.1 The temperature rise of an inlet intended for mounting in or on an outlet box and employing wire-binding screw, clamp terminals, or spring action clamp terminals for field connection to branch-circuit conductors, when measured at the points described in 52.2, shall not be more than 54°F (30°C) when the device is carrying its maximum rated current.

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

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

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

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

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

52.6 The terminals are to be tightened to the marked torque limit or, if no tightening torque is specified, to 14 in-lbf (1.6 N·m).

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

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

53 Fuseholder Temperature Test

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

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

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

c) 30°C (54°F) at the wiring terminals or cord connections at any time (see 53.7); and

d) The relative thermal index of the surrounding insulating material, minus an assumed ambient of 25°C (77°F), at any time (see 53.7).

53.2 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 53.6 and 53.7).

Exception: The test is not prohibited from being conducted in conjunction with the Terminal Temperature Test, Section 52.

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

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

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

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

53.6 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.

53.7 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 UL 4248-1, UL 4248-4, UL 4248-5, UL 4248-6, UL 4248-8, UL 4248-9, UL 4248-11, UL 4248-12, and UL 4248-15. The dummy fuse size for devices employing miscellaneous, miniature and micro fuses is to be as indicated in Table 53.1. To represent the heating of a

live fuse, 36°F(20°C) is to be added to the recorded temperature rise on the wiring terminals, cord connections, or surrounding insulating materials.

Table 53.1
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)

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

54 Pressure-Wire Terminals

54.1 In addition to the requirements in Sections 51 – 53, the following types of inlets, intended for mounting in or on an outlet box, shall comply with the Strength of Insulating Base Test, Section 56, and with the applicable performance requirements in UL 486E.

54.2 An inlet rated less than 30 A and employing setscrew-type pressure-wire terminals for field connection to copper branch circuit conductors only.

54.3 The copper test conductors to be used in these tests are to be selected in accordance with Table 54.1.

Table 54.1
Copper Test Conductor Sizes

Device rating, A	Conductor size, AWG
20	12 solid, 12 stranded
30	10 solid , 10 stranded

54.4 An inlet rated less than 30 A, intended for mounting in or on an outlet box, and employing clamp-type pressure-wire terminals for use on copper alloy branch circuit conductors only, shall comply with the general requirements for inlets contained in Sections 51 – 53, only.

55 Combination Wire Binding/Pressure Wire-Type Terminals

55.1 In addition to the requirements as specified in Sections 51 – 53, an inlet rated less than 20 A and also employing a combination wire binding/pressure wire-type terminal for field connection to copper branch circuit conductors, intended for mounting in or on an outlet box, shall comply with the Strength of Insulating Base Test, Section 56, and with the applicable performance requirements in UL 486E.

55.2 The copper test conductors to be used in these tests are to be selected in accordance with Table 55.1.

Table 55.1
Copper Test Conductor Sizes

Device rating, A	Conductor size, AWG
20	12 solid 12 stranded, 10 solid 10 stranded

56 Strength of Insulating Base Test

56.1 An inlet intended for mounting in or on an outlet box and employing pressure-wire terminals for field connection to branch circuit conductors, shall not be damaged when 110 percent of the specified terminal tightening torque is applied to the wire securing means of the pressure-wire terminal which secures the maximum intended size conductor.

56.2 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.

56.3 The terminal tightening torque to be used for this test is to be that assigned by the manufacturer in accordance with 12.4.3 and marked in accordance with Reference No. 4 of Table 89.2.

57 Spring Action Clamp Terminal Pull Test

57.1 An inlet employing spring action clamp terminals shall be subjected to the test conditions as specified in 57.2 – 57.6.

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

57.3 Each terminal of each device (three terminals minimum) shall be tested. Each terminal shall be wired with the smallest AWG conductor size and wired with the largest conductor size, as specified by the manufacturer. If the spring action clamp is also intended for both solid and stranded AWG conductors, both solid and stranded shall be tested.

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

57.5 Following the 100 cycles, the conductor shall be reattached to the spring action clamp terminal and the lever place in the latched and locked position as intended. A static pull force as specified in Table 57.1 shall be applied to the conductor for 1 minute in a direction perpendicular to the plane of the inlet body, tending to remove the conductor.

Table 57.1
Test Values For Spring Action Clamp Terminal Pull Test

Size of conductor AWG	Pullout force lbf (pounds) (N)
12	13.5 (60)
10	18.0 (80.1)
8	20.5 (91.2)

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

CORD CONNECTORS

58 All Devices

58.1 The performance of a cord connector is to be investigated by means of the tests described in Sections 35 – 44 and 62 – 69.

58.2 A cord connector with a spring-activated latching mechanism shall be subjected to the tests described in Sections 62 – 63 with the mechanism defeated. If compliance with any of the tests in the sequence is unable to be determined, a new set of devices is to be subjected to the test sequence with the mechanism engaged. The cord connector shall then be subjected to the Latching Mechanism Test, Section 85.

59 Overload Tests

59.1 General

59.1.1 A cord connector shall be capable of performing acceptably when subjected to the current overload test as described in this section. A cord connector additionally rated in horsepower shall also be capable of performing acceptably when subjected to the horsepower overload test as described in this section. In either case, there shall not be any electrical or mechanical failure of the device, opening of a line or grounding fuse, welding of the contacts, nor burning or pitting of the contacts that would affect the intended function of the device.

Exception No. 1: A cord connector that is intended for disconnecting use only and not for current interruption, is not required to be subjected to this test. See also 88.5.

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.

59.1.2 A cord connector with a spring-activated latching mechanism shall be subjected to this test with its mechanism defeated. See 58.2.

59.1.3 The device is to be mounted and wired to represent service conditions. Any metal armor is to be connected to the grounding conductor of the test circuit.

59.1.4 The fuse in the grounding conductor is to be a 15 A fuse if the device being tested is rated 30 A or less.

59.1.5 The fuse in the test circuit is to have the next higher standard fuse rating than the value of the test current.

59.1.6 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.

59.1.7 Each of six devices is to be tested by machine or manually by inserting and withdrawing an attachment plug having rigidly secured solid blades that are connected through a flexible cord to a load. When an equipment-grounding connection is provided in the device being tested, a grounding-type attachment plug is to be used and the grounding blade of the plug connected to the grounding contact of the device being tested. The grounding contact is then to be grounded through a fuse as specified in 59.1.4.

59.1.8 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.

59.1.9 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 59.1.9.

59.1.10 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 three 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.

59.1.11 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.

59.1.12 In the event that unacceptable results are obtained in the machine testing described in 59.1.7 or 59.1.8, referee tests may be conducted manually under conditions similar to those described in 59.1.7 or 59.1.8.

59.2 Current overload test

59.2.1 The test current shall be 150 percent of the rated current of the device. For devices with standard configurations rated 125 V, 250 V, or 125/250 V ANSI/NEMA WD6, the test is to be conducted on direct current. All other devices with standard configurations denoted as "AC" or "3-phase" are to be tested on alternating current. For devices with nonstandard configurations, the test is to be conducted using direct current with a resistive load, except that alternating current is to be used if the device is rated for alternating current only. Whenever alternating current is used for the test, the power factor of the load is to be from 0.75 to 0.80.

59.2.2 Testing of a device that has a dual voltage rating and a dual current rating is to be performed at the maximum rating in volts and with 150 percent of the rated current that corresponds to the maximum voltage rating.

Exception: A test on alternating current is not required when equivalent results have been obtained from a direct potential that is equal to or greater than the alternating-potential rating.

59.3 Horsepower overload test

59.3.1 If a separate horsepower overload test is conducted, the tests for the horsepower ratings are to be conducted on separate sets of previously untested devices. For devices with a phase to phase (L-L) and phase to neutral (L-N) horsepower rating, the test for each rating is to be conducted on a separate set of previously untested devices.

59.3.2 For devices with standard configurations illustrated in ANSI/NEMA WD6, the test current corresponding to the AC horsepower rating shall be as specified in Table 59.1. 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 having a L9-20R, L9-30R, L13-30R, L17-30R, L20-20R, L20-30R, L23-20R, L23-30R, SS1-50R, SS2-50R, TT-R, ML-1R, ML-2R, or ML-3R configuration in Wiring Devices – Dimensional Specifications, ANSI/NEMA WD6 or one of the configurations illustrated in Figures C1.1 – C1.5 of UL 1681 do not have assigned horsepower ratings and are not required to be subjected to the horsepower overload test.

Table 59.1
Test Current (Locked Rotor Amperes) for Horsepower Rated NEMA Configuration Cord Connectors

NEMA configuration	AC HP rating[a]	LRA (amperes)	AC test voltage
L5-20C	1	96	125
L5-30C	2	144	125
L6-20C	2[b]	72	250
		79.2	208
L6-30C	2[b]	72	250
		79.2	208
L7-20C	2	59.8	277
L7-30C	3	84.7	277
L8-20C	3	51	480
L8-30C	5	84	480
L14-20C	2 L-L[b]	72	250
		79.2	208
	1 L-N	96	125
L14-30C	2 L-L[b]	72	250
		79.2	208
	2 L-N	144	125
L15-20C	3	64	250
L15-30C	3	64	250
L16-20C	5	45.6	480
L16-30C	10	84	480
L21-20C	2	55	208
L21-30C	3	71	208

Table 59.1 Continued on Next Page

Table 59.1 Continued

NEMA configuration	AC HP rating[a]	LRA (amperes)	AC test voltage
L22-20C	5	45.6	480
L22-30C	10	84	480

[a] The phase to phase horsepower ratings are noted by "L-L". The phase to neutral ratings is identified by "L-N".

[b] Also suitable for 208 V motor applications at the indicated horsepower rating.

59.3.3 For all devices with nonstandard configurations, the test current corresponding to the horsepower rating is to be as specified in UL 20, for a device having an alternating-current rating of 2 horsepower or less and as specified in 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.

60 Temperature Test

60.1 The temperature rise of a cord connector measured at the points described in 60.2 shall not be more than 54°F (30°C) when the device is carrying its maximum rated current.

60.2 Each of six devices is to be tested. Temperatures are to be measured by means of thermocouples attached to the wiring terminals or cord connections.

Exception: When the wiring terminals or cord connections are not accessible for mounting thermocouples or when the device does not have any wiring terminals, the thermocouples are to be attached to the blades of the mated attachment plug as close as possible to the face of the device.

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

60.4 The generation of heat from sources other than the female contacts is to be minimized as much as possible. Each connection to the device being tested is to be made by means of a 12-inch (300 mm) or greater length of the appropriate type of flexible cord that has an ampacity at least equal to that of the device. The wire size and type are to be determined using the appropriate value for the device's current rating from Table 400.5(A) or 400.5(B) of ANSI/NFPA 70.

60.5 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 solid blades, and the terminals of the plug are to be short-circuited by means of the shortest feasible lengths of the appropriate flexible cord as described in 60.4.

60.6 The terminals are to be tightened to the marked torque limit or, when a tightening torque is not provided, the torque used is to be 14 in-lbf (1.6 N·m).

60.7 Temperature readings are to be obtained by means of thermocouples consisting of 28 – 32 AWG (0.08 – 0.03 mm^2) iron and constantan wires. It is a common practice to employ thermocouples consisting of 30 AWG (0.05 mm^2) iron and constantan wires with a potentiometer type of indicating instrument. This equipment is to be used when a referee measurement of temperature is necessary.

61 Resistance to Arcing Test

61.1 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 59, shall perform acceptably when subjected to an

additional 200 cycles of operation under the overload-test conditions following the temperature test. 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.

61.2 Alternatively one set of devices may be subjected to the 50 cycles of operation in the overload test described in Overload Tests, Section 59, 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.

62 Fuseholder Temperature Test

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

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

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

c) 54°F (30°C) at the wiring terminals or cord connections at any time (see 62.7); and

d) The relative thermal index of the surrounding insulating material, minus an assumed ambient of 77°F (25°C), at any time (see 62.7).

62.2 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 62.6 and 62.7).

Exception: The test is not prohibited from being conducted in conjunction with the Temperature Test, Section 60, when agreeable to all concerned.

62.3 The cord connectors are to be wired in a series circuit as described in the Temperature Test, Section 60.

62.4 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.

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

62.6 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.

62.7 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 UL 4248-1, UL 4248-4, UL 4248-5, UL 4248-6, UL 4248-8, UL 4248-9, UL 4248-11, UL 4248-15. The dummy fuse size for devices employing miscellaneous, miniature and micro fuses is to be as indicated in Table 62.1. To represent the heating of a live fuse, 36°F (20°C) is to be added to the recorded temperature rise on the wiring terminals, cord connections, or surrounding insulating materials.

Table 62.1
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)

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

62A Spring Action Clamp Terminal Pull Test

62A.1 A cord connector employing spring action clamp terminals shall be subjected to the test conditions as specified in 62A.2 - 62A.6.

62A.2 Upon completion of this test, there shall not be any damage to the terminal or its securement mechanism. The spring action clamp shall remain capable of functioning as intended. There shall not be any damage, arcing or dielectric breakdown during application of the test potential. The conductor shall not pull free from the terminal during application of the test force.

62A.3 Each terminal of each device (three terminals minimum) shall be tested. Each terminal shall be wired with the smallest AWG conductor size of the intended flexible cord and wired with the largest conductor size of the intended flexible cord, as specified by the manufacturer. The cord connector enclosure housing and strain relief clamp shall not be used.

62A.4 The conductor insulation shall be prepared by removing the insulation from the conductor according to manufacturer's instructions (strip length) and then inserted into the spring action clamp terminal as intended. The lever of the spring action clamp shall then be operated to the fully latched and locked position and back to the unlatched and unlocked position. This sequence of operation shall be repeated for a total of 100 cycles.

62A.5 Following the 100 cycles, the conductor shall be reattached to the spring action clamp terminal and the lever placed in the latched and locked position as intended. A static pull force as specified in Table 62A.1 shall be applied to the conductor for 1 minute in a direction perpendicular to the plane of the device under test, tending to remove the conductor.

Table 62A.1
Test values for spring action clamp terminal pull test

Size of conductor AWG	Pullout force lbf (pounds)
16	9
14	11.5
12	13.5
10	18.0

Table 62A.1 Continued on Next Page

Table 62A.1 Continued

Size of conductor AWG	Pullout force lbf (pounds)
8	20.5
6	21
4	30

62A.6 Each device is then to be subjected to a 50 – 60 Hz essentially sinusoidal potential equal to twice the rated voltage plus 1000 V applied between live parts of opposite polarity and between live parts and grounding or dead metal parts. The test voltage is to be increased at a uniform rate and as rapidly as is consistent with its value being correctly indicated by a voltmeter and maintained at the test potential for 1 minute.

63 Potential Drop in Grounding Connections Test

63.1 A pressure connection that is secured by a means other than riveting, bolting, or welding in the grounding path of a cord connector grounding device (see 5.11) 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.

64 Integrity of Assembly Test

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

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

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

64.2 A field-wired device is to be wired in accordance with the manufacturer's instructions using 12 inch (305 mm) lengths of the sizes and types of flexible cord chosen to represent the range of cords intended for use with the device. See Reference No. 5 to Table 89.3.

64.3 The device is to be anchored securely and the cord is to be pulled steadily as follows:

a) 30 lbf (133 N) for a cord with 18 AWG (0.82 mm^2) or larger conductors for 1 minute in the direction perpendicular to the plane of the cord entrance.

65 Self-Hinged Cord Connectors

65.1 If the cord connector employs a self-hinge that is relied upon to hold the flexible cord in place, the tests described in 64.1 – 64.3 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 66.

66 Self-Hinge Flexing Test

66.1 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.

66.2 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 212°F (100°C); and

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

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

RECEPTACLES

67 All Devices

67.1 The performance of a receptacle is to be investigated by means of the applicable tests described in Sections 35 – 44 and 68 – 87 as specified in Table 34.4.

67.2 Flush receptacles shall be subjected to the series of tests described Sections 68 – 70 along with other additional sections as indicated in Table 34.4.

68 Overload Test

68.1 General

68.1.1 A receptacle shall be capable of performing acceptably when subjected to the current overload test as described in this section. A receptacle additionally rated in horsepower shall also be capable of performing acceptably when subjected to the horsepower overload test as described in this section. In either case, there shall not be any electrical or mechanical failure of the device, opening of a line or grounding fuse, welding of the contacts, nor burning or pitting of the contacts that would affect the intended function of the device.

Exception No. 1: A receptacle that is intended for disconnecting use only and not for current interruption, is not required to be subjected to this test. See also 88.5.

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.

68.1.2 The device is to be mounted and wired to represent service conditions. If the device is intended for use with a face plate or the like, it is to be mounted with a metal plate as in service. If the device is rated at 250 V or less, the metal plate is to be connected through a fuse to ground, to the grounded conductor of the test circuit, or to a circuit conductor that differs from at least 125 V in potential from one or more of the remaining conductors in the circuit. If the device is rated more than 250 V, the plate is to be connected similarly to a circuit conductor that differs by at least the rated potential from one or more of the remaining conductors in the circuit. The frame (yoke) and enclosure, if any, are to be electrically positive with respect to the nearest arcing point of the device.

68.1.3 The fuse in the grounding conductor is to be a 15 A fuse if the device being tested is rated 30 A or less.

68.1.4 The fuse in the test circuit is to have the next higher standard fuse rating than the value of the test current.

68.1.5 The potential of the test circuit is to be from 95 to 105 percent of the rating of the device in volts. Devices rated 250 V are to be tested on circuits with a potential to ground of 125 V. 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.

68.1.6 Each of six devices is to be tested by machine or manually by inserting and withdrawing an attachment plug having rigidly secured solid blades that are connected through a flexible cord to a load. When an equipment-grounding connection is provided in the device being tested, a grounding-type attachment plug is to be used and the grounding blade of the plug connected to the grounding contact of the device being tested. The grounding contact is then to be grounded through a fuse as specified in 68.1.3.

68.1.7 For a device rated 20 A or less, the test machine is to withdraw and insert an unrestricted attachment plug with an average velocity of 30 ±3 inches/s (760 ±75 mm/s) in each direction during a 2-1/2 inch (64 mm) stroke measured from the fully inserted position. The velocity is to be determined without the outlet device installed on the machine to eliminate restrictions on the plug motion.

68.1.8 For a device rated more than 20 A the test machine unrestricted plug velocity and stroke length are to be adjusted as necessary to obtain the maximum mating time required in 68.1.8.

68.1.9 The device is then to make and break the required test load for 50 cycles of operation at a rate no faster than 10 cycles per minute. The blade of the attachment plug is to mate with the female contact of the device for no more than 1 second for straight-blade devices, and 3 seconds for locking devices during each cycle. For locking devices, each cycle of operation is to include rotation of the test plug to the full lock position after insertion, and back to the unlocked position before withdrawal.

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

68.1.11 In the event that unacceptable results are obtained in the machine testing described in 68.1.6 or 68.1.7, referee tests may be conducted manually under conditions similar to those described in 68.1.6 or 68.1.7.

68.2 Current overload test

68.2.1 The test current shall be 150 percent of the rated current of the device. For devices with standard configurations rated 125 V, 250 V, or 125/250 V illustrated in ANSI/NEMA WD6, the test is to be conducted on direct current. All other devices with standard configurations denoted as "AC" or "3-phase" are to be tested on alternating current. For devices with nonstandard configurations, the test is to be conducted using direct current with a resistive load, except that alternating current is to be used if the device is rated for alternating current only. Whenever alternating current is used for the test, the power factor of the load is to be from 0.75 to 0.80.

68.2.2 Testing of a device that has a dual voltage rating and a dual current rating is to be performed at the maximum rating in volts and with 150 percent of the rated current that corresponds to the maximum voltage rating.

Exception: A test on alternating current may be waived if equivalent results have been obtained from a direct potential that is equal to or greater than the alternating-potential rating.

68.3 Horsepower overload test

68.3.1 If a separate horsepower overload test is conducted, the tests for the horsepower ratings are to be conducted on separate sets of previously untested devices. For devices with a phase to phase (L-L) and phase to neutral (L-N) horsepower rating, the test for each rating is to be conducted on a separate set of previously untested devices.

68.3.2 For devices with standard configurations illustrated in ANSI/NEMA WD6, the test current corresponding to the AC horsepower rating shall be as specified in Table 68.1. 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 a L9-20R, L9-30R, L13-30R, L17-30R, L20-20R, L20-30R, L23-20R, L23-30R configuration in ANSI/NEMA WD6 or one of the configurations illustrated in Figures C1.1 – C1.5 of UL 1681 do not have assigned horsepower ratings and are not required to be subjected to the horsepower overload test.

Exception No. 2: Appliance, equipment or fixture outlets do not have assigned horsepower ratings and are not to be subjected to the horsepower overload test.

Table 68.1
Test Current (Locked Rotor Amperes) for Horsepower Rated NEMA Configuration Receptacles

NEMA configuration	AC HP rating[a]	LRA (amperes)	AC test voltage
L5-20R	1	96	125
L5-30R	2	144	125
L6-20R	2[b]	72	250
		79.2	208
L6-30R	2[b]	72	250
		79.2	208
L7-20R	2	59.8	277
L7-30R	3	84.7	277
L8-20R	3	51	480
L8-30R	5	84	480
L14-20R	2 L-L[b]	72	250
		79.2	208
	1 L-N	96	125
L14-30R	2 L-L[b]	72	250
		79.2	208
	2 L-N	144	125
L15-20R	3	64	250
L15-30R	3	64	250
L16-20R	5	45.6	480
L16-30R	10	84	480
L21-20R	2	55	208
L21-30R	3	71	208
L22-20R	5	45.6	480

Table 68.1 Continued on Next Page

Table 68.1 Continued

NEMA configuration	AC HP rating[a]	LRA (amperes)	AC test voltage
L22-30R	10	84	480

[a] The phase to phase horsepower ratings are noted by "L-L". The phase to neutral ratings is identified by "L-N".

[b] Also suitable for 208 V motor applications at the indicated horsepower rating.

68.3.3 For all devices with nonstandard configurations, the test current corresponding to the horsepower rating is to be as specified in UL 20, for a device having an alternating-current rating of 2 horsepower or less and as specified 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.

69 Temperature Test

69.1 Contact and terminal temperature

69.1.1 The temperature rise of a receptacle measured as at the points described in 69.1.2, shall not be more than 54°F (30°C) when the device is carrying its maximum rated current.

69.1.2 Each of six devices is to be tested. Temperatures are to be measured by means of thermocouples attached to the wiring terminals of the device when they are accessible for the mounting of thermocouples.

Exception: When the wiring terminals are not accessible for mounting thermocouples or when the device is not provided with wiring terminals, the thermocouples are to be attached to the blades of the mated attachment plug as close as possible to the face of the device.

69.1.3 The temperature test is to be made following the overload test on the devices and is to continue until stabilized temperatures are attained. A temperature is considered to be stabilized when three consecutive readings, taken at no less than 5-minute intervals, indicate no further rise above the ambient temperature.

69.1.4 The generation of heat from sources other than the female contacts is to be minimized as much as possible. Each connection to the device being tested is to be made by means of a 12-inch (300-mm) or greater length of Type RH, Type TW, or other equivalent building wire. The wire size and type are to be determined using the appropriate value for the device's current rating from Table 310-16 of ANSI/NFPA 70, as follows:

a) Ampacities for copper conductors temperature rated at 140°F (60°C) for a receptacle rated 100 A or less for use on copper conductors only.

b) Ampacities for copper conductors temperature rated at 167°F (75°C) for a receptacle rated greater than 100 A for use on copper conductors only.

c) Ampacities for copper conductors temperature rated at 167°F (75°C) for a receptacle rated greater than 30A, and 100 A or less, for use on copper conductors only and marked in accordance with Table 89.4.

69.1.5 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 solid blades and the terminals of the plug are to be short-circuited by means of the shortest feasible length of flexible cord that has an ampacity at least equal to that of the device. The wire size and type are to be determined using the appropriate value for the device's current rating from Table 400.5(A) or 400.5(B) of ANSI/NFPA 70.

69.1.6 The terminals are to be tightened to the marked torque limit or, when a tightening torque is not provided, the torque used is 14 in-lbf (1.6 N·m).

69.1.7 Temperature readings are to be obtained by means of thermocouples consisting of 28 – 32 AWG (0.8 – 0.032 mm^2) iron and constantan wires with a potentiometer type of indicating instrument. This equipment is to be used when a referee measurement of temperature is necessary.

69.2 Feed-through terminal temperature

69.2.1 The temperature rise of the terminals of a receptacle that has a current rating of 20 A at 125 or 250 V and that is provided with wiring terminals for through connection, shall not be more that 54°F (30°C) when a current of 20 A is passed through both terminals.

Exception: A receptacle that employs the conventional form of terminal plate with two wire-binding screws or pressure-wire connectors is not required to be subjected to this test.

69.2.2 The test is to be made in accordance with 69.1.2 – 69.1.6 but without a load on the receptacle contacts. Approximately 12-inch (300-mm) lengths of 12 AWG (3.3 mm^2) wire are to be used for connections.

69.2.3 Temperature readings are to be obtained by means of thermocouples consisting of 28 – 32 AWG (0.8 – 0.032 mm^2) iron and constantan wires with a potentiometer type of indicating instrument. This equipment is to be used when a referee measurement of temperature is necessary.

70 Resistance to Arcing Test

70.1 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 68, shall perform acceptably when subjected to an additional 200 cycles of operation under the overload-test conditions following the temperature test.. 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.

70.2 Alternatively one set of devices may be subjected to the 50 cycles of operation in the overload test described in Overload Test, Section 68, 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.

71 Fuseholder Temperature Test

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

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

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

c) 54°F (30°C) at the wiring terminals or cord connections at any time (see 71.7); and

d) The relative thermal index of the surrounding insulating material, minus an assumed ambient of 77°F (25°C), at any time (see 71.7).

71.2 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 71.6 and 71.7).

Exception: The test may be conducted in conjunction with the Temperature Test, 69.1, if agreeable to all concerned.

71.3 The receptacles are to be wired in a series circuit as described in the Temperature Test, 69.1.

71.4 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.

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

71.6 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.

71.7 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 UL 4248-1, UL 4248-4, UL 4248-5, UL 4248-6, UL 4248-8, UL 4248-9, UL 4248-11, UL 4248-12, and UL 4248-15. The dummy fuse size for devices employing miscellaneous, miniature and micro fuses is to be as indicated in Table 71.1. To represent the heating of a live fuse, 36°F (20°C) is to be added to the recorded temperature rise on the wiring terminals, cord connections, and surrounding insulating materials.

Table 71.1
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)

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

72 Pressure-Wire Terminals

72.1 In addition to the requirements in Sections 67 – 71, a receptacle rated 30 A or greater and employing pressure-wire terminals for field connection to circuit conductors shall comply with the Strength of Insulating Base Test, Section 74, and with the applicable performance requirements in UL 486E. The copper test conductors to be used for all other tests in UL 486E shall be selected in accordance with Table 72.1.

Table 72.1
Copper Test Conductor Sizes

Device Rating, A	Conductor size, AWG
20	12 stranded 12 solid
30	10 stranded 10 solid

72.2 In addition to the requirements in Sections 67 – 87, the following types of receptacles shall comply with the Strength of Insulating Base Test, Section 74, and with the applicable performance requirements in UL 486E.

72.3 A receptacle rated less than 30 A and employing setscrew-type pressure-wire terminals for field connection to copper branch circuit conductors only.

72.4 The copper test conductors to be used in these tests shall be selected in accordance with Table 72.1.

72.5 A receptacle less than 30 A and employing clamp-type pressure-wire terminals intended for use on copper branch circuit conductors only shall comply with the general requirements for receptacles contained in Sections 67 – 75, only.

73 Combination Wire Binding/Pressure Wire-Type Terminals

73.1 In addition to the requirements in Sections 67 – 75, a receptacle rated less than 20 A and also employing a combination wire binding/pressure wire-type terminal for field connection to copper branch circuit conductors shall comply with the Strength of Insulating Base Test, Section 74, and with the applicable performance requirements in UL 486E.

73.2 The copper test conductors to be used in these tests shall be selected in accordance with Table 73.1.

Table 73.1
Copper Test Conductor Sizes

Device rating, A	Conductor size, AWG
20	12 solid 12 stranded 10 solid 10 stranded

74 Strength of Insulating Base Test

74.1 A receptacle employing pressure-wire terminals for field connection to branch circuit conductors shall not be damaged when 110 percent of the specified terminal tightening torque is applied to the wire securing means of the pressure-wire terminal which secures the maximum intended size conductor.

74.2 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.

74.3 The terminal tightening torque to be used for this test is to be that assigned by the manufacturer in accordance with 12.4.3 and marked in accordance with Reference No. 18 of Table 89.4.

75 Spring Action Clamp Terminal Pull Test

75.1 A receptacle employing spring action clamp terminals shall be subjected to the test conditions as specified in 75.2 – 75.6.

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

75.3 Each terminal of each device (three terminals minimum) shall be tested. Each terminal shall be wired with the smallest AWG conductor size and wired with the largest conductor size, as specified by the manufacturer. If the spring action clamp is also intended for both solid and stranded AWG conductors, both solid and stranded shall be tested.

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

75.5 Following the 100 cycles, the conductor shall be reattached to the spring action clamp terminal and the lever place in the latched position as intended. A static pull force as specified in Table 75.1 shall be applied to the conductor for 1 minute in a direction perpendicular to the plane of the receptacle body, tending to remove the conductor.

Table 75.1
Test Values for Spring Action Clamp Terminal Pull Test

Size of conductor AWG	Pullout force lbf (pounds) (N)
12	13.5 (60)
10	18.0 (80.1)

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

76 Self-Grounding Receptacles

76.1 In addition to the general performance requirements for receptacles, a self-grounding receptacle shall comply with the requirements in Section 77.

77 Fault Current Test

77.1 When tested as described in this section, the cotton surrounding the mounting screw and the self-grounding device shall not ignite. Electrical continuity between the mounting yoke and the metal test outlet box shall be maintained. The circuit breaker shall operate as a result of this test.

Exception: This test is not required for isolated-ground receptacles or receptacles rated more than 150 V to ground that are provided with devices intended solely to bond a metal flush plate to the metal test outlet box. Such devices are not intended for use in lieu of the bonding jumper required by ANSI/NFPA 70.

77.2 When the receptacle is provided with a self-grounding device on each end of the yoke, each self-grounding device is to be evaluated separately.

77.3 Each of six previously untested receptacles is to be conditioned by completely removing the mounting screw from the self-grounding device and mounting yoke and replacing it three times. The mounting screw is to be removed by exerting a straight pull (not by rotating the screw) using a pair of pliers or other tool and reinserted by exerting a straight push. When mounting screws are not provided, steel flat-headed No. 6-32 mounting screws are to be used.

77.4 Each receptacle is to be tightly installed in a metal test outlet box using the mounting screws provided with the receptacles or steel flat-headed No. 6-32 mounting screws when mounting screws are not provided. Each receptacle is then to be removed from the outlet box and replaced three times without removing the mounting screws from the mounting yoke or self-grounding device. The installations and removals are to be made using a screwdriver or other tool and engaging the screw threads in the mounting hole and self-grounding device in the intended manner.

77.5 Each receptacle is then to be removed from the outlet box. A 4 foot (1.22 m) length of copper wire sized in accordance with Table 77.1 is to be connected to the grounding terminal of the receptacle and a second 4 foot (1.22 m) length is to be connected to the grounding terminal of the outlet box. Each receptacle is then to be installed in the outlet box as shown in Figure 77.1, so that the mounting yoke and all other grounded parts except the mounting screw passing through the self-grounding device are fully isolated from the outlet box. To isolate the box, the mounting screw passing through the self-grounding device is to be tightened to seat the yoke securely against the outlet box, then backed off until the yoke and the outlet box are separated by 1/4 inch (6.4 mm). The mounting screw and self-grounding device are to be loosely covered with cotton. The other end of the yoke is to be secured to the outlet box by a plastic mounting screw.

Table 77.1
Grounding Conductor Sizes

Receptacle rating, A	Grounding conductor size, AWG (mm^2)
20	12 (3.3)
30	10 (5.3)

Figure 77.1

Fault Current Assembly