



UL 1594

Underwriters Laboratories Inc. Standard for Safety

Sewing and Cutting Machines



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UL Standard for Safety for Sewing and Cutting Machines, UL 1594

Fourth Edition, Dated April 18, 2008

Summary of Topics

These revisions to UL 1594 are being issued to address the editorial maintenance of UL Standards for Safety. These revisions are considered to be non-substantive and not subject to UL's STP process.

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. Changes in requirements are marked with a vertical line in the margin and are followed by an effective date note indicating the date of publication or the date on which the changed requirement becomes effective.

A reference to UL 60730-1 and/or a Part 2 standard from that series has been added to this standard. The addition of this reference provides an alternate standard for investigating components currently covered by UL 244A until October 19, 2016. This added reference will facilitate the use of components that have been investigated to the UL 60730 series. Such components have been determined to fulfill the requirements of the legacy standards.

UL 60730-1 (4th Edition) becomes effective on October 19, 2016. All components that were previously investigated to the requirements in UL 244A will have to comply with the requirements in either UL 60730-1 and/or a Part 2 standard from that series in order to maintain UL Listing or Recognition, as appropriate. UL 244A legacy control standard will be withdrawn on October 19, 2016.

This is intended to provide end product manufacturers with sufficient time to a) address the impact of the standards changes during normal design changes over the intervening years, b) submit any modified products for investigation, and c) implement any necessary changes in production.

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that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.

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UL 1594

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This UL Standard for Safety consists of the Fourth Edition including revisions through June 25, 2010.

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 <http://csds.ul.com>.

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INTRODUCTION

1 Scope

1.1 These requirements cover both household and industrial sewing and cutting machines to be employed in accordance with the National Electrical Code.

1.2 These requirements also cover small utilization products, such as vibrator-powered scissors where motion of an operating part is produced by electrical means.

1.3 These requirements do not cover equipment rated more than 600 V; nor do they cover products involving universal motors rated more than 250 V.

1.4 These requirements also cover textile equipment for use in ordinary locations but do not cover equipment intended for use in hazardous locations such as certain textile processing equipment, and yarn handling equipment.

2 General

2.1 Components

2.1.1 Except as indicated in 2.1.2, a component of a product covered by this standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components generally used in the products covered by this standard.

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

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

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

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

2.2 Units of measurement

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

2.2.2 Unless otherwise indicated, all voltage and current values mentioned in this Standard are root-mean-square.

2.3 Undated references

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

3 Glossary

3.1 For the purpose of this standard the following definitions apply.

3.2 **AUTOMATICALLY CONTROLLED PRODUCT** – A product is determined to be automatically controlled if it complies with one or more of the following conditions:

- a) The repeated starting of the product is independent of any manual control after one complete cycle of operation, after which some form of limit device opens the circuit.
- b) During any single preset cycle of operation, the motor is caused to stop and restart.
- c) When the product is energized, the initial starting of the motor may be intentionally delayed beyond intended, conventional starting.
- d) For a product employing a motor with a separate starting winding, during any single predetermined cycle of operation, automatic changing of the mechanical load reduces the motor speed sufficiently to reestablish starting-winding connections to the supply circuit.

3.3 **DEAD METAL PART** – A metal or other electrically conductive part, accessible or inaccessible, that is not conductively connected to a live part.

3.4 **FIRMWARE** – Computer program contained permanently in a hardware device as read-only memory.

3.5 **HAND-HELD PRODUCT, HAND-GUIDED PRODUCT** – A portable product that during intended use is contacted by the hand of the user for purposes of electrical or physical control but not for complete support.

3.6 **HAND-SUPPORTED PRODUCT** – A product such as an electric scissor, that is physically supported by any part of the user during the performance of its intended functions.

3.7 **ISOLATING TRANSFORMER** – A transformer having one or more output windings electrically insulated from all other windings.

3.8 **LINE-VOLTAGE CIRCUIT** – A circuit involving a potential of not more than 600 V and having circuit characteristics in excess of those of a low-voltage circuit.

3.9 **LIVE PART** – A part energized with respect to earth or energized with respect to some other part.

3.10 LOW-VOLTAGE CIRCUIT – A circuit involving a peak open-circuit potential of not more than 42.4 V supplied by a primary battery; a Class 2 transformer; or a combination of an isolation transformer and a fixed impedance that (as a unit) complies with all performance requirements for a Class 2 transformer. A circuit derived from a line-voltage circuit by connecting a resistance in series with the supply circuit as a means of limiting the voltage and current, is not considered to be a low-voltage circuit.

3.11 PORTABLE – Capable of being carried or conveyed.

3.12 REMOTELY CONTROLLED PRODUCT – A product that is out of view of the operator at the starting device.

3.13 SEWING MACHINE TRANSMITTER – A motor, provided with either a mechanically or electrically operated clutch assembly, used to provide rotary drive for an industrial sewing machine.

CONSTRUCTION

4 General

4.1 A product shall employ materials that are acceptable for the particular use, and shall be made and finished with the degree of uniformity and grade of workmanship practicable in a well-equipped factory.

5 Frame and Enclosure

5.1 General

5.1.1 A product shall be formed and assembled so that it will have the strength and rigidity necessary to resist the abuses that it is likely to be subjected to under normal and foreseeable abnormal conditions.

5.1.2 The enclosure of a remotely or automatically controlled product shall be so constructed as to prevent molten metal, burning insulation, flaming particles, or similar materials from falling on combustible materials, including the surface upon which the product is supported.

5.1.3 A door or a cover of an enclosure that provides access to any overload-protective device that requires resetting or renewal shall be hinged or otherwise attached in an equivalent manner.

5.1.4 Means shall be provided for holding the door or cover over a fuseholder in a closed position.

5.2 Cast and sheet metal

5.2.1 For unreinforced, flat surfaces in general, cast metal shall not be less than 1/8 inch (3.2 mm) thick, except that malleable iron may not be less than 3/32 inch (2.4 mm) and die-cast metal may be not less than 5/64 inch (2.0 mm) thick. Corresponding thicknesses of not less than 3/32, 1/16 (1.6 mm), and 3/64 inch (1.2 mm), respectively, may be acceptable if the surface under consideration is curved, ribbed, or otherwise reinforced, or if the shape or size, or both, of the surface is such that adequate mechanical strength is provided.

5.2.2 An enclosure of sheet metal is to be judged with respect to its size, shape, thickness of metal, and its application, considering the intended use of the complete product. The use of sheet steel having a thickness of less than 0.026 inch (0.66 mm) if uncoated or 0.029 inch (0.74 mm) if galvanized or of nonferrous sheet metal having a thickness of less than 0.036 inch (0.91 mm) is not recommended, except for relatively small areas or for surfaces that are covered or otherwise reinforced.

5.2.3 Sheet metal to which a wiring system is to be connected in the field shall have a thickness not less than 0.032 inch (0.81 mm) for uncoated steel, not less than 0.034 inch (0.86 mm) for galvanized steel, and not less than 0.045 inch (1.14 mm) for nonferrous metal.

5.3 Polymeric enclosures

5.3.1 Enclosures of polymeric material shall comply with the requirements for enclosures contained in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

Exception No. 1: The ball impact test for portable table top or counter supported products shall be conducted using a 3 ft·lbf (4.07 J) impact.

Exception No. 2: A polymeric material having a volume resistivity lower than that required by the section for volume resistivity of UL 746C may only be used if, with the enclosure considered to be a dead metal part, the product complies with the requirements for spacings in Spacings, Section 22.

Exception No. 3: For the impact tests specified in UL 746C:

- a) Each surface that is likely to be exposed to abuse during normal use is to be tested, but no more than 3 impacts are to be applied to any one sample;*
- b) In lieu of the requirements for dielectric voltage-withstand, the requirements for accessibility in Accessibility of Uninsulated Live Parts and Magnet Wire, Section 9, shall be applied after the impact test.*

Exception No. 4: For the mold stress-relief distortion conditioning requirements specified in UL 746C, the requirement that specify conditioning results shall not cause interference with the intended operation or servicing of the equipment, is not applicable.

Exception No. 5: For the abnormal operation requirements specified in UL 746C:

- a) Cheesecloth is not required to be applied.*
- b) There shall be no ignition of the enclosure material, exposure of live part, nor glowing or flaming of the material upon which the product is placed as a result of emission of flame through other than existing openings.*

6 Adhesives Used to Secure Parts

6.1 An adhesive that is relied upon to reduce a risk of electric shock, fire, or injury to persons shall comply with the requirements for adhesives in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

6.2 The requirement in 6.1 also applies to an adhesive used to secure a conductive part, including a nameplate, that may, if loosened or dislodged:

- a) Energize an accessible dead metal part,
- b) Make a live part accessible,
- c) Reduce spacings below the minimum acceptable values, or
- d) Short circuit live parts.

7 Mechanical Assembly

7.1 A product shall be assembled so that it will not be adversely affected by the vibration of normal operation. Brush caps shall be tightly threaded or otherwise constructed to be kept from loosening.

7.2 A switch other than a through-cord switch, a lampholder, an attachment-plug receptacle, a motor-attachment plug, or similar component shall be mounted securely and shall be kept from turning. See 7.4.

Exception No. 1: A switch is not required to be kept from turning if all four of the following conditions are met:

- a) The switch is of a plunger or other type that does not tend to rotate when operated. A toggle switch is considered to be subject to forces that tend to turn the switch during normal operation of the switch.*
- b) The means for mounting the switch makes it unlikely that operation of the switch will cause it to loosen.*
- c) The spacings are not reduced below the minimum required values if the switch rotates.*
- d) The intended operation of the switch is by mechanical means rather than by direct contact by persons.*

Exception No. 2: A nonserviceable lamp such as a neon light in which the lamp is sealed in a nonremovable jewel, is not required to be kept from turning if rotation does not reduce spacings below the minimum required values.

7.3 Uninsulated live parts shall be secured to the base or mounting surface so that they will be kept from turning or shifting in position, if such motion results in a reduction of spacings below the minimum acceptable values.

7.4 The means used to keep the parts mentioned in 7.2 and 7.3 from turning or shifting is to consist of more than friction between surfaces. For example, a properly applied lock washer is acceptable as the means for keeping a small stem-mounted switch, or other device having a single-hole mounting means, from turning.

8 Protection Against Corrosion

8.1 Iron and steel parts shall be protected against corrosion by enameling, galvanizing, plating, or other equivalent means, if corrosion of such unprotected parts would be likely to result in a risk of fire, electric shock, or injury to persons.

Exception: Bearings, laminations, or small parts of iron or steel, such as washers, screws, and similar parts are not required to comply with this requirement.

9 Accessibility of Uninsulated Live Parts and Magnet Wire

9.1 General

9.1.1 The requirements in 9.1.2 – 9.2.3 shall apply to uninsulated live parts and magnet wire in circuits other than Class 2 and limited voltage/current circuits as described in 21.2 and 21.3.

9.1.2 To reduce the likelihood of unintentional contact that may involve a risk of electric shock, an uninsulated live part or magnet wire shall comply with either (a) or (b).

- a) For an opening that has a minor dimension (see 9.1.6) less than 1 inch (25.4 mm), such a part or wire shall not be contacted by the probe illustrated in Figure 9.1.
- b) For an opening that has a minor dimension of 1 inch or more, such a part or wire shall be spaced from the opening as specified in Table 9.1.

Exception: A motor used in an appliance intended for commercial use other than one used in either a hand-held product or a hand-supported portion of a product is not required to comply with these requirements if it complies with the requirements in 9.1.3.

Table 9.1

Minimum acceptable distance from an opening to a part that may involve a risk of electric shock

Minor dimension of opening, ^a		Minimum distance from opening to part,	
inches ^b	(mm ^b)	inches ^b	(mm ^b)
3/4	(19.1)	4-1/2	(114.0)
1 ^c	(25.4)	6-1/2	(165.0)
1-1/4	(31.8)	7-1/2	(190.0)
1-1/2	(38.1)	12-1/2	(318.0)
1-7/8	(47.6)	15-1/2	(394.0)
2-1/8	(54.0)	17-1/2	(444.0)
d	d	30	(762.0)
^a See 9.1.6 ^b Between 3/4 and 2-1/8 inches, interpolation is to be used to determine a value between values specified in the table. ^c Any dimension less than 1 inch applies to a motor only. ^d More than 2-1/8 inches (54.0 mm), but not more than 6 inches (152.0 mm).			

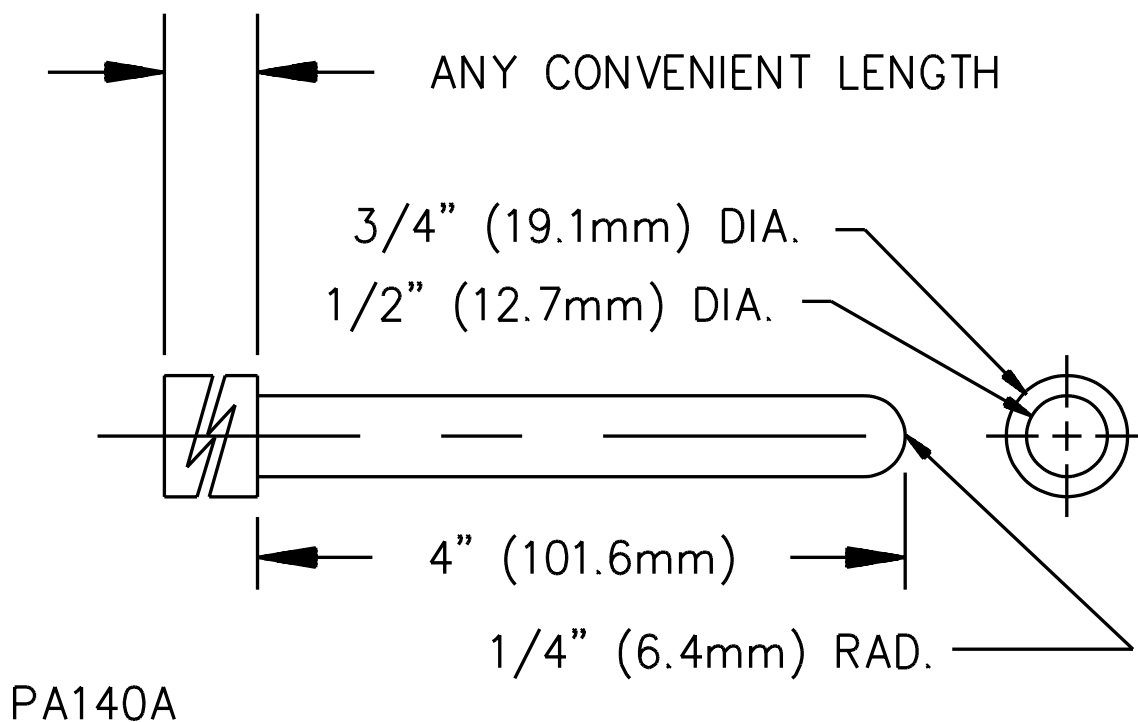
9.1.3 With respect to a part or wire as mentioned in 9.1.2, in an integral enclosure of a motor as mentioned in the Exception to 9.1.2:

a) An opening that has a minor dimension (see 9.1.6) less than 3/4 inch (19.1 mm) is acceptable if:

- 1) Magnet wire cannot be contacted by the probe illustrated in Figure 9.2
- 2) An uninsulated live part cannot be contacted by the probe illustrated in Figure 9.3.

b) An opening that has a minor dimension of 3/4 inch or more is acceptable if a part or wire is spaced from the opening as specified in Table 9.1.

Figure 9.2
Straight probe



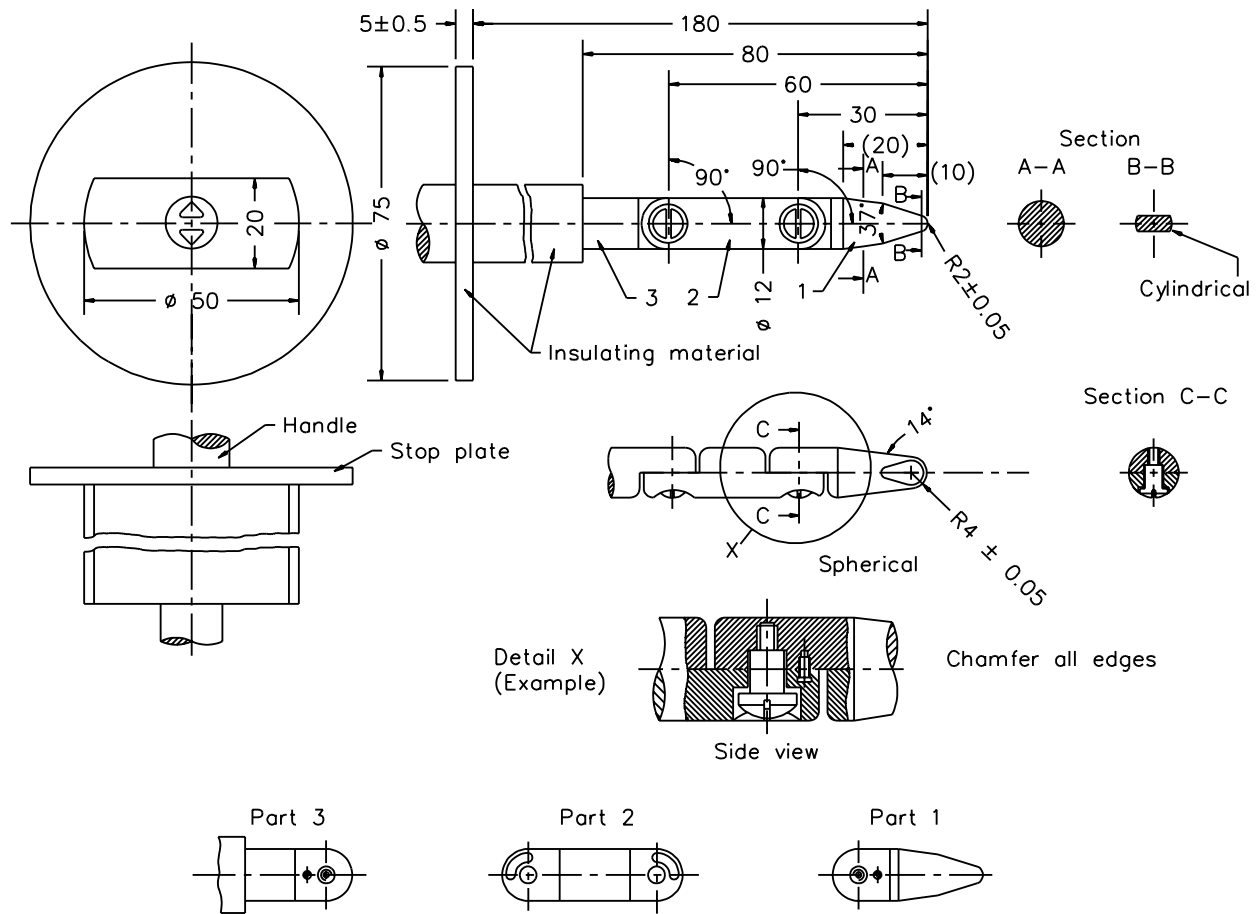
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Figure 9.3
Articulate probe with stop plate



SA1788A

NOTE – All dimensions in millimeters

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9.1.4 The probes mentioned in 9.1.2 and 9.1.3 and illustrated in Figures 9.1 – 9.3 shall be applied to any depth that the opening will permit; and shall be rotated or angled before, during, and after insertion through the opening to any position that is necessary to examine the enclosure. The probes illustrated in Figures 9.1 and 9.3 shall be applied in any possible configuration; and, if required, the configuration shall be changed after insertion through the opening.

9.1.5 The probes mentioned in 9.1.2 and 9.1.3 shall be used as measuring instruments to judge the accessibility provided by an opening, and not as instruments to judge the strength of a material; they shall be applied with the minimum force necessary to determine accessibility.

9.1.6 With reference to the requirements in 9.1.2 and 9.1.3, the minor dimension of an opening is the diameter of the largest cylindrical probe having a hemispherical tip that can be inserted through the opening.

9.1.7 During the examination of a product to determine whether it complies with the requirements in 9.1.2 or 9.1.3, a part of the enclosure that may be opened or removed by the user without using a tool (to attach an accessory, to make an operating adjustment, or for other reasons) is to be opened or removed.

9.1.8 With reference to the requirements in 9.1.2 and 9.1.3, insulated brush caps are not required to be additionally enclosed.

9.2 Accessibility of parts requiring servicing

9.2.1 For routine operator servicing or adjustment, a fuseholder, or a circuit breaker shall be constructed and installed so that a person servicing the fuse, or the circuit breaker will not come in contact with an uninsulated live part.

9.2.2 A door or a cover that is accessible from outside the enclosure shall be hinged or otherwise permanently attached to the product if it gives access to any overload-protective device other than a type that does not require an additional enclosure.

9.2.3 Means shall be provided for holding the door or the cover over a fuseholder in a closed position.

10 Supply Connections

10.1 Cord-connected products

10.1.1 Cords and plugs

10.1.1.1 A product intended to be connected to the power-supply circuit by means of a power-supply cord shall be provided with a flexible cord and an attachment plug acceptable for the connection.

10.1.1.2 The power-supply cord shall have a voltage rating not less than the rated voltage of the product, and shall have an ampacity that is not less than the current input to the product as measured during the input test or the rating of the product, whichever is higher.

10.1.1.3 The power-supply cord shall be as specified in Table 10.1, or shall be of a type at least equally serviceable for the application.

Table 10.1
Cords for products

Product	Types of cord
Cloth-cutting machines:	
Household (includes scissors)	SP-2, SPT-2, SPE-2, SV, SVE, SVT
Commercial	SJ, SJT, SJE
Commercial textile equipment	S, ST, SE
Knitting machines:	
Household	SP-2, SPT-2, SPE-2, SV, SVE, SVT
Commercial	S, ST, SE
Sewing machines:	
Household	SP-2, SPT-2, SPE-2, SV, SVE, SVT
Transmitters	S, ST, SE

10.1.1.4 For a product not specifically mentioned in Table 10.1, Type SJ, SJT, or equivalent cord is ordinarily required if the product is intended for commercial use, and Type SP-1, SPT-1 or equivalent if the product is intended for household use.

10.1.1.5 The power-supply cord shall not be less than 5 feet (1.52 m) long.

10.1.1.6 The length of an attached power-supply cord includes the attachment plug. The length of a cord set includes the attachment plug and cord-connector body.

10.1.1.7 A household product intended for use with a detachable cord set shall be provided with terminal pins that will not accommodate a standard flatiron or appliance plug.

10.1.1.8 The attachment cap shall have an ampacity not less than the current input to the product as measured during the input test or the rating of the product, whichever is higher, and a voltage rating equal to the rated voltage of the product. If a product is acceptable for adaptation for use on two or more different values of voltage by field alteration of internal connections, the attachment plug provided with the product shall be acceptable for the voltage for which the product is intended to be connected when shipped from the factory. See 58.1.4.

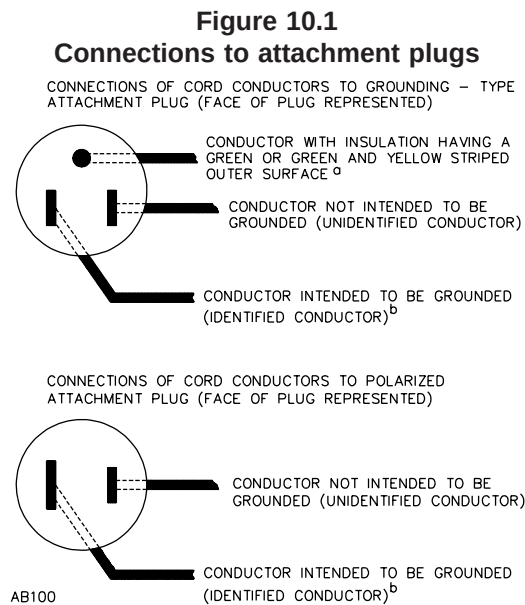
10.1.1.9 A 3- to 2-wire, grounding-type adapter shall not be provided with a product.

10.1.1.10 A product provided with special-use pin terminals shall be constructed so that no live parts will be exposed to unintentional contact either during or after placement of an intended plug on the pins in the intended manner.

10.1.1.11 With reference to 10.1.1.10 a pin guard shall be provided such that:

- a) A flat straight edge placed in any position, across and in contact with edges of the plug opening without the plug in place, will not contact any current-carrying pin and
- b) The probe illustrated in Figure 9.1 will not contact any current carrying pin when the probe is inserted through any opening created by aligning the plug with its face in the plane perpendicular to the axis of, and tangent to the end of the farthest projecting current-carrying pin.

10.1.1.12 A product intended for connection to a nominal 120 V circuit, and provided with a manually operated, line-connected, single-pole switch for appliance on-off operation, an Edison base lampholder, or a 15- or 20-ampere receptacle shall have a polarized attachment plug (2-blade polarized or 3 wire-grounding). The connections to the attachment plug shall be in accordance with Figure 10.1 and Table 10.2.



^a In the above illustration, the blade to which the green conductor is connected may have a U-shaped or a circular cross section.

^b Signifies a conductor identified in accordance with Table 10.2.

Table 10.2
Polarity identification of flexible cords

Method of identification	Acceptable combinations	
	Conductor intended to be grounded ^{a,b}	All other conductors ^a
Color of braids on individual conductors	Solid white or gray – without tracer	Solid color other than white or gray – without tracer
	Color other than white or gray, with tracer in braid	Solid color other than white or gray – without tracer
Color of insulation on individual conductors	Solid white or gray ^c	Solid color other than white or gray
	Solid light blue ^d	Solid color other than light blue, white, or gray.
Color of separators	White or gray ^e	Color other than white or gray
Other means	Tin or other white metallic coating on all strands of the conductor ^e	No tin or other white metallic coating on the strands of the conductor
	A stripe, ridge, or groove on the exterior surface of the cord ^e	
^a A conductor finished to show a green color with or without one or more yellow stripes or tracers is to be used only as an equipment grounding conductor. See 10.1.1.12 and Figure 10.1.		

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Table 10.2 Continued on Next Page



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Table 10.2 Continued

Method of identification	Acceptable combinations	
	Conductor intended to be grounded ^{a,b}	All other conductors ^a
^b The grounded (identified) conductor is the neutral supply conductor. ^c Only for cords – other than Type SP-2 or SPT-2 – having no braid on any individual conductor. ^d For jacketed cord. ^e Only for Type SP-2 and SPT-2 cords.		

10.1.1.13 A product rated 120 V shall have the circuit conductors in the flexible cord connected to the plug and to the wiring in the product so that any of the following devices used in the primary circuit are connected in an ungrounded side of the line: the center contact of an Edison-base lampholder, a single-pole switch, a fuseholder, any other single-pole overcurrent protective device, and an automatic control with a marked off position.

10.1.1.14 A product not intended to be moved during use may be provided with not more than 8 feet (2.44 m) of Type S, SO, ST, or STO cord and an attachment plug for supply connection. The investigation of such a feature will include consideration of the utility of the product and the necessity of having it readily detachable from its source of supply by means of a plug.

10.1.2 Strain relief

10.1.2.1 Strain relief shall be provided so that mechanical stress, including a rotational stress, on any external cord will not be transmitted to terminals, splices, or interior wiring. The strain relief shall comply with the requirements of the Strain Relief Test, Section 42.

10.1.2.2 A metal strain-relief clamp or band used with Type SP-2 or lighter general-use rubber-insulated cord shall be provided with auxiliary insulation over the cord for mechanical protection.

10.1.2.3 A clamp of any material is not acceptable for use on Type SVT, SVE, SVTO, SPE-2, or SPT-2 cord.

Exception No. 1: The construction may be acceptable if the cord is protected by varnished-cloth tubing or the equivalent under the clamp.

Exception No. 2: A clamp that has been investigated and found to be acceptable is not required to comply with this requirement. See 42.3.

10.1.2.4 For types of thermoplastic-insulated cord, heavier than Type SPT-2, SPE-2, SVE, SVT or SVTO, a clamp may be employed without auxiliary insulation if it is determined that the design of the clamp will not damage the cord insulation.

10.1.2.5 Means shall be provided to prevent a flexible cord from being pushed into a product through a cord-entry hole when such displacement:

- a) Subjects the cord to mechanical damage or exposure to a temperature higher than that for which the cord is rated or
- b) Reduces a spacing, such as to a metal strain-relief clamp, below the minimum values specified in 22.1.

See the Push-Back Relief Test, Section 43.

10.1.2.6 If a knot in a flexible cord serves as strain relief, the surface that the knot may contact shall be free from sharp edges, burrs, fins, and other projections likely to damage the cord.

10.1.3 Bushings

10.1.3.1 At a point where a flexible cord passes through an opening in a wall, barrier, or enclosing case, there shall be a bushing or the equivalent that shall be substantial, reliably secured in place, and shall have a smooth, well-rounded surface that the cord may bear against.

10.1.3.2 The insulating bushing shall be provided if;

- a) Type SP-2, SPE-2, SPT-2, or other cord lighter than Type SV is used,
- b) The wall or barrier is of metal, or
- c) The construction is such that the cord may be subjected to strain or motion.

Exception: An insulated metal grommet having insulating material that is not less than 1/32 inch (0.8 mm) thick and that completely fills the space between the grommet and the metal may be used instead of the insulating bushing.

10.1.3.3 A cord hole in wood, porcelain, phenolic composition, or other nonconducting material having a smooth, rounded surface is considered to be equivalent to a bushing.

10.1.3.4 A separate bushing shall not be made of wood or of hot-molded shellac-or-tar compositions.

10.1.3.5 A vulcanized fiber bushing shall not be less than 3/64 inch (1.2 mm) thick and so formed and secured in place that it will not be adversely affected by conditions of ordinary moisture.

10.1.3.6 A separate soft-rubber, neoprene, or polyvinyl chloride bushing shall not be employed in the product.

Exception No. 1: A separate soft-rubber, neoprene, or polyvinyl chloride bushing may be used in the frame of a motor or in the enclosure of a capacitor attached to a motor provided that:

- a) The bushing is not less than 3/64 inch (1.2 mm) thick and*
- b) The bushing is located so that it will not be exposed to oil, grease, oily vapor, or other substances having a deleterious effect on the compound used.*

Exception No. 2: A bushing of any of the materials mentioned above may be used at any point in a product if used in conjunction with a type of cord for which an insulating bushing is not required. If a bushing of one of these materials is used anywhere in the product, the edges of the hole in which the bushing is mounted are to be smooth and free from burrs, fins, and similar hazards.

10.1.3.7 At any point in a product, a bushing integrally molded of the same material as the supply cord is acceptable on a Type SP-2, SPE-2, SPT-2 or heavier cord if the built-up section is not less than 1/16 inch (1.6 mm) thick at the point where the cord passes through the enclosure.

10.2 Permanently-connected products

10.2.1 General

10.2.1.1 Except as noted in 10.1.1.14 a product intended for permanent connection to a power supply shall have provision for connection of one of the wiring systems that would be acceptable for the product.

10.2.2 Terminal compartment

10.2.2.1 A terminal box or compartment shall be provided on all products intended to be permanently connected and located so that the connections may be readily inspected after the product is installed without moving the product. Electrical components shall not be mounted on the door or cover of the terminal box or compartment.

10.2.2.2 A wiring space or compartment intended to enclose wires shall be free of any sharp edge, burr, fin, moving part, or similar hazards, that may abrade the insulation on conductors or otherwise damage the wires.

10.2.2.3 A terminal compartment intended for connection of a supply raceway shall be attached to the product so as to be keep it from turning.

10.2.2.4 If it is intended that supply connections be made directly to a motor, the terminal compartment on the motor shall comply with the requirements for terminal compartments in the Standard for Electric Motors, UL 1004.

10.2.3 Wiring terminals and leads

10.2.3.1 A product intended to be permanently connected shall be provided with wiring terminals for the connection of conductors having an ampacity acceptable for the product.

10.2.3.2 A field-wiring terminal is a terminal to which a wire is intended to be connected in the field, unless the wire and a means of making the connection such as a pressure wire connector, soldering lug, soldered loop, or crimped eyelet factory-assembled to the wire, are provided as a part of the product.

10.2.3.3 Wiring terminals for the supply conductors— excluding the ground conductor — shall be provided with a pressure-wire connector securely fastened in place; for example, firmly bolted or held by a screw.

Exception No. 1: A soldering lug may be used.

Exception No. 2: A No. 10 or larger wire binding screw or stud-and-nut combination may be used at a wiring terminal intended to accommodate a 10 AWG (5.3 mm²) or smaller conductor if upturned lugs or the equivalent are provided to hold the wire in place.

Exception No. 3: A No. 8 screw or stud-and-nut combination may be used at a terminal intended only for the connection of a 14 AWG (2.1 mm²) conductor.

10.2.3.4 A wiring terminal shall be kept from turning.

10.2.3.5 The free length of a lead inside an outlet box or wiring compartment shall be 6 inches (152.4 mm) or more if the lead is intended for field connection to an external circuit. The leads provided for connection to the branch-circuit supply shall have an ampacity rating not less than that of a conductor of the next smaller size than that acceptable for the rating of the product.

Exception: The lead may be less than 6 inches long if the use of a longer lead might result in a risk of fire or electric shock.

10.2.3.6 A wire-binding screw shall thread into metal.

10.2.3.7 A terminal plate tapped for a wire-binding screw shall be of metal not less than 0.050 inch (1.27 mm) thick and shall not have less than two full threads in the metal.

Exception: A plate not less than 0.030 inch (0.76 mm) thick, is acceptable if the tapped threads have adequate mechanical strength.

10.2.3.8 A terminal plate formed from stock having the thickness specified in 10.2.3.7 may have the metal extruded at the tapped hole to provide two full threads for the binding screw.

10.2.3.9 Upturned lugs or a cupped washer shall be capable of retaining a supply conductor of the size specified in 10.2.3.1 under the head of the screw or washer.

10.2.4 Identified terminals and leads

10.2.4.1 A product intended to be permanently connected rated 125 or 125/250 V (3-wire) or less and employing a lampholder of the Edison-screw-shell type, or a single-pole switch or overcurrent-protective device other than an automatic control without a marked off position, shall have one terminal or lead identified for the connection of the grounded conductor of the supply circuit.

10.2.4.2 A terminal intended for the connection of a grounded supply conductor shall be of or plated with metal that is substantially white in color and shall be readily distinguishable from the other terminals, or proper identification of that terminal shall be clearly shown in some other manner, such as on a permanently attached wiring diagram.

10.2.4.3 A lead intended for the connection of a grounded power-supply conductor shall be colored white or gray color and shall be readily distinguishable from the other leads.

10.2.4.4 Wiring compartments or the equivalent for field-wiring terminals of low-voltage circuits shall be separate from wiring compartments for other terminals.