

UL 1082

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Household Electric Coffee Makers and Brewing-Type Appliances



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UL Standard for Safety
for
Household Electric Coffee Makers and Brewing-Type Appliances, UL 1082

Fifth Edition, Dated November 22, 1996

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

The new and/or revised requirements are substantially in accordance with Appendix A of UL's Bulletin on this subject dated June 24, 1996. The bulletin is now obsolete and may be discarded.

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

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

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Standard for

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Fifth Edition

November 22, 1996

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

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.

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

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SUPPLEMENT SA – HOUSEHOLD ELECTRIC DRIP-TYPE COFFEE MAKERS AND SIMILAR DRIP-TYPE BREWING APPLIANCES

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FOREWORD

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

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

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

D. A product employing materials or having forms of construction differing from those detailed in the requirements of this Standard may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be judged to comply with the Standard.

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

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

INTRODUCTION

1 Scope

1.1 These requirements cover portable electric coffee makers, percolators, coffee urns, and other brewing-type appliances rated at a nominal 120 V, for use in accordance with the National Electrical Code.

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 oz (7.4 L), appliances intended for outdoor use, or appliances that are covered in individual requirements that are separate from this Standard.

1.4 In the following text, a requirement that applies to one type of equipment coming within its scope (percolators, and the like) will be so identified by a specific reference in that requirement to the type of equipment involved. 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 of the types of equipment covered by the Standard.

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

2 Glossary

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

2.2 **CIRCUIT, LINE-VOLTAGE** – 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.

2.3 **CIRCUIT, LOW-VOLTAGE (SECONDARY)** – 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.

3 Components

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

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

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

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

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

4 Units of Measurement

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

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

5 References

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

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.

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, that 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.

For a nonmetallic enclosure, see 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 38 for resistance to impact.

Exception No. 1: When considering the abnormal and severe conditions tests of UL 746C, the appliance enclosure is to be judged under the abnormal operation tests of Abnormal Operation Tests, Section 43 of this Standard.

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 as outlined in 39.1 shall be conducted.

Exception No. 3: An appliance employing a thermoplastic enclosure with a 94HB flammability rating need not 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
94V-0 94V-1 94V-2	None
94HB	1. 3/4 inch (19 mm) Flame Test (UL 746C, Section 52) or 1. Overheating Protection (Section 23), 2. Minimum 1/2 inch (12.7 mm) spacing from enclosure material (including ribs, grills, and the like) to any uninsulated live parts, 3. HWI – Minimum 7 seconds (PLC-0,1,2,3,4), and 4. HAI – Minimum 60 arcs (PLC-0,1)

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 are mentioned in 7.3.

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

7.6 For an appliance as mentioned in 43.2.6.4, 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 will 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.

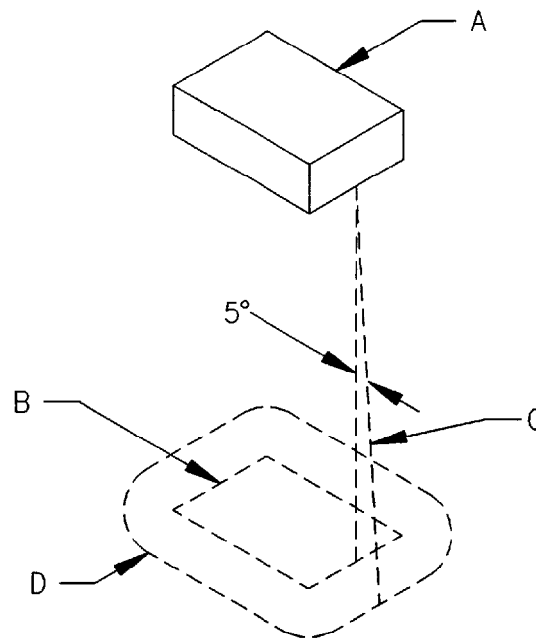
Table 7.2
Minimum acceptable thicknesses of enclosure metal

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	Millimeters	Inches	Millimeters
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.				

7.9 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.

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.

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.

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.

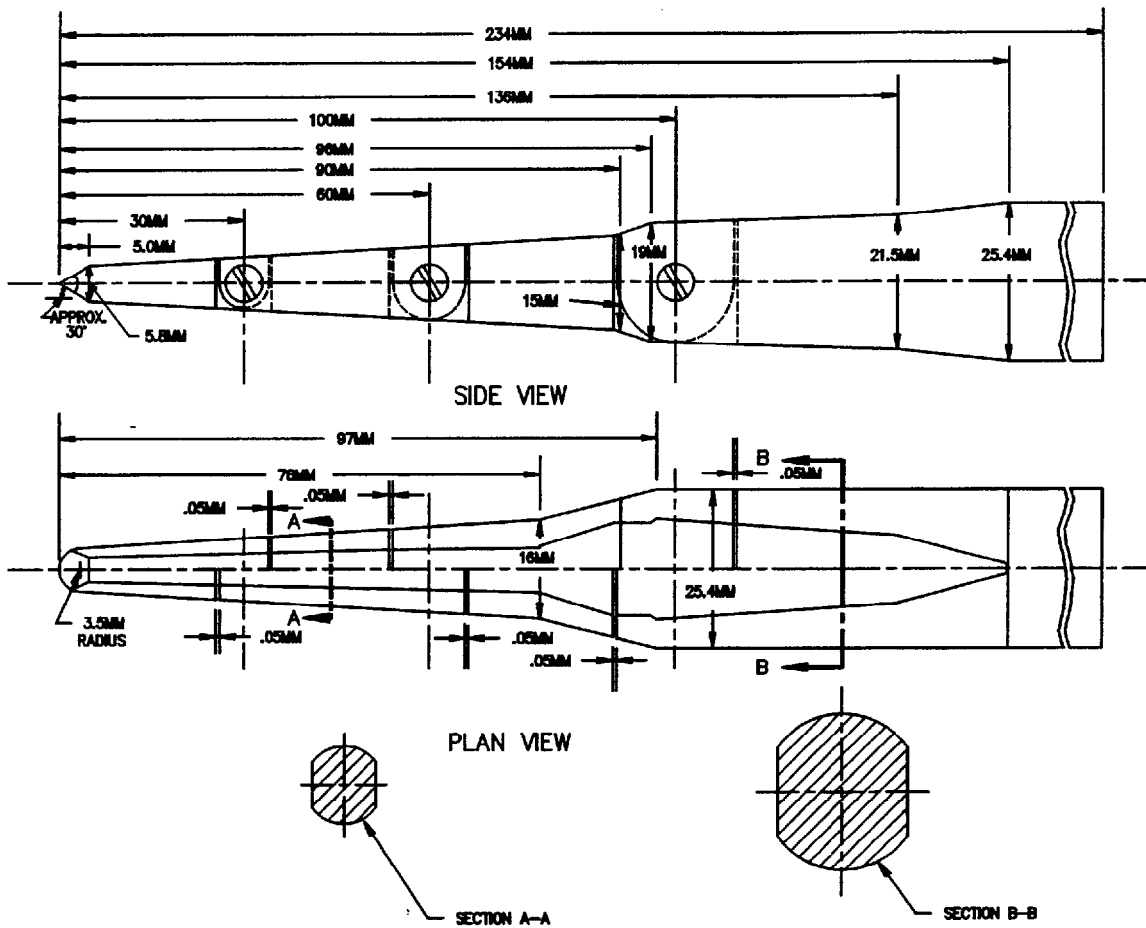
7.12 If a marking draws attention of the user to a hole of any size in the enclosure for the adjustment of a thermostat or for a similar activity, it shall not be possible to damage insulation or contact uninsulated live parts through the hole with a 1/16-inch-diameter rod (1.6 mm).

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.

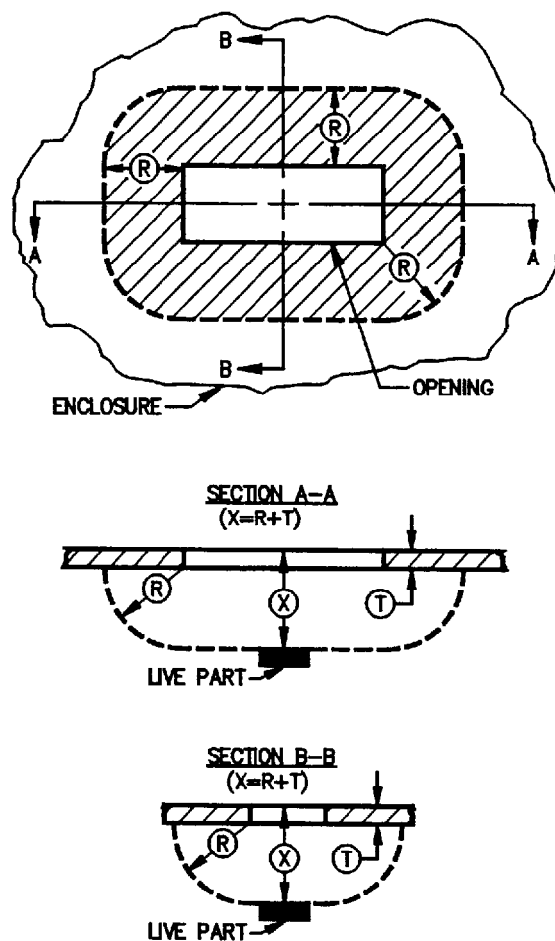
Exception: A part that requires a tool for opening or removal to perform manufacturer's recommended user servicing, maintenance, operating adjustments, attachment of accessories, or other instructions is to remain in place if the appliance is marked in accordance with 50.6.

Figure 7.2
Accessibility probe



PA100

Figure 7.3
Opening in enclosure



SB0610-1

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 would increase the risk of fire.

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 so secured to the base or surface that they will be 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

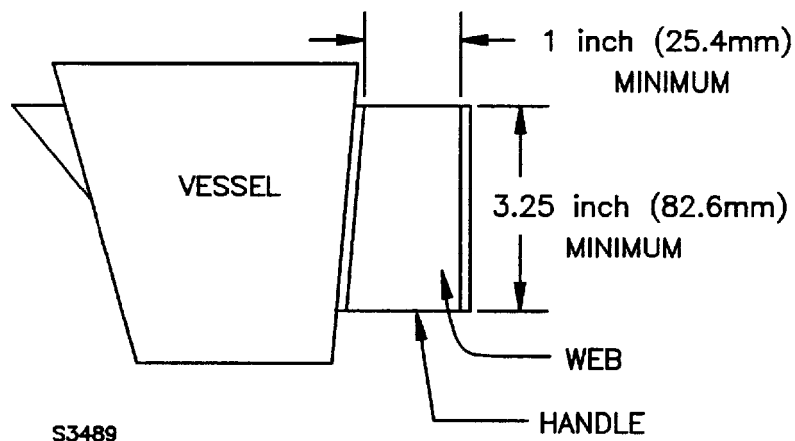
9.1 Unless determined to be acceptable for the purpose, fastening of the vessel handle assembly of an appliance shall not rely on cement or equivalent materials alone. Mechanical means, such as pressure clamping, bosses and lances, and the like, shall be provided.

9.2 A handle assembly that is utilized to lift and tilt a vessel, which is either integral to the appliance or a separate unit, to dispense a heated liquid shall comply with the requirements in 9.3 – 9.7, and Normal Temperature Tests, Section 33, and Handle Securement Tests, Section 40. The handle assembly of an integrally heated vessel shall also comply with 43.2.3.6.

Exception: A carafe type vessel having a capacity of less than 17.5 oz and provided with a product not employing a keep warm feature for the vessel.

9.3 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



9.4 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.

9.5 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 from the vessel will 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.

9.6 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.

9.7 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.

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 would increase 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 will not result eventually 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 50.7 or 50.8, 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 will be at least equally as serviceable for the particular application.

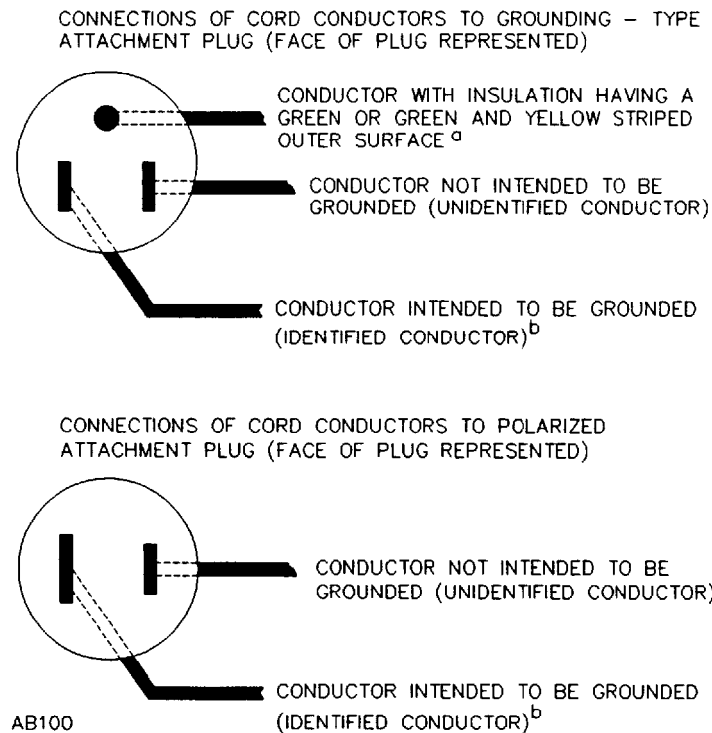
11.1.5 Supplementary insulation, if employed, shall not extend more than 1/2 inch (13 mm) outside the appliance (unless provided with additional mechanical protection), shall be prevented from fraying or unraveling, and shall not affect adversely the means for providing strain relief.

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) A manually operated, line-connected, single pole switch for appliance on-off operation or
- b) 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



^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.

11.2 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.

11.2.2 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 prevent an attached flexible cord from being pushed into the enclosure of an appliance through the cord-entry hole if such displacement is likely to subject the cord to mechanical damage or to expose the cord to a temperature higher than that for which it is acceptable, or if it is likely to reduce spacings (such as to a metal strain-relief clamp) below the minimum acceptable values.

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 will be 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 should 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) is to 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 so spaced that they will not accommodate a flatiron or appliance plug or cord-connector body. The plug which these pins will 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)

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.

11.4.2 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.

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 natural gray – without tracer	Solid color other than white or natural gray – without tracer
	B Color other than white or natural gray, with tracer in bold	Solid color other than white or natural gray – without tracer
Color of insulation on individual conductors	C ^a Solid white or natural gray	Solid color other than white or natural gray
	C1 ^e Light blue	Solid color other than light blue, white, or natural gray
Color of separators	D ^b White or natural gray	Color other than white or natural 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.		

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 3.1 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 unimpregnated asbestos, glass fiber, beads of inorganic material, or the equivalent employed as conductor insulation, but asbestos insulation is not acceptable for use in a damp or wet location.

13.1.3 Thermoplastic-insulated wire or impregnated-asbestos-insulated wire employed for the internal wiring of an appliance shall be fixture wire, or appliance-wiring material acceptable for the particular application.

13.2 Protection of wiring

13.2.1 If the wiring of an appliance is so located 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 so disposed or protected that no damage to conductor insulation can result 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.

13.3 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 may result in any risk of fire or electric shock.

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.

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 described in 14.2.1 – 14.2.9.*

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 is to 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 is also to 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 is enclosed or protected by barriers or covers that require tools for removal, and it complies with the accessibility of live parts requirements outlined in 7.5 – 7.13 and the broken element test of 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.

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 will not be damaged by the temperatures to which they will be subjected under conditions of actual use. Molded parts shall be so constructed that they will 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, Section 33, Functional-Use Temperature Indices, Section 34, and Generic Thermal Indices, Section 35, 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 outlined in 39.1 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.

17 Thermal Insulation

17.1 Thermal insulation, if employed, shall be of such a nature and so located and mounted or supported that it will not be 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 shall be so located that it will be accessible for replacement without damaging other connections or internal wiring. See 50.6.

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.

18.3 To determine whether or not a thermal cutoff complies with the requirement in 18.2 the appliance is to be operated with separate cutoffs five times as described in 18.2 while any other thermally operated control devices in the appliance are short-circuited. Each cutoff is required to perform acceptably. During the test, the enclosure is to be connected through a 3-A fuse to a supply conductor not containing the thermal cutoff.

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 so wired that the screw shell is connected to the grounded conductor.

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

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

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 so located or protected that it will not be 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.

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 54.5.

22 Limit Controls

22.1 General

22.1.1 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.

22.1.2 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.