



UL 1082

STANDARD FOR SAFETY

Household Electric Coffee Makers and Brewing-Type Appliances

UL Standard for Safety for Household Electric Coffee Makers and Brewing-Type Appliances, UL 1082
Sixth Edition, Dated March 17, 2009

Summary of Topics

This revision of ANSI/UL 1082 dated July 10, 2024 includes the following changes in requirements:

- Adding DC voltage as output of equipment for Dielectric Voltage-Withstand; [51.1](#), [51.7](#)***
- Revisions to references to UL 4200A to Update Standard Title and Reference to Supplement SB Products Based on Reese's Law; [26.10](#)***

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

The revised requirements are substantially in accordance with Proposal(s) on this subject dated May 31, 2024.

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The most recent designation of ANSI/UL 1082 as an American National Standard (ANSI) occurred on July 10, 2024. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

The Department of Defense (DoD) has adopted UL 1082 on February 6, 1976. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

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

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Appendix A

INTRODUCTION

1 Scope

1.1 These requirements cover portable electric coffee makers, percolators, coffee urns, and other brewing-type appliances rated 120 V or less, for use in ordinary locations in accordance with the National Electrical Code, NFPA 70.

1.2 In addition to coffee makers, this Standard covers tea pots, water kettles, carafes, soup warmers, and other similar appliances in which liquid is heated to greater than 115°F (46°C), and are lifted and tilted to dispense the liquid in normal service.

1.3 These requirements do not cover coffee-making-type appliances with capacities of more than 250 ounces (7.4 L), appliances intended for outdoor use, or appliances that are covered in individual requirements that are separate from this Standard.

1.4 For the purposes of this Standard, a requirement that applies to one type of equipment is identified by a specific reference to the type of equipment involved (for example, percolator or other specific appliance). In the absence of such specific reference or if the term "appliance" is employed, it is to be understood that the requirement applies to all types of equipment covered by the Standard.

2 Components

Section 2 deleted

3 Undated References

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.

4 Units of Measurement

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

4.2 Unless indicated otherwise all voltages and current values mentioned in this Standard are root-mean-square (rms).

5 Glossary

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

5.1.1 **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 appliance inlet (motor attachment plug).

5.1.2 **APPLIANCE INLET (Motor Attachment Plug)** – A male contact device mounted on an end product appliance to provide an integral blade configuration for the connection of an appliance coupler or cord connector.

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

5.1.3.1 **CAPSULE-TYPE BREWING APPLIANCE** – An appliance intended to be used with open capsules or sealed capsules.

5.1.4 **COMPONENT** – A device or fabricated part of the appliance covered by the scope of a safety standard dedicated to the purpose. When incorporated in an appliance, equipment otherwise typically field installed (e.g. luminaire) is considered to be a component. Unless otherwise specified, materials that compose a device or fabricated part, such as thermoplastic or copper, are not considered components.

5.1.5 **CONTROL, AUTOMATIC ACTION** – A control in which at least one aspect is non-manual.

5.1.6 **CONTROL, AUXILIARY** – A device or assembly of devices that provides a functional utility, is not relied upon as an operational or protective control, and therefore is not relied upon for safety. For example, an efficiency control not relied upon to reduce the risk of electric shock, fire, or injury to persons during normal or abnormal operation of the end product is considered an auxiliary control.

5.1.7 **CONTROL, MANUAL** – A device that requires direct human interaction to activate or rest the control.

5.1.8 **CONTROL, OPERATING** – A device or assembly of devices, the operation of which starts or regulates the end product during normal operation. For example, a thermostat, the failure of which a thermal cutout/limiter or another layer of protection would reduce the risk of electric shock, fire, or injury to persons, is considered an operating control.

5.1.9 **CONTROL, PROTECTIVE** – A device or assembly of devices, the operation of which is intended to reduce the risk of electric shock, fire or injury to persons during normal and reasonably anticipated abnormal operation of the appliance. For example, a thermal cutout/limiter, or any other control/circuit relied upon for normal and abnormal conditions, is considered a protective control. (During the testing of the protective control/circuit, the protective functions are verified under normal and single-fault conditions of the control.)

5.1.10 **CONTROL, TYPE 1 ACTION** – The actuation of an automatic control for which the manufacturing deviation and the drift (tolerance before and after certain conditions) of its operating value, operating time, or operating sequence has not been declared and tested under this standard.

5.1.11 **CONTROL, TYPE 2 ACTION** – The actuation of an automatic control for which the manufacturing deviation and the drift (tolerance before and after certain conditions) of its operating value, operating time, or operating sequence have been declared and tested under this standard.

5.1.12 **CORD CONNECTOR** – A female contact device 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.

5.1.13 **CORDLESS KETTLE** – Kettle which is connected to the electricity supply only when placed on the base provided with it.

5.1.14 **ELECTRONIC CIRCUIT** – Circuit incorporating at least one electronic component. Parts of the circuit may also be used for functional purposes.^a

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5.1.15 **ELECTRONIC COMPONENT** – Part in which conduction is achieved principally by electrons moving through a vacuum, gas, or semiconductor. Neon indicators are not considered to be electronic components.^a

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5.2 LINE-VOLTAGE CIRCUIT – A circuit involving a potential of not more than 120 volts, and having circuit characteristics in excess of those of a low-voltage or an isolated-limited secondary circuit.

5.3 LOW-VOLTAGE (SECONDARY) CIRCUIT – A circuit involving a potential of not more than 30 volts alternating-current, (42.4 volt peak or direct-current), and supplied by an isolating transformer. A circuit derived from a source of supply classified as a line voltage circuit, using impedance in series with the supply circuit as a means of limiting the voltage and current, is not considered to be a low voltage nor an isolated limited-energy secondary circuit. See [14.2.1](#).

5.3.1 OFF POSITION – Stable position of a switching device in which the circuit controlled by the switch is disconnected from its supply or, for electronic disconnection, the circuit is de-energized. Off position does not imply an all-pole disconnection.^a

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5.3.1.1 OPEN CAPSULE – A capsule that is able to receive the brewing media or provides a permeable container for brewing media that can operate in a pressure brewing appliance.

5.3.1.2 PRESSURE BREWING APPLIANCE – A heated appliance intended to make a brewed beverage such as coffee or tea, and with a water reservoir separate from the brewed beverage container; the brewed beverage container is not required to be provided with the appliance. A pressure brewing appliance has either an integrated sealed brewing chamber or is capable of using a sealed capsule as brewing material.

5.3.2 PROTECTIVE ELECTRONIC CIRCUIT – An electronic circuit which is intended to reduce the risk of electric shock, fire, or injury to persons during normal and reasonable anticipated abnormal operation of the appliance.

5.3.3 PUMP – A device which has as its primary function to move fluid by mechanical action.

5.3.4 SEALED CAPSULE – Prepackaged brewing media in a non-permeable container that must be punctured for brewing.

5.4 TEMPERATURE-LIMITING THERMOSTAT – A thermostat which functions only under conditions which produce abnormal temperatures. The malfunction of such a thermostat might or might not result in a risk of fire.

5.5 TEMPERATURE-REGULATING THERMOSTAT – A thermostat which functions only to regulate the temperature of the appliance under normal conditions of use, and whose malfunction does not result in a risk of fire.

5.6 TEMPERATURE-REGULATING AND -LIMITING THERMOSTAT – A thermostat which functions to regulate the temperature of the heating appliance under normal conditions of use, and also serves to prevent a risk of fire which might result from conditions of abnormal operation of the appliance.

5.7 THERMOSTAT – A temperature-sensing device or system, the operating temperature of which may be either fixed or adjustable, and which keeps the temperature of the controlled part between certain limits by automatically opening and/or closing a circuit.

CONSTRUCTION

6 General

6.1 Only materials that are acceptable for the particular use shall be used in an appliance. An appliance shall be made and finished with the degree of uniformity and grade of workmanship practicable in a well-equipped factory.

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

- a) Comply with the requirements for that component as indicated in the individual section covering that component;
- b) Be used in accordance with its rating established for the intended conditions of use;
- c) Be used within its established use limitations or conditions of acceptability;
- d) Additionally comply with the applicable requirements of this end product Standard; and
- e) Not contain mercury, unless used within a fluorescent, high intensity discharge, or neon lamp bulb.

Exception No. 1: 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.*

Exception No. 2: A component complying with a component standard other than those cited in this Standard is acceptable if:

- a) The component also complies with the applicable component standard indicated in this Standard; or*
- b) The component standard:*
 - 1) Is compatible with the ampacity and overcurrent protection requirements in the National Electrical Code, NFPA 70, where appropriate;*
 - 2) Considers long-term thermal properties of polymeric insulating materials in accordance with the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B; and*
 - 3) Any use limitations of the other component standard is identified and appropriately accommodated in the end use application. For example, a component used in a household application, but intended for industrial use and complying with the relevant component standard may assume user expertise not common in household applications.*

6.3 A component that is also intended to perform other functions, such as over current 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 that cover devices that provide those functions.

Exception: Where these other functions are not required for the application and not identified as part of markings, instructions, or packaging for the appliance, the additional component standard need not be applied.

6.4 A component not anticipated by the requirements of this end product Standard, not specifically covered by the component standards noted in this Standard, and that involves a risk of fire, electric shock, or injury to persons, shall be additionally investigated in accordance with the applicable UL standard, and shall comply with [6.2](#) (b) – (e).

6.5 With regard to a component being additionally investigated, reference to construction and performance requirements in another UL end product standard is suitable where that standard anticipates normal and abnormal use conditions consistent with the application of this end product Standard.

7 Frame and Enclosure

7.1 The frame and enclosure of an appliance shall be strong and rigid enough to resist the abuses likely to be encountered during normal service. The degree of resistance inherent in the appliance shall preclude total or partial collapse with the attendant reduction of spacings, loosening or displacement of parts, and other serious defects that alone or in combination constitute an increase in the risk of fire, electric shock, or injury to persons.

7.2 An appliance shall be provided with an enclosure of material acceptable for the particular application. The enclosure shall house all electrical parts, except a supply cord, that may present a risk of fire, electric shock, or injury to persons under any conditions of use.

7.3 Among the factors that shall be considered when an enclosure is being judged for acceptability are its:

- a) Physical strength;
- b) Resistance to impact;
- c) Moisture-absorptive properties;
- d) Combustibility;
- e) Resistance to corrosion; and
- f) Resistance to distortion at temperatures to which the enclosure may be subjected under conditions of normal or abnormal use.

A nonmetallic enclosure shall comply with the enclosure requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. A metal enclosure or enclosure part shall be tested in accordance with Metal Enclosure Impact Tests, Section [39](#), for resistance to impact.

Exception No. 1: When considering the abnormal and severe conditions tests of UL 746C, the appliance enclosure is to be subjected to the Abnormal Operation Tests of Section [47](#).

Exception No. 2: Thermoset materials need not be subjected to the relative thermal capability requirements of UL 746C. For a thermoset material operating at a temperature above its temperature rating, the 1000 hour aging test specified in [40.1](#) shall be conducted.

Exception No. 3: An appliance employing a thermoplastic enclosure with a HB flammability rating is not required to comply with the flammability requirements of UL 746C if it complies with the requirements in [Table 7.1](#).

Table 7.1
Flammability requirements for enclosures

Flammability rating of enclosure material	Flammability requirements, additional testing, or both
V-0	None 1. 3/4 inch (19 mm) Flame Test (UL 746C) or 1. Minimum 1/2 inch (12.7 mm) spacing from enclosure material (including ribs, grills, and the like) to any uninsulated live parts, 2. HWI – Minimum 7 seconds (PLC-0,1,2,3,4), and 3. HAI – Minimum 60 arcs (PLC-0,1)
V-1	
V-2	
HB	

7.4 Cast- and sheet-metal portions of the enclosure shall be no thinner than indicated in [Table 7.2](#) unless the enclosure is found to be acceptable when judged under considerations such as mentioned in [7.3](#).

Table 7.2
Minimum acceptable thicknesses of enclosure metal

Metal	At small, flat, unreinforced surfaces and at surfaces that are reinforced by curving, ribbing and the like (or are otherwise of a shape and/or size) to provide equivalent physical strength		At relatively large unreinforced flat surfaces	
	Inches	(mm)	Inches	(mm)
Die-cast	3/64	(1.2)	5/64	(2.0)
Cast malleable iron	1/16	(1.6)	3/32	(2.4)
Other cast metal	3/32	(2.4)	1/8	(3.2)
Uncoated sheet steel	0.026 ^a	(0.66) ^a	0.026	(0.66)
Galvanized sheet steel	0.029 ^a	(0.74) ^a	0.029	(0.74)
Nonferrous sheet metal	0.036 ^a	(0.91) ^a	0.036	(0.91)

^a Thinner sheet metal may be employed if found to be acceptable when the enclosure is judged under considerations such as those mentioned in [7.3](#).

7.5 Electrical parts of an appliance shall be located or enclosed so that protection against unintentional contact with uninsulated live parts is provided.

7.6 For an appliance as mentioned in [47.2.6.4](#), the enclosure mentioned in [7.5](#) shall be provided with drainholes located below the lowest live part.

7.7 The enclosure shall be constructed so that molten metal, burning insulation, flaming particles, or the like does not fall on the supporting surface.

7.8 The requirement in [7.7](#) necessitates that an enclosure bottom with an opening be provided with a barrier above or below the opening if the opening is:

a) Under a motor unless:

1) The structural parts of the motor or of the appliance provide the equivalent of such a barrier;

2) The protection provided with the motor is such that no burning insulation or molten material falls to the surface that supports the appliance when the motor is energized under each of the following fault conditions:

- i) Open main winding;
- ii) Open starting winding;
- iii) Starting switch short-circuited; and
- iv) For a permanent-split-capacitor motor the capacitor is short circuited. The short circuit is to be applied before the motor is energized and the rotor is to be blocked.

3) The motor is provided with a thermal motor protector (a protective device that is sensitive to both temperature and current) that prevents the temperature of the motorwindings from becoming more than 125°C (257°F) under the maximum load under which the motor runs without causing the protector to cycle, and from becoming more than 150°C (302°F) with the rotor of the motor locked; or

4) The motor complies with the requirements for impedance-protected motors.

b) Under wiring, unless the wiring complies with the VW-1 (FR-1) flame test or the Vertical Flame Test described in the Reference Standard for Electrical Wires, Cables, and Flexible Cords, UL 1581.

c) Under an unenclosed switch, transformer, relay solenoid, and the like, unless it can be shown that malfunction of the component is not likely to result in a fire.

d) Under field- and factory-made splices and overload and overcurrent protective devices.

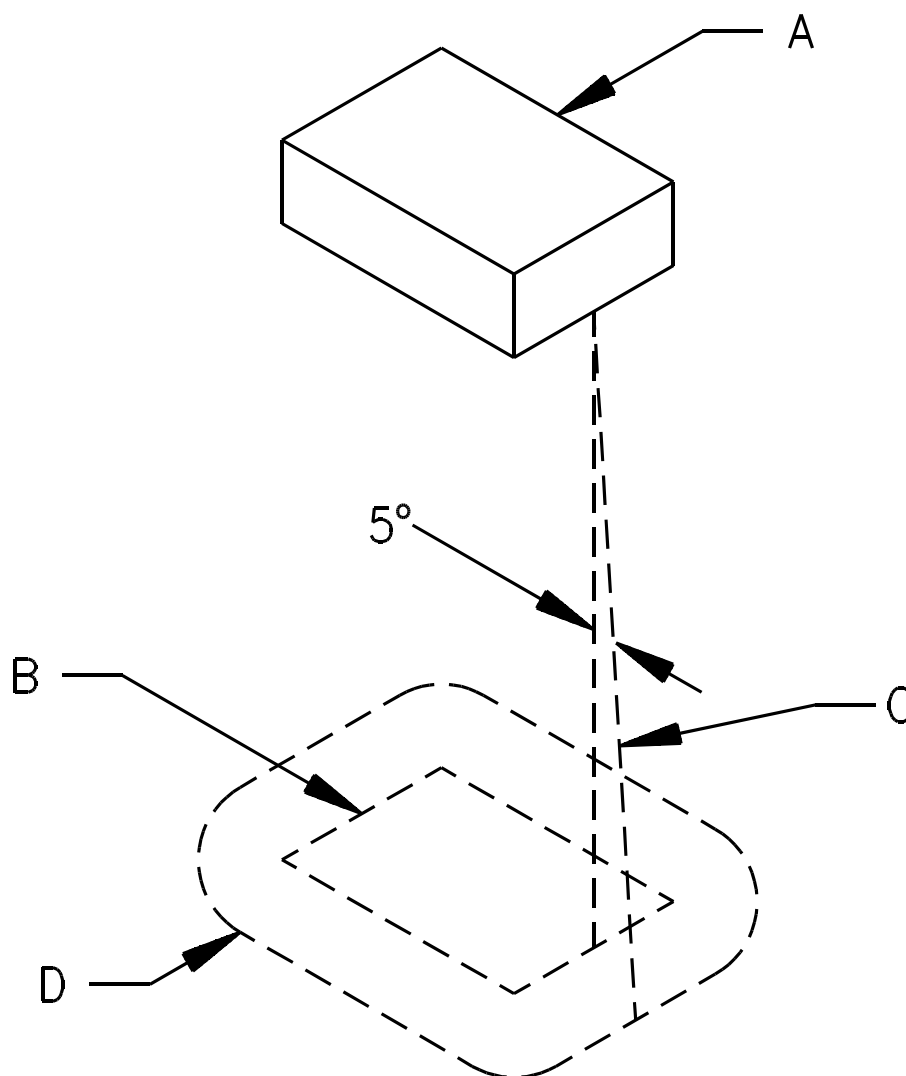
Exception: A barrier need not be provided if the opening is not within the area under the component requiring a barrier as illustrated by Line D in [Figure 7.1](#).

7.9 The barrier mentioned in [7.8](#) shall be:

- a) Of metal, ceramic, or a material that would be acceptable as an enclosure in accordance with [7.3](#);
- b) Horizontal; and
- c) Located as indicated in [Figure 7.1](#), and shall not have an area less than that described in [Figure 7.1](#).

7.10 An opening in the enclosure that has a minor dimension of less than 1 inch (25.4 mm) is acceptable if a probe as illustrated in [Figure 7.2](#), inserted through the opening, cannot be made to touch any uninsulated live part of film-coated wire that involves the risk of electric shock. The probe shall be applied in all possible articulated positions before, during, and after insertion.

Figure 7.1
Location and extent of barrier



SA0604-1

A – Region to be shielded by barrier. This will consist of the entire component if it is not otherwise shielded and will consist of the unshielded portion of a component that is partially shielded by the component enclosure or equivalent.

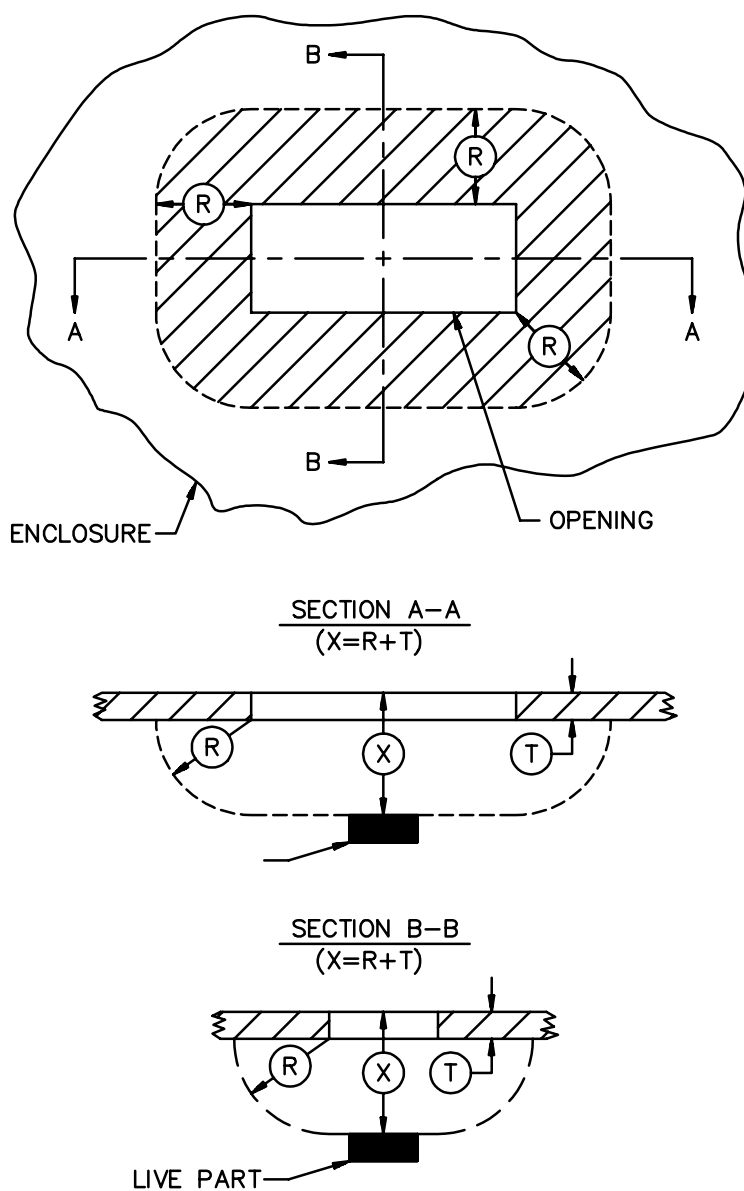
B – Projection of outline of component on horizontal plane.

C – Inclined line that traces out minimum area of barrier. The line is always:

- 1) Tangent to the component;
- 2) 5 degrees from the vertical; and
- 3) So oriented that the area traced out on a horizontal plane is maximum.

D – Location (horizontal) and minimum area for barrier. The area is that included inside the line of intersection traced out by the inclined line C and the horizontal plane of the barrier.

Figure 7.3
Opening in enclosure



SB0610-1

7.11 An opening that has a minor dimension of 1 inch (25.4 mm) or more, in an enclosure, as illustrated in [Figure 7.3](#), is acceptable if, within the enclosure, there is no uninsulated live part or film-coated wire less than:

- a) R distance from the inside edge of the perimeter of the opening; and
- b) X distance from the plane of the opening.

T equals the enclosure thickness, R equals X minus T, and X equals 5 times the diameter of the largest round rod that can be inserted through the opening but not less than 6-1/16 inches (154 mm). In evaluating an opening, any barrier located within the volume is to be ignored unless it intersects the boundaries of the volume in a continuous, closed line.

7.12 If a marking draws attention of the user to a hole of any size in the enclosure for the adjustment of a thermostat or for a similar activity, it shall not be possible to damage insulation or contact uninsulated live parts through the hole with a 1/16-inch-diameter rod (1.6 mm).

7.13 During the examination of an appliance in connection with the requirements in [8.2](#) – [8.4](#), any part of the enclosure is to be disregarded – that is, it will not be assumed that the part in question affords protection against electric shock or injury to persons – if it either:

- a) Must be opened or removed, with or without the use of tools, to perform manufacturer's recommended user servicing, maintenance, operating adjustments, attachment of accessories, or other instructions; or
- b) Can be opened or removed without the use of tools.

Exception: A part that requires a tool for opening or removal to perform manufacturer's recommended user servicing, maintenance, operating adjustments, attachment of accessories, or other instructions is to remain in place if the appliance is marked in accordance with [54.6](#).

7.14 A component of an appliance that is likely to need inspection, replacement, cleaning, or other servicing shall be as accessible as possible. The component shall be readily accessible without the use of special tools (tools not available to other than service personnel) if it is intended to be manually operated or adjusted or periodically serviced.

7.15 The bulb and capillary tube of a thermostat shall be protected from mechanical damage if damage of the tube or bulb increases the risk of fire.

7.16 A part relied upon for compliance with this Standard, when fabricated from polymeric materials, shall have clear traceability as to composition, ingredients, and processing for the fabricated part to the extent that the composition, ingredients, or process impacts the compliance of the product. Fabricated parts complying with the Standard for Polymeric Materials – Fabricated Parts, UL 746D, meets this requirement.

8 Assembly

8.1 A switch, lampholder, or plug-type connector provided as a part of an appliance shall be mounted securely and prevented from turning by means other than friction between surfaces.

8.2 A lock washer properly applied is acceptable as a means to prevent turning of a stem-mounted switch.

8.3 Uninsulated live parts shall be secured to the base or surface so that they are prevented from turning or shifting in position as the result of stresses if such motion may result in a reduction of spacings below the minimum required in [24.1.1](#) and [24.1.2](#).

8.4 Friction between surfaces is not acceptable as a means to prevent shifting or turning of live parts, but a lock washer properly applied is acceptable.

9 Handles

9.1 *Relocated at 9.1.1*

9.2 *Relocated at 9.1.2*

9.3 *Relocated at 9.1.3*

9.4 *Relocated at 9.1.4*

9.5 *Relocated at 9.1.5*

9.6 *Relocated at 9.1.6*

9.7 *Relocated at 9.1.7*

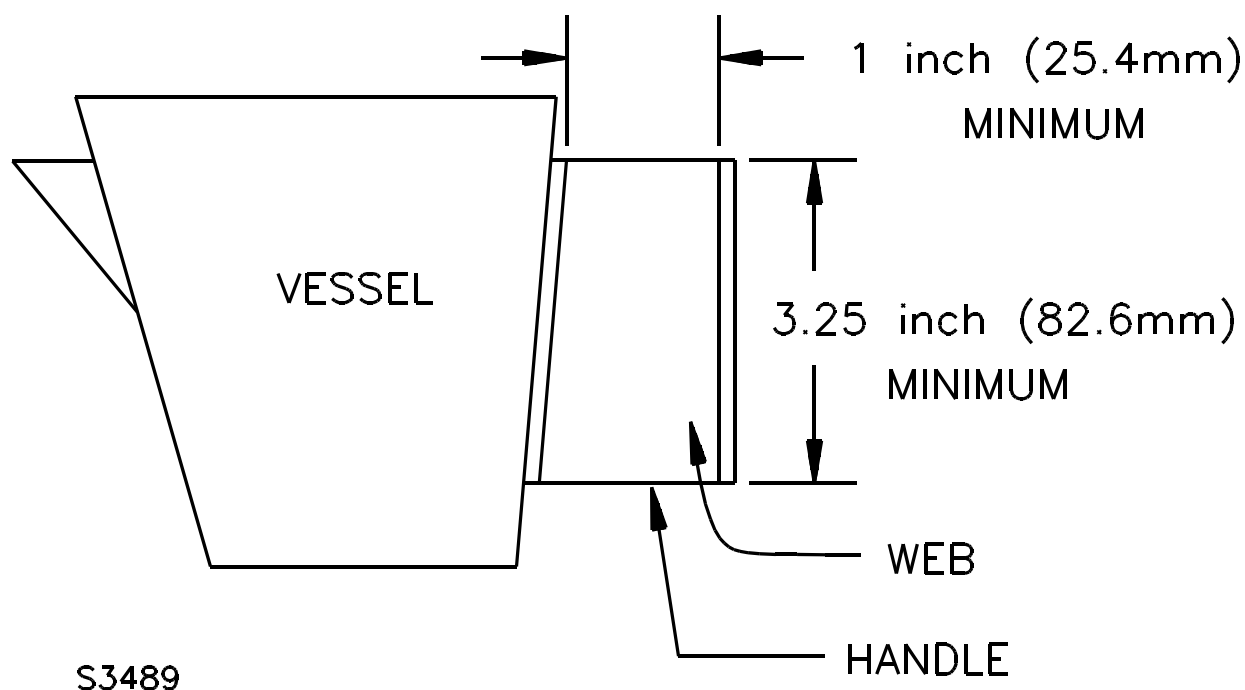
9.1 General

9.1.1 Unless determined to be acceptable for the purpose, fastening of the vessel handle assembly of an appliance shall not rely on cement or equivalent materials alone. Mechanical means, such as pressure clamping, bosses and lances, and the like, shall be provided.

9.1.2 A handle assembly for a percolator, kettle, carafe, or other vessel used to lift, tilt, and hold a beverage shall be subjected to the requirements of Dynamic load, [41.7](#). This test is not to be applied to a percolator, kettle, carafe, or other hot liquid container vessel in which the handle and vessel (or vessel outer enclosure) are molded of one continuous material.

9.1.3 For an appliance or separate vessel that is provided with a webbed handle – that is a solid handle that cannot be grasped by wrapping the fingers around it – the web shall be a minimum of 1 inch in width and 3.25 inches in length. See [Figure 9.1](#).

Figure 9.1
Webbed handle



9.1.4 No portion of a nonmetallic handle whose failure could result in the loss of handle strength or integrity is to be subjected to a temperature in excess of the mechanical temperature index (without impact) of the material when tested as indicated in Normal Temperature Tests, Section [33](#).

9.1.5 On a vessel where handle securement is accomplished by a band around the body of the vessel, the diameter of the vessel above and below the band securement area shall be larger than the diameter at the area of securement. A handle shall be fastened so that a positive stop, interference screw, rivet, or other arrangement is provided so that with minor loosening, disengagement of the handle does not result.

Exception: The diameter of the vessel above and below the band securement need not be larger than the diameter at the area of securement if an equivalent means of preventing movement of the handle assembly is provided.

9.1.6 Iron and steel parts of a handle assembly shall be provided with corrosion protection in accordance with [10.1](#) or shall be constructed of stainless steel or other noncorrosive metal acceptable for the application.

9.1.7 A handle secured by a single fastening means shall be prevented from rotating by means other than friction. A lockwasher alone shall not be sufficient.

9.2 Handle assembly

9.2.1 A handle assembly for a percolator, kettle, carafe, or other vessel used to lift, tilt, and hold a beverage shall be subjected to the requirements of Dynamic load, [41.7](#). This test is not to be applied to a

percolator, kettle, carafe, or other hot liquid container vessel in which the handle and vessel (or vessel outer enclosure) are molded of one continuous material.

10 Corrosion Protection

10.1 Iron and steel parts shall be protected against corrosion by enameling, galvanizing, plating, or other equivalent means, if the deterioration of such unprotected parts increases the risk of fire or electric shock.

Exception: Where the oxidation of steel is not likely to be accelerated due to the exposure of metal to air and moisture or other oxidizing influence – thickness of metal and temperature also being factors – surfaces of sheet steel within an enclosure may not be required to be protected against corrosion. Cast-iron parts are not required to be protected against corrosion. A sheath employed on a heating element operating in air and terminal parts attached directly to the heating element need not be protected against corrosion.

10.2 The aging characteristics of plating or other finish used in an appliance shall be such that deterioration of the finish does not result in unacceptable performance of the appliance.

11 Supply Connections

11.1 General

11.1.1 An appliance shall be provided with a length of attached flexible cord and an attachment plug for connection to the supply circuit, or shall have male pin terminals that accommodate a detachable power-supply cord. The length of flexible cord shall be within the limits indicated in [Table 11.1](#).

Table 11.1
Lengths of cord connection

Means of dispensing liquid	Kind of cord connection	Minimum acceptable length ^a		Maximum acceptable length ^{a,c}	
		Feet	(Meters)	Feet	(Meters)
Lifting and tilting appliance	Attached cord or detachable power-supply cord	2.0	(0.6)	3.0	(0.9)
	Coiled (retractile) detachable power-supply cord	–	–	3.0 ^b	(0.9) ^b
Separable vessel, spigot or the like	Attached cord or detachable power-supply cord	2.0	(0.6)	7.0	(2.1)
^a Measured external to the appliance and including the fittings but excluding the blades on the attachment plug. ^b Measured with the cord relaxed on a horizontal surface. Measured with the cord fully extended, the length is not to exceed 7.0 ft (2.1 m) and is not to be less than 6.0 ft (1.8 m). ^c An appliance shall be provided with instructions in accordance with 54.7 or 54.8 , whichever is applicable.					

11.1.2 The rating (both current and voltage) of the cord and the fittings of a nondetachable and a detachable power supply cord, shall not be less than that of the appliance.

11.1.3 A 3- to 2-wire grounding-type adapter shall not be provided with an appliance.

11.1.4 An attached flexible cord and the cord in a detachable power-supply cord that is provided with an appliance shall be of a Type HPD, HPN, HSJ, HSJO, SP-2, SPE-2, SPT-2, SV, SVE, SVO, SVT, SVTO, SJ, SJE, SJO, SJT, or SJTO cord, or shall have such properties that are at least equally as serviceable for the particular application.

11.1.4.1 A cord set or power supply cord shall comply with the Standard for Cord Sets and Power-Supply Cords, UL 817.

11.1.4.2 Flexible cords and cables shall comply with the Standard for Flexible Cords and Cables, UL 62. Flexible cord and cables are considered to fulfill this requirement when preassembled in a cord set or power supply cord complying with the Standard for Cord Sets and Power-Supply Cords, UL 817.

11.1.5 Supplementary insulation, if employed, shall not extend more than 1/2 inch (13 mm) outside the appliance (unless provided with additional mechanical protection), shall be prevented from fraying or unraveling, and shall not affect adversely the means for providing strain relief.

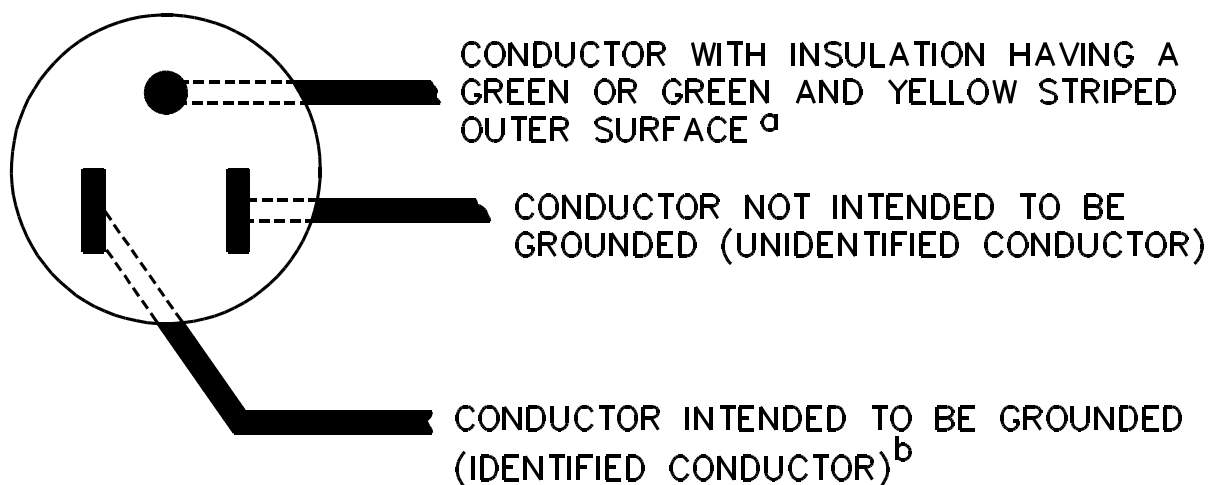
11.1.6 The attachment plug of the power supply cord of an appliance provided with a 15- or 20- ampere general use receptacle shall be of the 3-wire grounding type. The attachment plug of the power supply cord of an appliance provided with a manually operated, line-connected, single pole switch for appliance on-off operation, or an Edison base lampholder, shall be of the polarized or grounding type.

11.1.7 If a 3-wire grounding-type attachment plug or a 2-wire polarized attachment plug is provided, the attachment plug connection shall comply with [Figure 11.1](#) and the polarity identification of the flexible cord shall comply with [Table 11.3](#).

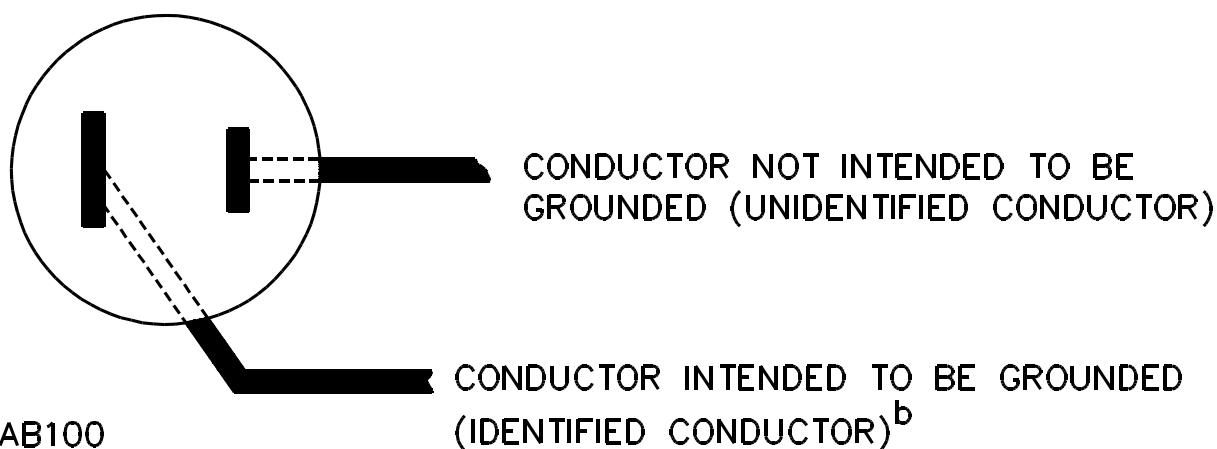
Figure 11.1

Connections to attachment plug

CONNECTIONS OF CORD CONDUCTORS TO GROUNDING – TYPE ATTACHMENT PLUG (FACE OF PLUG REPRESENTED)



CONNECTIONS OF CORD CONDUCTORS TO POLARIZED ATTACHMENT PLUG (FACE OF PLUG REPRESENTED)



AB100

^a In the above illustration, the blade to which the green conductor is connected may have a U-shaped or circular cross section.^b Signifies a conductor identified in accordance with [Table 11.3](#).

11.1.8 The conductor of the power supply cord that is intended to be grounded shall have the following items connected to it:

- a) The screw shell of an Edison base lampholder; and
- b) The terminal or lead of a receptacle intended to be grounded.

[Table 11.3](#) identifies the supply cord conductor intended to be grounded.

11.1.9 Attachment plugs, receptacles, appliance couplers, appliance inlets (motor attachment plugs), and appliance (flatiron) plugs, shall comply with the Standard for Attachment Plugs and Receptacles, UL 498.

Exception No. 1: Attachment plugs and appliance couplers integral to cord sets or power supply cords that are investigated in accordance with the Standard for Cord Sets and Power-Supply Cords, UL 817, are not required to comply with UL 498.

Exception No. 2: A fabricated pin terminal assembly need not comply with UL 498 if it complies with Frame and Enclosure, Section [7](#); Assembly, Section [8](#); [11.3](#); Current-Carrying Parts, Section [12](#); and Spacings, Section [24](#), of this end product Standard.

11.1.10 Female devices (such as receptacles, appliance couplers, and connectors) that are intended, or that may be used, to interrupt current in the end product, shall be suitably rated for current interruption of the specific type of load, when evaluated with its mating plug or connector. For example, an appliance coupler that can be used to interrupt the current of a motor load shall have a suitable horsepower rating when tested with its mating plug.

11.2 Strain relief

11.2.1 Strain relief shall be provided to reduce the risk of a mechanical stress on an attached flexible supply cord from being transmitted to terminals, splices, or interior wiring.

11.2.1.1 Insulating bushings serving as strain relief shall comply with the Standard for Insulating Bushings, UL 635. Tests specified in this Standard (e.g. Strain Relief Test) may still need to be performed to confirm the combination of the insulating bushing and the supporting part are suitable.

11.2.2 If wood, pressed board, or other fibrous material is used to secure the strain relief assembly, the fibrous material shall be secured to the appliance by a pin, setscrew, or other positive means.

11.2.3 Means shall be provided to reduce the likelihood of an attached supply cord or lead from being pushed into the enclosure of an appliance through the cord entry hole. To determine compliance with this requirement, the supply cord or lead shall be tested in accordance with Push-Back Relief Test, Section [38](#).

11.2.4 If a knot serves as strain relief in an attached flexible cord, any surface with which the knot may come in contact shall be free from projections, sharp edges, burrs, fins, and the like, which may cause abrasion of the insulation on the conductors.

11.3 Pin terminals

11.3.1 If an appliance is provided with pin terminals, the design of the appliance shall be such that no live parts are exposed to unintentional contact both during and after the placement of the plug on the pins, in the intended manner.

11.3.2 A pin guard is required, such that:

a) A straight edge placed in any position, across and in contact with edges of the plug opening without the plug in place, cannot be made to contact any current-carrying pin.

b) With the plug aligned with the pins and the face of the plug in a plane located perpendicular to the end or ends of the farthest projecting current-carrying pin, the probe illustrated in [Figure 7.2](#) shall not touch any current-carrying pin while the probe is inserted through any opening with the appliance in any position.

11.3.3 The plug used in [11.3.2\(b\)](#) shall be the plug intended for use with the appliance.

11.3.4 If an appliance employs three or more pin terminals designed for use with a plug that covers all the pins, the terminals shall be spaced so that they do not accommodate a flatiron or appliance plug or cord-connector body. The plug which these pins accommodate shall be acceptable for the particular application.

11.3.5 An appliance provided with three pin terminals, one of which is for grounding, shall not be provided with or capable of being used with a two-conductor detachable power-supply cord.

11.3.6 An appliance provided with two pin terminals shall not be provided with or capable of being used with a three-conductor detachable power-supply cord employing a grounding conductor.

11.3.7 A pin terminal shall be securely and rigidly mounted and shall be prevented from shifting in position by means other than friction between surfaces.

11.3.8 The requirement in [11.3.7](#) is intended primarily to provide for the maintenance of spacings as given in [24.1.1](#) and to provide for the maintenance of proper spacings between pin terminals. Under this requirement, consideration is also to be given to the means for locking terminals in position to maintain tightness.

11.3.9 The dimensions of pins and their center-to-center spacings (including the corresponding spacings of the female contacts of general-use plugs which these arrangements of pins will accommodate) are as indicated in [Table 11.2](#).

Table 11.2
Pins

Type and rating of plug that accommodates the pins	Configuration of pins			Dimensions of pins	
	Number	Agreement	Spacing between centers, inch (mm)	Diameter, inch (mm)	Length, inch (mm)
Appliance plug rated 10 A at 125 V	2	In line	1/2 (12.7)	0.156 ±0.005 (3.97 ±0.13)	9/16 – 5/8 (14.3 – 15.9)
Flatiron plug rated 10 A at 125 V	2	In line	11/16 (17.5)	0.188 ±0.005 (4.76 ±0.13)	3/4 – 7/8 (19.1 – 22.2)

Table 11.3
Polarity identification of flexible cords

Method of identification	Acceptable combinations		
	Wire intended to be grounded ^d		All other wires ^d
Color of braids on individual conductors	A	Solid white or gray – without tracer	Solid color other than white or gray – without tracer
	B	Color other than white or gray, with tracer in bold	Solid color other than white or gray – without tracer
Color of insulation on individual conductors	C ^a	Solid white or gray	Solid color other than white or gray
	C1 ^e	Light blue	Solid color other than light blue, white, or gray
Color of separators	D ^b	White or gray	Color other than white or gray
Other means	E ^c	Tin or other white metal on all strands of the conductor	No tin or other white metal on the strands of the conductor
	F ^b	A stripe, ridge, or groove on the exterior surface of the cord	

^a Only for cords – other than Type SP-1, and SPT-1 – having no braid on any individual conductor.

^b Only for Types SP-1, SP-2, and SPT-2 cords.

^c Only for Type SPT-1 and SPT-2 cords.

^d A wire 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 [25.1](#) and [Figure 11.1](#).

^e For jacketed cord.

11.4 Bushings

11.4.1 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 which shall be substantial, reliably secured in place, and shall have a smooth, well-rounded surface against which the cord may bear. If Type SP-2, SPT-2, or other cord lighter than Type HSJ is employed, if the wall or barrier is of metal, and if the construction is such that the cord may be subjected to strain or motion, an insulating bushing shall be provided. The heat- and moisture-resistant properties of the bushing material shall be such that the bushing is acceptable for the particular application.

11.4.1.1 In addition to the requirements in [11.4](#), Insulating bushings shall comply with the Standard for Insulating Bushings, UL 635.

11.4.2 If the cord hole is in wood, porcelain, phenolic composition, or other acceptable nonconducting material, a smooth, well-rounded surface is considered to be equivalent to a bushing.

11.4.3 Ceramic materials and some molded compositions are acceptable generally for insulating bushings, but a separate bushing of wood, hot-molded shellac and tar composition, or rubber material (other than in a motor) is not acceptable. Vulcanized fiber may be employed if the bushing is not less than 3/64 inch (1.2 mm) thick and if it is so formed and secured in place that it will not be affected adversely by conditions of ordinary moisture.

11.4.4 An insulated metal grommet may be accepted in place of an insulating bushing if the insulating material used is not less than 1/32 inch thick (0.8 mm), and completely fills the space between the grommet and the metal in which it is mounted.

12 Current-Carrying Parts

12.1 Each current-carrying part shall be made of metal that is acceptable for the particular application.

12.2 Current-carrying parts made of corrosion-resistant alloys (for example, stainless steel) are acceptable regardless of temperature. Current-carrying parts made of ordinary iron and steel are not acceptable unless they are rendered corrosion-resistant by an appropriate coating and, even then, they are acceptable only as follows:

- a) Pin terminals.
- b) Parts whose normal operating temperature is higher than 100°C (212°F).
- c) Parts of a component that the requirements referred to in [6.2](#) – [6.5](#), indicate as being acceptable with coated iron and steel parts.

12.3 If a reservoir is part of an appliance, all live parts shall be so located or protected that they will not be subject to dripping if the reservoir develops leaks, unless:

- a) The reservoir is adequately resistant to corrosion from the liquid intended for use in it; and
- b) The reservoir does not develop cracks as a result of aging.

13 Internal Wiring

13.1 General

13.1.1 The internal wiring of an appliance shall consist of wire of a size and type or types which are acceptable for the particular application, when considered with respect to the temperature and voltage to which the wiring is likely to be subjected.

13.1.2 There is no temperature limit applicable to glass fiber, beads of inorganic material, or the equivalent employed as conductor insulation.

13.1.3 *Deleted*

13.1.4 Internal wiring composed of insulated conductors shall comply with the Standard for Appliance Wiring Material, UL 758.

Exception No. 1: Insulated conductors need not comply with UL 758 if they comply with one of the following:

- a) The Standard for Thermoset-Insulated Wires and Cables, UL 44;*
- b) The Standard for Thermoplastic-Insulated Wires and Cables, UL 83; or*
- c) The applicable UL standard for other insulated conductor types specified in Wiring Methods and Materials, of the National Electrical Code, NFPA 70.*

Exception No. 2: Insulated conductors for specialty applications (e.g. data processing or communications) and located in a low-voltage circuit not involving the risk of fire, electric shock or injury to persons need not comply with UL 758.

13.2 Protection of wiring

13.2.1 If the wiring of an appliance is located so that it may be in proximity to combustible material or may be subjected to mechanical injury, it shall be protected.

13.2.2 Wires within an enclosure or the like shall be disposed or protected so that no damage to conductor insulation results from contact with any rough, sharp, or moving part.

13.2.3 A hole by means of which insulated wires pass through a sheet-metal wall within the over-all enclosure of an appliance shall be provided with a smooth, well-rounded bushing or shall have smooth, well-rounded surfaces upon which the wires may bear, to prevent abrasion of the insulation.

13.2.4 Insulated wires may be bunched and passed through a single opening in a metal wall within the enclosure of an appliance.

13.2.5 Wire positioning devices shall comply with the requirements in Electrical Insulation, Section [16](#). A device that complies with the Standard for Positioning Devices, UL 1565, is considered to comply with this requirement.

13.3 Splices

13.3.1 All splices and connections shall be mechanically secure and shall provide adequate and reliable electrical contact. A soldered connection shall be made mechanically secure before being soldered if breaking or loosening of the connection results in any risk of fire or electric shock.

Exception: Printed-wiring board joints need not be mechanically secure before soldering.

13.3.2 A splice shall be provided with insulation equivalent to that of the wires involved if permanence of spacing between the splice and other metal parts of the appliance is not reliably maintained.

13.3.3 Insulation consisting of two layers of friction tape, two layers of thermoplastic tape, or of one layer of friction tape on top of one layer of rubber tape, is acceptable on a splice. In determining whether splice insulation consisting of coated fabric, thermoplastic, or other type of tubing is acceptable, consideration is to be given to such factors as its dielectric properties, heat resistant and moisture-resistant characteristics. Thermoplastic tape wrapped over a sharp edge is not acceptable.

13.3.4 Where stranded internal wiring is connected to a wire-binding screw, loose strands of wire shall be positively prevented from contacting any other uninsulated live part that is not always of the same polarity as the wire, and from contacting any dead metal part. This may be accomplished by the use of pressure terminal connectors, soldering lugs, crimped eyelets, soldering all strands of the wire together, or other equivalent means.

13.3.5 Quick-connect type wire connectors shall be suitable for the wire size, type (solid or stranded), conductor material (copper or aluminum) and the number of conductors terminated. If insulated, they shall be rated for the voltage and temperature of the intended use. They shall be applied per the installation instructions of the wire connector manufacturer.

13.3.6 Quick-connect terminals, both connectors and tabs, for use with one or two 22 – 10 AWG copper conductors, having nominal widths of 2.8, 3.2, 4.8, 5.2, and 6.3 mm (0.110, 0.125, 0.187, 0.205, and 0.250 in), intended for internal wiring connections in appliances, or for the field termination of conductors to the appliance, shall comply with the Standard for Electrical Quick-Connect Terminals, UL 310.

Exception: Other sizes of quick-connect terminals shall be investigated with respect to crimp pull out, insertion-withdrawal, temperature rise, and all tests shall be conducted in accordance with UL 310.

13.3.7 Wire connectors shall comply with the Standard for Wire Connectors, UL 486A-486B.

13.3.8 Splicing wire connectors shall comply with the Standard for Splicing Wire Connectors, UL 486C.

13.3.9 Single and multi-pole connectors for use in data, signal, control and power applications within and between electrical equipment, and that are intended for factory assembly to copper or copper alloy conductors, or for factory assembly to printed-wiring boards, shall comply with the Standard for Component Connectors for Use in Data, Signal, Control and Power Applications, UL 1977.

13.3.10 Multi-pole splicing wire connectors that are intended to facilitate the connection of hard-wired utilization equipment to the branch-circuit conductors of buildings shall comply with the Standard for Insulated Multi-Pole Splicing Wire Connectors, UL 2459.

13.3.11 Equipment wiring terminals for use with all alloys of copper, aluminum, or copper-clad aluminum conductors, shall comply with the Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors, UL 486E.

13.3.12 Terminal blocks shall comply with the Standard for Terminal Blocks, UL 1059, and, if applicable, be suitably rated for field wiring.

Exception: A fabricated part performing the function of a terminal block need not comply with UL 1059, if the part complies with the requirements of [11.3](#); Current-Carrying Parts, Section [12](#); Electrical Insulation, Section [16](#); and Spacings, Section [24](#), of this end product Standard. This exception does not apply to protective conductor terminal blocks.

14 Secondary Circuits

14.1 General

14.1.1 Each secondary circuit shall be judged under the requirements for line-voltage circuits.

Exception: A secondary circuit need not be investigated if:

- a) It is not a circuit that is intended to reduce the risk of injury to persons; and*
- b) It complies with the requirements for a limited-energy secondary circuit as specified in [14.2](#).*

14.1.2 Secondary circuits may be connected to the frame of the appliance. Except as noted in [14.1.3](#) and [14.2.6](#), the connection shall be made at only one point in the appliance or system.

14.1.3 A grounding bus of adequate ampacity that is used as the return for a secondary circuit other than as covered by [14.2.6](#) may be connected to the frame at more than one point.

14.1.4 If any secondary circuit having an open-circuit potential of more than 42.4 volts peak is connected to the frame of an appliance, all exposed dead metal parts that may become energized, and all dead metal parts within the enclosure that can be contacted during servicing and that may become energized, shall be reliably connected together.

14.2 Limited-energy secondary circuits

14.2.1 A limited-energy secondary circuit shall be supplied from:

- a) A Class 2 transformer; or
- b) An isolating transformer having an open-circuit sinusoidal potential of 30 volts, rms (42.4 volts, peak) or less, and that includes at least one of the following means, that limits the power available to the levels specified for a Class 2 transformer.
 - 1) A reliable fixed impedance;
 - 2) A noninterchangeable fuse – the largest fuse that fits in the fuseholder provided;
 - 3) A nonadjustable manually reset circuit protector; or
 - 4) A reliable regulating network.

14.2.2 The impedance, the fuse, the protector, or the regulating network and the wiring between them and the isolating transformer described in [14.2.1](#) shall be judged as if they were part of a line-voltage circuit.

14.2.3 A fuse or a circuit protector used to limit the power as specified in [14.2.1](#) shall be rated or set at not more than 3.2 amperes for a circuit operating between 15 and 30 volts and at not more than 5.0 amperes for a 0 – 15 volt circuit.

14.2.4 An impedance or a regulating network that is used to limit the current shall be of such value or design as to limit the current under short-circuit conditions to not more than 8.0 amperes measured after 1 minute.

14.2.5 The performance of a regulating network used to limit the power in accordance with [14.2.1](#) shall not be adversely affected by either a short circuit or an open circuit between any two terminals of any single rectifier, capacitor, transistor, or similar component in the network.

14.2.6 The frame may be used as the return for a limited-energy secondary circuit.

14.2.7 The wiring in a limited-energy secondary circuit shall be routed away from the wiring of other circuits or shall be provided with insulation that is for use at the highest of the voltages in the other circuits.

14.2.8 The wiring in a limited-energy secondary circuit shall be routed away from the uninsulated live components of other circuits.

14.2.9 Wires and cables that are part of a limited-energy secondary circuit shall be provided with strain relief in accordance with [37.1](#) and [37.2](#) if stress on the wire or cable could cause the internal wiring of the circuits to contact uninsulated live parts of other circuits.

15 Heating Elements

15.1 A heating element shall be supported in a sturdy and reliable manner. It shall be protected against mechanical damage and contact with outside objects.

15.2 In determining that a heating element is adequately supported, consideration shall be given to sagging, loosening, and other adverse conditions of the element resulting from continuous heating. For an open-wire (uninsulated resistance wire) heating element, consideration shall also be given to breakage at any point.

15.3 An open-wire element, that is, uninsulated resistance wire, may be used in an appliance provided it complies with the following:

- a) It is enclosed or protected by barriers or covers that require tools for removal;
- b) It complies with the accessibility of live parts requirements specified in [7.5](#) – [7.13](#); and
- c) It complies with the Broken Element Test, Section [36](#).

15.4 A sheathed heating element, rope heater, or the like shall be judged under the applicable requirements of this Standard.

15.4.1 Heating wire (e.g. rope heater) that complies with the Standard for Appliance Wiring Material, UL 758, and the requirements of this end product Standard are considered to fulfill this requirement.

15.4.2 Thermistor-type heaters (e.g. PTC and NTC heaters) shall comply with the Standard for Thermistor-Type Devices, UL 1434.

16 Electrical Insulation

16.1 Insulating washers, bushings, and the like that are integral parts of an appliance and bases or supports for the mounting of current-carrying parts shall be of a moisture-resistant material that is not damaged by the temperatures to which they are subjected under conditions of actual use. Molded parts shall be constructed so that they have the mechanical strength and rigidity necessary to withstand the stresses of actual service.

16.2 Insulating material employed in an appliance shall be judged with respect to its acceptability for the particular application. Materials such as mica, some molded compounds, and certain refractory materials are usually acceptable for use as the direct support of live parts. Other materials which are not acceptable for general use, such as magnesium oxide, may be acceptable if used in conjunction with other more appropriate insulating materials or if located and protected against mechanical damage and the absorption of moisture is minimized. When it is necessary to investigate a material to determine whether it is acceptable, consideration is to be given to its mechanical strength, dielectric properties, insulation resistance, heat-resistant qualities, the degree to which it is enclosed or protected, and any other features having a bearing on the risk of fire, electric shock, or injury to persons involved, in conjunction with conditions of actual service. All of these factors are considered with respect to thermal aging. The appropriate tests in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C (see Temperature Considerations – General, Functional-Use Temperature Indices, and Generic Thermal Indices) are to be used to evaluate a material for the above-mentioned properties.

Exception: Thermoset materials need not be subject to the relative thermal capability requirements of UL 746C. For a thermoset material operating at a temperature above its temperature rating, the 1000 Hour Aging Test as specified in [40.1](#) shall be conducted.

16.3 In the mounting or supporting of small fragile insulating parts, screws or other fastenings should not be tight enough to cause cracking or breaking of these parts with expansion and contraction. Generally, such parts should be slightly loose.

16.4 Sleeving or tubing used as an insulator for uninsulated live parts (such as glass fiber in rope heaters) shall be so disposed or protected that no damage to the sleeving or tubing can result from contact with any rough, sharp, or moving part. The sleeving or tubing shall not be installed under a compression that renders it incapable of complying with the dielectric voltage-withstand requirements in [35.1](#).

16.5 The requirements for supplemental insulation (e.g. tape, sleeving or tubing) are not specified unless the insulation or device is required to fulfill the requirements of [16.4](#), or a performance requirement of this Standard. In such cases:

- a) Insulating tape shall comply with the Standard for Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape, UL 510;
- b) Sleeving shall comply with the Standard for Coated Electrical Sleeving, UL 1441; and
- c) Tubing shall comply with the Standard for Extruded Insulating Tubing, UL 224.

16.6 A printed-wiring board shall comply with the requirements in the Standard for Printed-Wiring Boards, UL 796. A printed-wiring board shall be rated V-1 or better.

16.7 Film-coated wire (magnet wire)

16.7.1 The component requirements for film coated wire and Class 105 (A) insulation systems are not specified.

16.7.2 Film coated wire in intimate combination with one or more insulators, and incorporated in an insulation system rated Class 120 (E) or higher, shall comply with the magnet wire requirements in the Standard for Systems of Insulating Materials – General, UL 1446, and shall have a suitable temperature class.

17 Thermal Insulation

17.1 Thermal insulation, if employed, shall be of such a nature and so located and mounted or supported that it is not adversely affected by any normal operation of the appliance.

17.2 Combustible or electrically conductive thermal insulation shall not make contact with uninsulated live parts of an appliance.

17.3 Some types of mineral-wool thermal insulation contain conductive impurities in the form of slag, which make its use unacceptable if in contact with uninsulated live parts. See [34.1](#).

18 Thermal Cutoffs

18.1 If an appliance is provided with a thermal cutoff, it shall be secured in place and be located so that it is accessible for replacement without damaging connections or internal wiring. See [54.6](#).

18.2 If an appliance is provided with a thermal cutoff, it shall be capable of opening the circuit in the intended manner without causing the short-circuiting of live parts and without causing live parts to become grounded to the enclosure when the appliance is connected to a circuit of voltage in accordance with [33.1.11](#), and operated in a normal position to cause abnormal heating in accordance with [47.4](#).

18.3 *Revised and Relocated as [47.4](#).*

18.4 A pressure brewing appliance provided with a function to keep water heated above room temperature before brewing, or to keep brewed beverage heated after the cycle is complete shall be provided with limiting-type devices in accordance with [22C.3](#).

19 Lampholders

19.1 If an appliance is equipped with a polarized attachment plug, a lampholder supplied as a part of the appliance shall be wired so that the screw shell is connected to the grounded conductor.

19.2 A lampholder shall be constructed and installed so that uninsulated live parts other than the screw shell are not exposed to contact by persons removing or replacing lamps in normal service.

Exception: This requirement does not apply if, in order to remove or replace a lamp, it is necessary to dismantle the appliance by means of tools.

19.3 Lampholders and indicating lamps with integral lamp/lampholder (e.g. neon pilot lamp) shall comply with the Standard for Lampholders, UL 496.

20 Switches

20.1 A switch or other control device provided as a part of an appliance shall be of a type intended for the particular application and shall have a current and voltage rating not less than that of the circuit (load) which it controls.

20.2 A switch employed on an appliance shall be located or protected so that it is not subjected to mechanical damage during use.

20.3 A manually operated, line-connected, single pole switch for appliance on-off operation shall not be connected to the conductor of the power supply cord intended to be grounded. [Table 11.3](#) specifies the identification of the power-supply cord conductor intended to be grounded.

20.4 Manually operated snap-switches shall comply with one of the following, as applicable:

- a) The Standard for Switches for Appliances – Part 1: General Requirements, UL 61058-1;
- b) *Deleted.*
- c) The Standard for General-Use Snap Switches, UL 20; or
- d) The Standard for Non-industrial Photoelectric Switches for Lighting Control, UL 773A.

Exception: Switching devices that comply with the appropriate UL standard for specialty applications (e.g. transfer switch equipment), industrial use (e.g. contactors, relays, auxiliary devices), or are integral to another component (e.g. switched lampholder) need not comply with this requirement.

20.5 A clock-operated switch, in which the switching contacts are actuated by a clock-work, by a gear-train, by electrically-wound spring motors, by electric clock-type motors, or by equivalent arrangements shall comply with one of the following:

- a) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1; and the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Timers and Time Switches, UL 60730-2-7; or
- b) The Standard for Clock-Operated Switches, UL 917.

20.6 A timer or time switch, incorporating electronic timing circuits or switching circuits, with or without separable contacts, shall comply with the requirements for an operating control with Type 1 action for 6000 cycles of operation, or as a manual control for 5000 cycles of operation, in accordance with the one of the following:

a) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1; and the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Timers and Time Switches, UL 60730-2-7; or

b) The Standard for Solid-State Controls for Appliances, UL 244A.

21 Dual Voltage Appliance

21.1 The construction of the circuit voltage selector shall be such that the circuit voltage setting cannot be changed inadvertently.

21.2 If the appliance is so constructed that the supply circuit voltage selector can be changed, the action of changing the voltage selector setting shall also change the supply circuit voltage indication.

21.3 An appliance that can be set to different rated supply circuit voltages shall be provided with the statement required by [58.5](#).

22 Controls and Control Circuits

22.1 A safety or temperature-limiting control constructed to reduce the risk of fire or electric shock shall be operative whenever the appliance is connected to its power supply.

22.2 A control device shall not be constructed to deliberately overload the branch-circuit protective device as a means of disconnecting the appliance from the supply.

22.3 The terminals of a safety device within the enclosure of an appliance shall be so located or further enclosed that they will be protected against unintentional short-circuiting and damage.

22.4 Auxiliary controls shall be evaluated in accordance with the applicable requirements of this end product Standard and the parameters in Controls – End Product Test Parameters, Section [22B](#), unless otherwise specified in this end product Standard; see [22.10](#).

22.5 Operating (regulating) controls shall be evaluated in accordance with the applicable component standard requirements specified in Electromechanical and Electronic Controls, Section [22A](#), if applicable, and the parameters in Controls – End Product Test Parameters, Section [22B](#), unless otherwise specified in this end product Standard; see [22.10](#).

22.6 Operating controls that rely upon software for the normal operation of the end product where deviation or drift of the control may result in a risk of fire, electric shock, or injury to persons, such as a speed control unexpectedly changing its output, shall comply with one of the following:

a) The Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991, and the Standard for Software in Programmable Components, UL 1998; or

b) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1.

22.7 Protective (limiting) controls shall be evaluated in accordance with the applicable component standard requirements specified in Electromechanical and Electronic Controls, Section [22A](#), and if applicable, the parameters in Controls – End Product Test Parameters, Section [22B](#), unless otherwise specified in this end product Standard.

22.8 Solid-state protective controls that do not rely upon software as a protective component shall comply with one of the following:

- a) The Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991; or
- b) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1, except the Controls Using Software requirements in Annex H.

22.9 Solid-state protective controls that rely upon software as a protective component shall comply with one of the following:

- a) The Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991, and the Standard for Software in Programmable Components, UL 1998; or
- b) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1.

22.10 An electronic, auxiliary or operating control (e.g. a non-protective control), the failure of which would not increase the risk of fire, electric shock, or injury to persons, need only be subjected to the applicable requirements of this end product Standard.

22A Electromechanical and Electronic Controls

22A.1 A temperature control shall comply with one of the following:

- a) The Standard for Solid-State Controls for Appliances, UL 244A;
- b) The Standard for Temperature-Indicating and -Regulating Equipment, UL 873; or
- c) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1; and the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Temperature Sensing Controls, UL 60730-2-9.

22A.2 A temperature sensing positive temperature coefficient (PTC) or a negative temperature coefficient (NTC) thermistor, that performs the same function as an operating or protective control shall comply with one of the following:

- a) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1; and the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Temperature Sensing Controls, UL 60730-2-9, with Annex J; or
- b) The Standard for Thermistor-Type Devices, UL 1434.

22A.3 A thermal cutoff shall comply with the Standard for Thermal-Links – Requirements and Application Guide, UL 60691.

22B Controls – End Product Test Parameters

22B.1 General

22B.1.1 Spacings of controls shall comply with the electrical spacing, or clearances and clearance distance requirements of the applicable control standard as determined in Spacings, Section [24](#).

22B.1.2 Where reference is made to declared deviation and drift, this indicates the manufacturer's declaration of the control's tolerance before and after certain conditioning tests.

22B.2 Auxiliary controls

22B.2.1 Auxiliary controls shall not introduce a risk of electric shock, fire, or personal injury.

22B.2.2 Auxiliary controls shall comply with the requirements of this end product Standard.

Exception: An auxiliary control that complies with a component standard specified in Electromechanical and Electronic Controls, Section [22A](#), is considered to fulfill this requirement.

22B.3 Operating controls (regulating controls)

22B.3.1 The following test parameters shall be among the items considered when judging the acceptability of an operating control investigated using the Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1:

- a) Control action Types 1 or 2;
- b) Unless otherwise specified in this Standard, manual and automatic controls shall be tested for 6,000 cycles with under maximum normal load conditions, and 50 cycles under overload conditions;
- c) Installation Class 2 as described in the Standard for Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test, IEC 61000-4-5;
- d) For the applicable Overvoltage Category, see [Table 22B.1](#);
- e) For the applicable Material Group, see [Table 22B.2](#); and
- f) For the applicable Pollution Degree, see [Table 22B.3](#).

Table 22B.1
Overvoltage categories

Appliance	Overvoltage category
Intended for fixed wiring connection	III
Portable and stationary cord-connected	II
Control located in low-voltage circuit	I
NOTE – Applicable to low-voltage circuits if a short circuit between the parts involved may result in operation of the controlled equipment that would increase the risk of fire or electric shock.	

Table 22B.2
Material group

CTI PLC value of insulating materials	Material group
CTI $\geq$ 600 (PLC = 0)	I
400 $\leq$ CTI < 600 (PLC = 1)	II
175 $\leq$ CTI < 400 (PLC = 2 or 3)	III ^a
100 $\leq$ CTI < 175 (PLC = 4)	IIII ^b
NOTE – PLC stands for Performance Level Category, and CTI stands for Comparative Tracking Index as specified in the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A.	

Table 22B.3
Pollution degrees

Appliance control microenvironment	Pollution degree
No pollution or only dry, nonconductive pollution. The pollution has no influence. Typically a hermetically sealed or encapsulated control without contaminating influences, or printed wiring boards with a protective coating can achieve this degree.	1
Normally, only nonconductive pollution. However, a temporary conductivity caused by condensation may be expected. Typically indoor appliances for use in household or commercial clean environments achieve this degree.	2
Conductive pollution, or dry, nonconductive pollution that becomes conductive due to condensation that is expected. Typically controls located near and may be adversely affected by motors with graphite or graphite composite brushes, or outdoor use appliances achieve this degree.	3

22B.3.2 The following test parameters shall be among the items considered when judging the acceptability of an operating control investigated using other than the Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1:

- a) Control action Types 1 or 2;
- b) Unless otherwise specified in this standard, manual and automatic controls shall be tested for 6,000 cycles with under maximum normal load conditions, and 50 cycles under overload conditions;
- c) For the applicable Overvoltage Category, see [Table 22B.1](#);
- d) For the applicable Material Group, see [Table 22B.2](#); and
- e) For the applicable Pollution Degree, see [Table 22B.3](#).

22B.4 Protective controls (limiting controls)

22B.4.1 An electronic control that performs a protective function shall comply with the applicable requirements in Controls and Control Circuits, Section [22](#), while tested using the parameters in this section. Examples of protective controls are as follows:

- a) A control used to sense abnormal temperatures of components within the appliance;
- b) An interlock function to de-energize a motor;
- c) Temperature protection of the motor due to locked rotor, running overload, loss of phase; or
- d) Other function intended to reduce the risk of electric shock, fire, or injury to persons.

22B.4.2 The following test parameters shall be among the items considered when determining the acceptability of an electronic protective control investigated using the Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1:

- a) Failure-Mode and Effect Analysis (FMEA) or equivalent Risk Analysis method;
- b) Power Supply Voltage Dips, Variation and Interruptions within a temperature range of 10°C (18°F) and the maximum ambient temperature determined by conducting the Temperature Test; see Normal Temperature Tests, Section [33](#);
- c) Surge Immunity Test – installation Class 3 shall be used;
- d) Electrical Fast Transient/Burst Test, a test level 3 shall be used;