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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UL 1082

Standard for Household Electric Coffee Makers and Brewing-Type Appliances

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Sixth Edition

March 17, 2009

This ANSI/UL Standard for Safety consists of the Sixth Edition including revisions through July 10, 2024.

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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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 V-1 V-2	None
HB	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)

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;

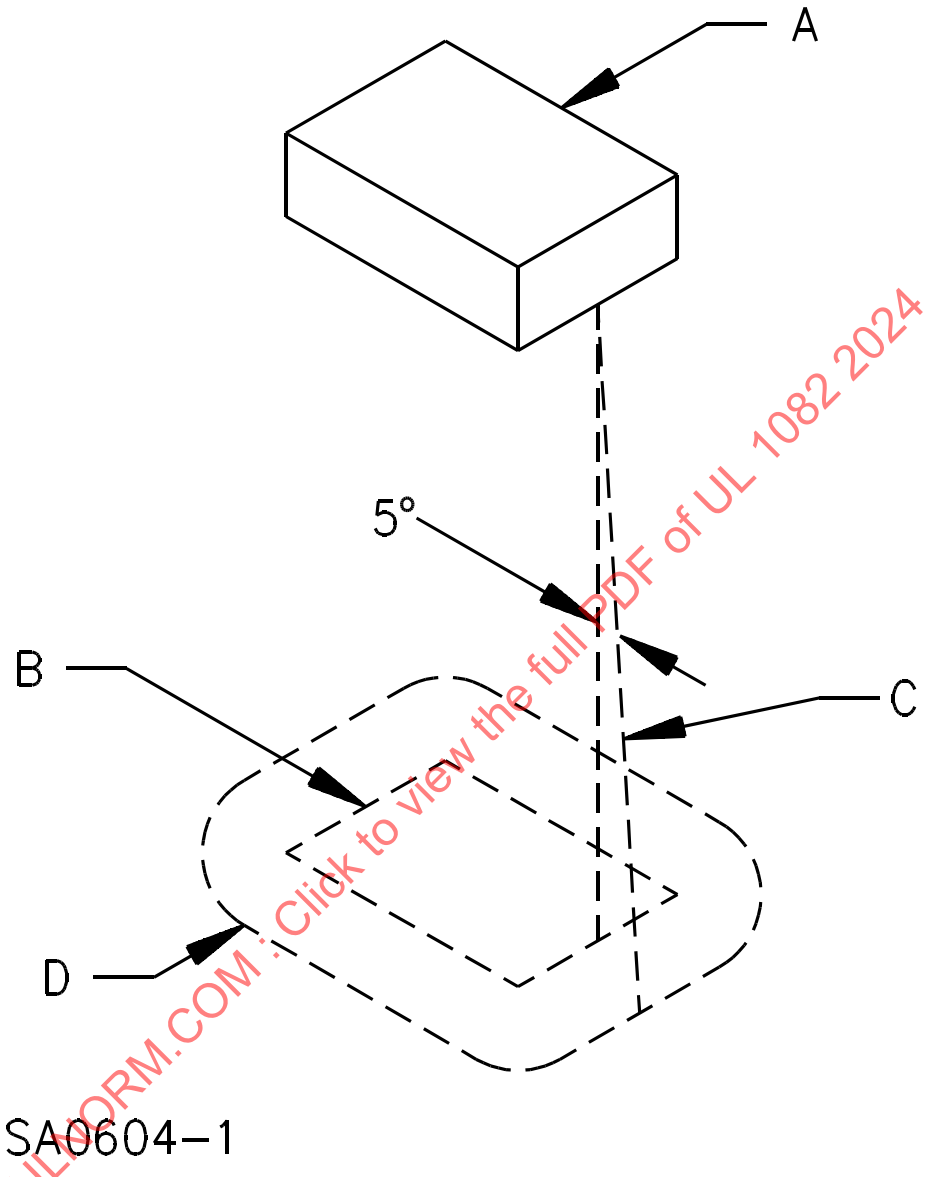
b) Horizontal; and

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



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 7.2

Accessibility probe

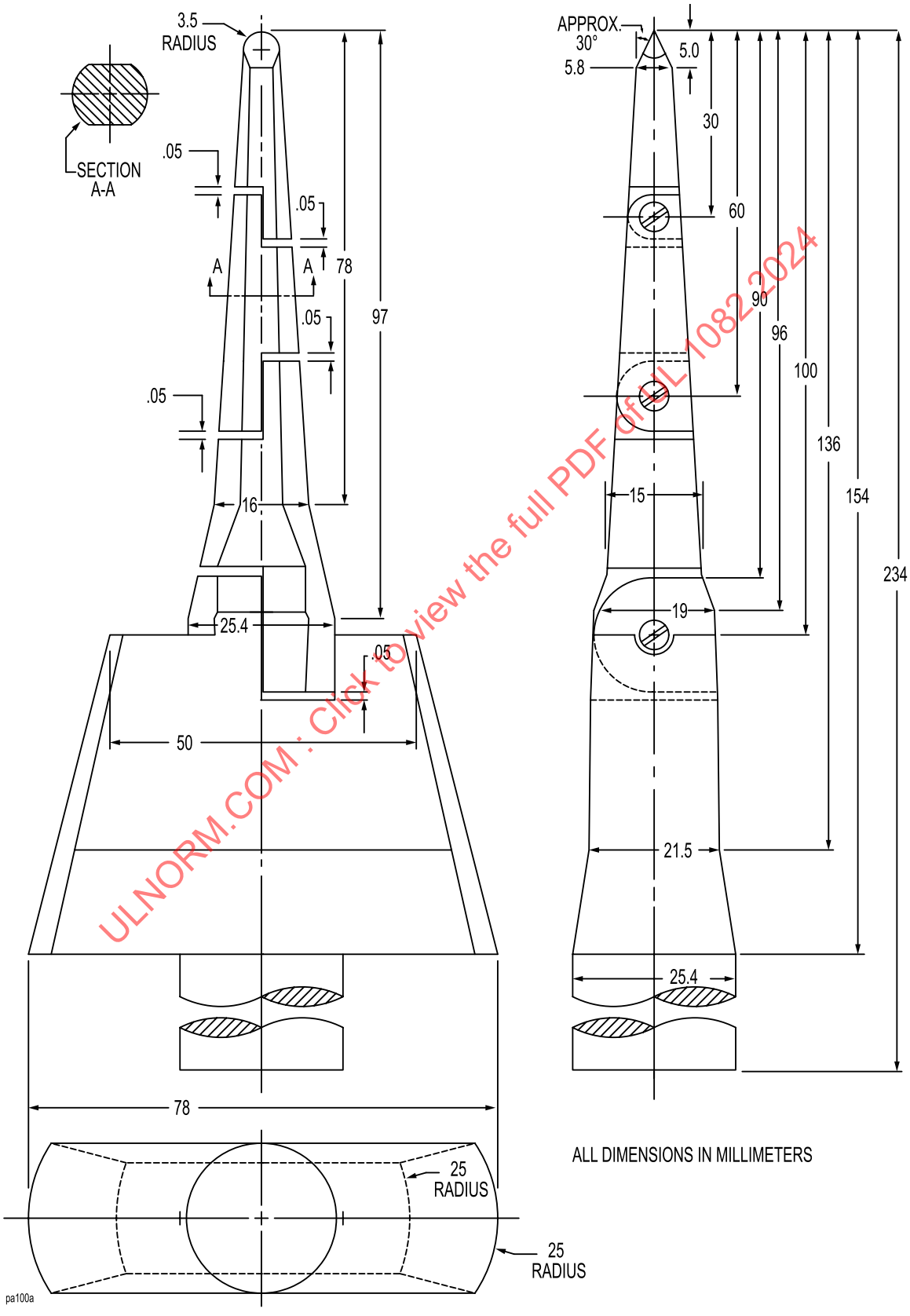
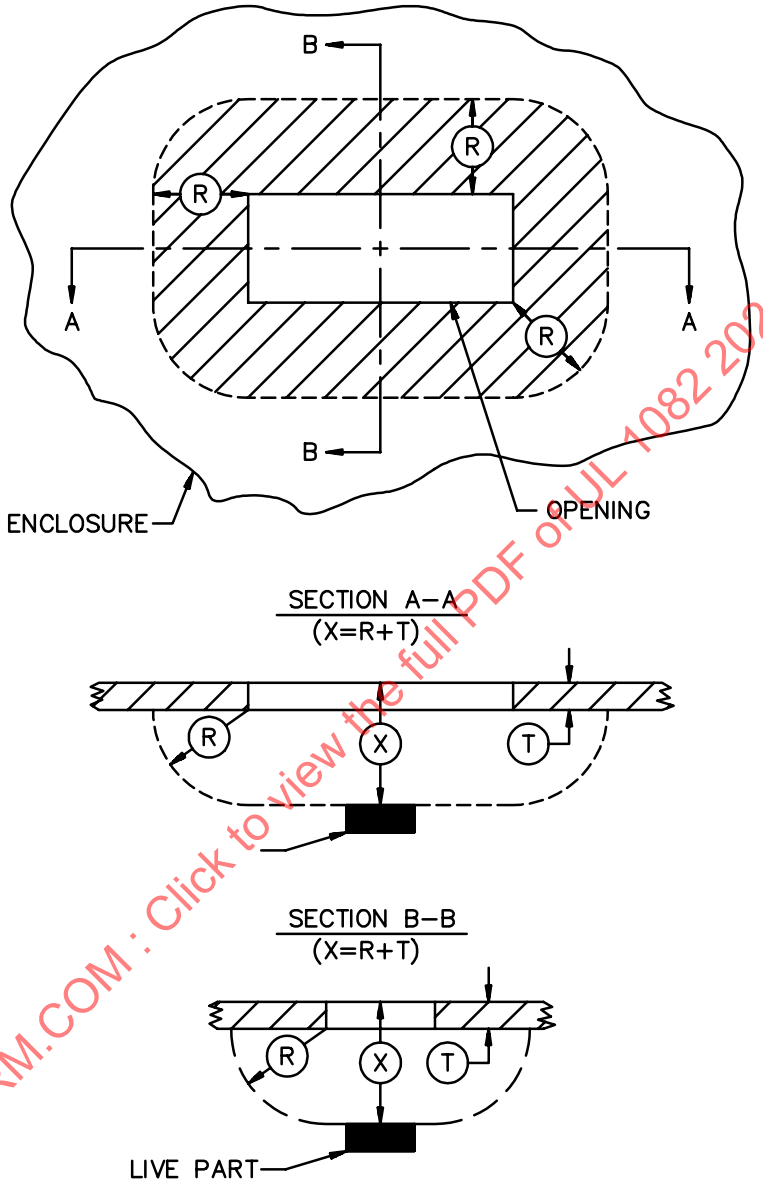


Figure 7.3

Opening in enclosure



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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

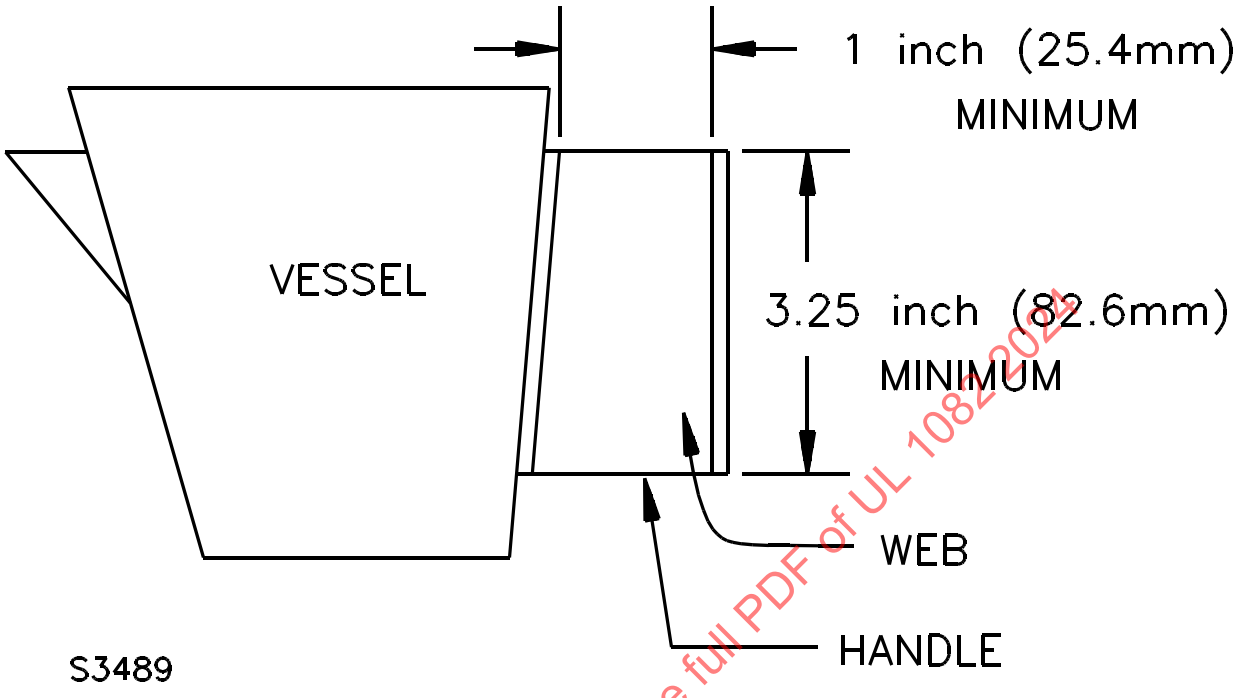
9.1.1 Unless determined to be acceptable for the purpose, fastening of the vessel handle assembly of an appliance shall not rely on cement or equivalent materials alone. Mechanical means, such as pressure clamping, bosses and lances, and the like, shall be provided.

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 from the vessel 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.

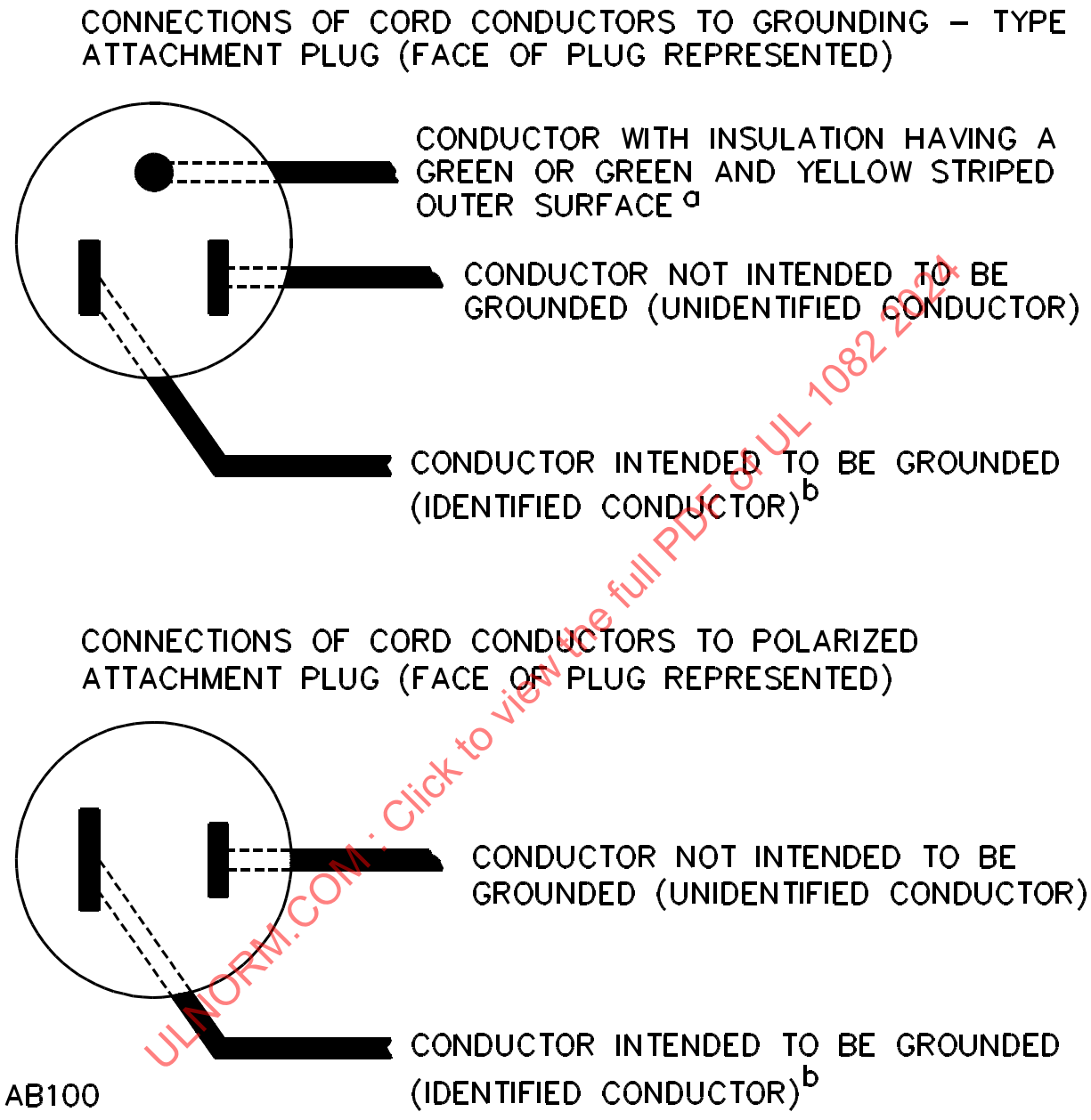
11.1.5 Supplementary insulation, if employed, shall not extend more than 1/2 inch (13 mm) outside the appliance (unless provided with additional mechanical protection), shall be prevented from fraying or unraveling, and shall not affect adversely the means for providing strain relief.

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



[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	2	In line	1/2	0.156 ±0.005	9/16 – 5/8
10 A at 125 V			(12.7)	(3.97 ±0.13)	(14.3 – 15.9)
Flatiron plug rated	2	In line	11/16	0.188 ±0.005	3/4 – 7/8
10 A at 125 V			(17.5)	(4.76 ±0.13)	(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 ≥ 600 (PLC = 0)	I
400 ≤ CTI < 600 (PLC = 1)	II
175 ≤ CTI < 400 (PLC = 2 or 3)	III[a]
100 ≤ 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;

e) Electrostatic Discharge Test;

f) Radio-Frequency Electromagnetic Field Immunity:

1) Immunity to conducted disturbances – When applicable, test level 3 shall be used; and

2) Immunity to radiated electromagnetic fields; field strength of 3 V/m shall be used;

g) Thermal Cycling Test shall be conducted at ambient temperatures of 10.0 ±2°C (50.0 ±3°F) and the maximum ambient temperature determined by conducting the Temperature Test; see Normal Temperature Tests, Section 33. The test shall be conducted for 14 days;

h) Overload shall be conducted based on the maximum declared ambient temperature (T_{max}) or as determined by conducting the Temperature Test; see Normal Temperature Test, Section 33; and

i) If software is relied upon as part of the protective electronic control, it shall be evaluated as software Class B.

22B.4.3 The test parameters and conditions used in the investigation of the circuit covered by 22B.4.1, shall be as specified in the Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991, using the following test parameters:

a) With regard to electrical supervision of critical components, for attended appliances, a motor operated system becoming permanently inoperative with respect to movement of an exposed portion of the appliance meets the criteria for trouble indication. For unattended appliances, electrical supervision of critical components may not rely on trouble indication;

b) A field strength of 3 V/m is to be used for the Radiated EMI Test;

c) The Composite Operational and Cycling Test is to be conducted for 14 days at temperature extremes of 0°C (32°F) and 70°C (158°F);

d) The Humidity Class is to be based on the appliance's intended end use and is to be used for the Humidity Test;

e) A vibration level of 5 g is to be used for the Vibration Test;

f) The Computational Investigation is not applicable to appliances covered by this end product Standard;

g) For the Demonstrated Method Test, the multiplier for the test acceleration factor is to be 576.30 for intermittent use appliances, or 5,763.00 for continuous use appliances. The test acceleration factor equation is to be based on a 25°C (77°F) use ambient;

h) The Endurance Test is to be conducted concurrently with the Operational Test. The control shall perform its intended function while being conditioned for 14 days in an ambient air temperature of 60°C (140°F) or 10°C (18°F) greater than the operating temperature of the control, whichever is higher. During the test, the control is to be operated in a manner representing normal use;

i) For the Electrical Fast Transient Burst Test, test level 1 is to be used;

j) Conduct a failure-mode and effect analysis (FMEA); and

k) If software is relied upon as part of the protective electronic control, it shall be evaluated as software Class 1 in accordance with the Standard for Software in Programmable Components, UL 1998.

22B.4.4 Unless otherwise specified in this Standard, protective controls shall be evaluated for 100,000 cycles for Type 2 devices and 6,000 cycles for Type 1 devices with rated current.

22B.5 Controls using a temperature sensing device

22B.5.1 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 be tested using the following number of cycles when testing a sensing device in accordance with the endurance test:

a) For a device employed as a operating device – 6,000 cycles;

b) For a device employed as a protective device – 100,000 cycles; and

c) For a device employed as a combination operating and protective device – 100,000 cycles.

22C Capsule-Type Brewing Appliance Controls

22C.1 General

22C.1.1 A capsule-type brewing appliance provided with an automatic reset temperature regulating thermostat that operates more than once during a function to keep water heated before the brew cycle, and/or to keep brewed beverage heated after the brew cycle shall comply with 22C.2 and 22C.3.

22C.1.2 A separate temperature limiting-type device is required if the short-circuiting of a temperature-regulating control during abnormal operation (see Abnormal Operation Tests, Section 47) increases the risk of fire or electric shock. A single combination regulating-limiting control is unacceptable for this purpose.

22C.2 Temperature regulating

22C.2.1 An automatic reset temperature-regulating thermostat that operates more than once during a complete cycle of brewing and warming shall comply with the applicable requirements for drip-type coffee maker thermostats in the Standard for Temperature-Indicating and -Regulating Equipment, UL 873. Compliance with 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, fulfills these requirements.

22C.2.2 The insulating material of a temperature regulating control shall have a Comparative Tracking Index of 175 or more. The Comparative Tracking Index (CTI) is referenced in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

22C.2.3 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 the following:

a) 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.

22C.3 Limiting-type devices

22C.3.1 A limiting-type device shall consist of one of the following:

a) A single thermal cutoff with an established TH-100 rating (which includes having a Conductive Heat (CH) rating) as described in the Standard for Thermal-Links – Requirements and Application Guide, UL 60691, and as tested per 33.2.5.8 and 33.2.5.10;

b) Two thermal cutoffs such that one of the following conditions is met:

1) Each of the thermal cutoffs has a Conductive Heat (CH) rating as described in UL 60691; or

2) One thermal cutoff has a Conductive Heat (CH) rating:

i) and temperature on the stationary contact lead of the thermal cutoff without a CH rating is greater than or equal to the temperature on its case, as tested per 33.2.5.10; or

ii) the CH rated thermal cutoff has a set-point temperature equal to or higher than the thermal cutoff without a CH rating; or

3) The temperature on the stationary contact lead of both thermal cutoffs without a CH rating is greater than or equal to the temperature on their respective cases as tested per 33.2.5.10.

c) A single-operation thermostat; or

d) A manual-reset thermostat that is inaccessible to the user without the use of tools.

22C.3.2 A single-operation thermostat or a manual-reset thermostat that is provided as the thermal limiting device shall comply with the applicable requirements in the Standard for Temperature-Indicating and -Regulating Equipment, UL 873, for limiting controls. Compliance with 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, fulfills these requirements.

22C.3.3 A thermal cutoff shall comply with the applicable requirements in the Standard for Thermal-Links – Requirements and Application Guide, UL 60691.

22C.3.4 If a grounding-type attachment plug is provided or the enclosure of the appliance has metal parts that are likely to become grounded, such as a metal bottom with bumped-out metal feet, the limiting-type device shall be located in the ungrounded supply conductor (if it can be identified) and the temperature-regulating control shall be in the other conductor. If the ungrounded supply conductor cannot be identified, the limiting-type device shall be located in one supply conductor and the temperature-regulating control shall be located in the other supply conductor.

23 Overheating Protection

23.1 The requirements in this section are applicable to all products. These requirements are in addition to or modify the applicable requirements in the Automatic Controls Test, Section 49.

23.2 An appliance shall be provided with a separate and distinct temperature-limiting device to limit temperatures within the appliance. A single combination regulating-limiting control is unacceptable for this purpose.

Exception No. 1: A temperature-limiting device is not required if, with all thermally responsive devices short-circuited, the results of all appropriate abnormal tests are in compliance with the Abnormal Operation Test, Section 47.

Exception No. 2: A temperature limiting device, as specified in 23.3, is not required if an appliance is provided with:

a) A manually reset operating control that operates during each cycle of normal operation to terminate the heating process; and

b) A minimum of two independent temperature limiting thermostats, as specified in Table 49.1.

23.3 A limiting-type device shall be a thermal cutoff, a single-operation thermostat or a manual-reset thermostat. The device and any means to actuate a reset function, shall be inaccessible to the user without the use of tools.

Exception: A manually reset device is permitted to have an accessible reset means if it is trip-free: that is, the automatic tripping shall be independent of the manipulation or position of the reset button, handle, lever, or the like. A manual reset control designated type M1 or M2 in accordance with the Standard for Temperature-Indicating and -Regulating Equipment, UL 873, is considered to comply with these requirements. Compliance with the Standard for Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements, UL 60730-1, and/or the applicable Part 2 standard from the UL 60730 series as a Type 2.H or Type 2.J action fulfills these requirements.

23.4 A single-operation thermostat or a manual-reset thermostat that is provided as the thermal limiting device of 23.3 shall comply with the applicable requirements in the Standard for Temperature-Indicating and Regulating Equipment, UL 873 for limiting controls. Compliance with the Standard for Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements, UL 60730-1, and/or the applicable Part 2 standard from the UL 60730 series fulfills these requirements.

23.5 A thermal cutoff shall comply with the applicable requirements in the Standard for Thermal-Links – Requirements and Application Guide, UL 60691.

23.6 If a grounding-type attachment plug is provided or the enclosure of the appliance has metal parts that are likely to become grounded, such as a metal bottom with bumped-out metal feet, the limiting-type device shall be located in one supply conductor and the temperature-regulating control shall be located in the other supply conductor. If identifiable, the ungrounded supply conductor shall contain the limiting-type device.

24 Spacings

24.1 General

24.1.1 The spacings in an appliance shall be 1/16 inch (1.6 mm) between uninsulated live parts of opposite polarity; and between a rigidly mounted uninsulated live part and a dead metal part that either is exposed for persons to contact or may be grounded.

Exception No. 1: If exact centering of the cold pin of a sheathed-type heating element is required to maintain the 1/16-inch (1.6-mm) spacing, a spacing of 3/64 inch (1.2 mm) in one location is acceptable.

Exception No. 2: As indicated in 24.1.2.

24.1.2 At closed-in points only, such as the screw-and-washer construction of an insulated terminal mounted in metal, a spacing of 3/64 inch (1.2 mm) is acceptable. Within a thermostat, except at contacts,

the spacings between uninsulated live parts on opposite sides of the contacts are to be not less than 1/32 inch (0.8 mm) through air and 3/64 inch (1.2 mm) over the surface of insulating material, and the construction is to be such that the spacings are maintained permanently.

24.2 Barriers

24.2.1 An insulating liner or barrier of fiber or similar material employed where spacings would otherwise be unacceptable shall not be less than 1/32 inch (0.8 mm) thick and shall be so located or of such material that it cannot be adversely affected by arcing, except that fiber not less than 1/64 inch (0.4 mm) thick may be used in conjunction with an air spacing of not less than 50 percent of the spacing required for air alone.

Exception: Insulating material having a thickness less than specified may be used if it is equivalent in appropriate properties for the application.

24.2.2 Unless protected from mechanical abuse during assembly and functioning of an appliance, a barrier of mica shall be 0.010 inch (0.25 mm) or thicker.

24A Spacings on Printed-Wiring Boards

24A.1 As an alternative to the spacing requirements of 24.1.1, a printed-wiring board with spacings between opposite polarity circuits (other than a low-voltage circuit) less than those required is acceptable provided that the spacings:

a) Are located on a portion of the printed wiring board provided with a conformal coating that complies with the requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, and the dielectric voltage-withstand test described in Dielectric Voltage-Withstand Test, Section 35;

b) Are located on the load side of a resistor such that a short circuit from the load side of the resistor to the other side of the line does not result in the resistor power dissipation exceeding the resistor wattage rating;

c) Comply with the spacing requirements in the Standard for Solid-State Controls for Appliances, UL 244A. Compliance with the Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1, and/or the applicable Part 2 standard from the UL 60730 series fulfills these requirements; or

d) Comply with the spacing requirements in the Standard for Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment, UL 840. The spacing requirements of UL 840 shall not be used for field wiring terminals and spacings to a dead metal enclosure.

24A.2 When conducting evaluations in accordance with the requirements in the Standard for Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment, UL 840, the following guidelines shall be used:

a) A household electric cooking appliance is to be categorized as Overvoltage Category II, see Table 22B.1;

b) The applicable Material Group per Table 22B.2;

c) The Pollution degree shall be Pollution Degree 2, see Table 22B.3; and

d) Any printed-wiring board which complies with the requirements in the Standard for Printed-Wiring Boards, UL 796, shall be determined to provide a Comparative Tracking Index (CTI) of 100, and when it further complies with the requirements for Direct Support in UL 796, then it shall be determined to provide a CTI of 175.

24A.3 In order to apply Clearance B (controlled overvoltage) clearances, control of overvoltage shall be achieved by providing an overvoltage device or system as an integral part of the product. This voltage limiting device or system shall comply with the Standard for Surge Protective Devices, UL 1449.

25 Grounding

25.1 On an appliance where grounding is provided, the flexible cord shall include a grounding conductor that shall be:

a) Green, with or without one or more yellow stripes;

b) Connected to the grounding blade of an attachment plug of a grounding type; and

c) Connected to the enclosure of the appliance by means of a screw not likely to be removed during ordinary servicing, or by other reliable means. Solder alone is not acceptable for making this connection.

25.2 All exposed dead metal parts of a cord-connected appliance that is equipped with a grounding conductor, and all dead metal parts within the enclosure that are exposed to contact during any user servicing and are likely to become energized, shall be conductively connected to the grounding conductor of the power-supply cord. The grounding means shall comply with the requirements in Resistance of Grounding Test, Section 29.

25.3 A separable connecting device provided with a grounding connection shall be such that the appliance grounding connection is made before connection to, and broken after disconnection from the supply circuit.

Exception: This requirement does not apply to an interlocked plug, receptacle, and connector that is not energized when the appliance grounding connection is made.

26 Protection Against Injury to Persons

26.1 Materials employed in the construction of the appliance depended upon for protection against personal injury shall be appropriate for the particular use. See 7.1 and 7.3.

26.2 An enclosure, a frame, a guard, a handle, or the like shall not be sharp enough to constitute a risk of injury to persons during normal maintenance and use.

Exception No. 1: A part or portion of a part needed to perform a working function need not comply with this requirement.

Exception No. 2: A part or portion of a part inaccessible to the probe illustrated in Figure 7.2 need not comply with this requirement.

26.3 Compliance with the requirement of 26.2 shall be determined by applying the test procedures, equipment, and acceptance criteria specified in the Standard for Tests for Sharpness of Edges on Equipment, UL 1439.

26.4 The stability of an appliance shall be such that it will not be overturned readily in normal use. The appliance shall be subjected to the Stability Test, Section 44.

26.5 If any part of an appliance requires proper assembly, for example fully inserting a lid or engagement of a twist-lock part, in order to reduce a risk of injury to persons, then improper assembly that may result in a risk of injury to persons shall be clearly visible to the user.

26.6 A coffee urn or similar water-heating appliance that is not lifted or tilted to dispense the liquid and that has a capacity of more than 17.5 oz (520 mL) shall be:

a) Provided with such a lid as described in 26.5; and

b) Subjected to the Tip Over Test, Section 45, wherein the lid does not become dislodged.

26.7 The construction of an appliance shall be such as to minimize the possibility of physical injury when pouring under conditions simulating intended normal use. The pouring spout shall be constructed so that the direction and rate of liquid flowing from the spout will be as anticipated. Liquid shall not be emitted from other than the spout in the intended use.

26.8 An appliance, or that part of an appliance (such as a carafe), that requires lifting and tilting to dispense the liquid and that has a capacity of more than 17.5 fluid oz (520 mL) shall be subjected to the Tip Over Test, Section 45.

Exception No. 1: The Tip Over Test is not required if the critical angle of balance is 45 degrees or greater. The critical angle of balance is determined as the angle at which a sample will tip over due only to the force of gravity, in any orientation throughout its vertical axis.

Exception No. 2: The Tip Over Test is not required if it complies with the Dynamic Stability Test, Section 46.

26.9 The release mechanism for detachable handles shall be:

a) Located and/or guarded so that inadvertent detachment of the handle does not occur during normal use of the appliance; and

b) Constructed so that complete and proper engagement of the handle is obvious to the user during the operation of attaching the handle.

26.10 The battery compartment of an appliance or any accessory, such as a wireless control, incorporating one or more replaceable coin cell batteries shall comply with the Standard for Safety for Products Incorporating Button Batteries or Coin Cell Batteries, UL 4200A, if the appliance or any accessory is intended for use with one or more single cell batteries having a diameter of 32 mm (1.25 in) maximum with a diameter greater than its height. UL 4200A is also applicable to appliances covered by Supplement SB.

Exception: Not applicable to an appliance intended only to be mounted above a countertop.

26.11 A pressure brewing appliance shall be provided with a brewer operation indicator that is readily visible and distinguishable from the "off" position. The brewer operation indicator shall be "on" starting when the user initiates the cycle, and shall turn off when the dispensing stops.

26.12 A pressure brewing appliance shall be constructed so that the brewing chamber cannot be opened by a simple or unintentional operation when the chamber is pressurized.

Note 1: An espresso coffee filter that can only be removed after having been rotated through an angle of at least 30 degrees is considered to comply with this requirement. For other brewing appliances, a brewing material holder provided with two separate and distinct means for securement, accomplished either manually or by an automatic process, is also acceptable.

Note 2: A brewing chamber that cannot be opened while under pressure by exerting a force of less than 2.25 pounds (10 Newtons) is considered to comply with this requirement.

Exception: An appliance that meets the requirements of the Open Brew Chamber Test – Pressure Brewing Appliances, Section 46B is not required to comply with this requirement.

26A Ground-Fault, Arc-Fault, and Leakage Current Detectors/Interrupters

26A.1 Ground-fault circuit-interrupters (GFCI) shall comply with the Standard for Ground-Fault Circuit-Interrupters, UL 943. The following statement, or equivalent, shall be included as a marking near the GFCI, or as an instruction in the manual: "Press the TEST button (then RESET button) every month to assure proper operation."

26A.2 Appliance-leakage-current interrupters (ALCI) shall comply with the Standard for Appliance-Leakage-Current Interrupters, UL 943B. An ALCI is not considered an acceptable substitute for a GFCI when a GFCI is required by the National Electrical Code, NFPA 70.

26A.3 Equipment ground-fault protective devices shall comply with the Standard for Ground-Fault Sensing and Relaying Equipment, UL 1053, and applicable requirements of the Standard for Ground-Fault Circuit-Interrupters, UL 943.

26A.4 Arc-fault circuit-interrupters (AFCI) shall comply with the Standard for Arc-Fault Circuit-Interrupters, UL 1699.

26A.5 Leakage-current detector-interrupters (LCDI) and any shielded cord between the LCDI and appliance shall comply with Standard for Arc-Fault Circuit-Interrupters, UL 1699.

26A.6 An arc-fault circuit-interrupter (AFCI) or leakage-current detector-interrupter (LCDI), when used on equipment having a power supply cord and plug, shall be installed as an integral part of the attachment plug or located in the supply cord within 4 inches (102 mm) of the attachment plug.

26A.7 Arc fault detection testing shall include the applicable tests required for cord-type arc-fault circuit-interrupters, found in the Standard for Arc-Fault Circuit-Interrupters, UL 1699.

Exception: The carbonized path arc clearing time test is not applicable for LCDIs that are provided with shielded power-supply cords.

26B Surge Protective Device

26B.1 A device providing surge protection or transient suppression shall comply with the Standard for Surge Protective Devices, UL 1449.

27 Pressure Vessels and Parts Subject to Pressure

27.1 *Revised and relocated as 26.12.*

27.2 *Revised and relocated as 54.14.*

27.3 Except as noted in 27.4, a pressure vessel having an inside diameter of more than 6 inches (152 mm) and subject to a gauge pressure of more than 15 lbf/in^2 (103 kN/cm^2 or 10.5 gf/mm^2) shall be certified by the National Board of Boiler and Pressure-Vessel Inspectors and marked in accordance with the appropriate boiler and pressure vessel code symbol of the American Society of Mechanical Engineers (ASME) ("H", "M", "S", or "U") for a working pressure not less than the pressure determined by applying 27.5.

27.4 If a pressure vessel, because of its application, is not covered under the inspection procedures of the ASME code, it shall be so designed and constructed that it complies with the requirements in 46A.1 – 46A.4.

27.5 *Revised and relocated as 46A.1.*

27.6 *Revised and relocated as 46A.2.*

27.7 *Revised and relocated as 46A.3.*

27.8 *Revised and relocated as 46A.4.*

27.9 *Revised and relocated as 46A.5.*

27.10 *Revised and relocated as 46A.6.*

27.11 A means for relieving pressure shall be provided for all parts in which pressure might be generated in the event of fire.

27.12 Pressure-relief devices (see 27.18), fusible plugs, soldered joints, nonmetallic tubing, or other pressure-relief means or the equivalent may be employed to comply with the requirements in 27.11.

27.13 There shall be no shut-off valve between the pressure-relief means and the parts that it is intended to protect.

27.14 A vessel having an inside diameter of more than 3.0 inches (76.2 mm) and subject to air or steam pressure generated or stored within the appliance shall be protected by a pressure-relief device.

27.15 The start-to-discharge pressure setting of the pressure-relief device shall not be higher than the maximum operating pressure of the vessel. The discharge rate of the device shall acceptably relieve the pressure. The Maximum Operating Pressure of a pressure vessel of 27.3 is the marked Maximum Allowable Operating Pressure.

27.16 A pressure-relief device shall comply with all of the following:

a) Shall be connected as close as possible to the pressure vessel or parts of the system that it is intended to protect;

b) *Deleted*

c) Shall have its discharge opening located and directed so that the risk of scalding is reduced to a minimum;

d) Shall have its discharge opening located and directed so that operation of the device does not deposit moisture on bare live parts or on insulation or components affected detrimentally by moisture; and

e) Shall be non-user serviceable.

27.17 A pressure-relief device having an adjustable setting is judged on the basis of its maximum setting unless the adjusting means is sealed at a lower setting.

27.18 A pressure-relief device is considered to be a pressure-actuated valve or rupture member intended to relieve excessive pressures automatically.

27.19 For pressure brewing appliances where a pressure-relief device is required, the control responsible for limiting the pressure in the vessel shall be capable of performing under rated load for 100,000 cycles of operation and shall prevent the pressure from exceeding 90 percent of the relief device setting under any condition of normal operation.

Exception: An appliance which has a maximum system pressure during normal operation with the inlet of the brewing chamber blocked less than 10 psi is not required to comply with this requirement. The pressure shall be measured at the exit of the heater and also at the exit of a pump that moves liquid at an elevated temperature, if provided.

PERFORMANCE

28 General

28.1 The performance of an appliance shall be investigated by subjecting the required number of appliances to all the applicable tests as described in Sections 29 – 49. Appliances employed for leakage-current tests shall be first tested for leakage prior to employing them for other tests.

29 Resistance of Grounding Test

29.1 The resistance between the point of connection of the equipment-grounding means at or within the appliance and any other point in the grounding circuit of the appliance shall not exceed 0.1 ohms.

29.2 Compliance with the requirement in 29.1 is to be determined by:

a) A resistance-measuring instrument; or

b) Passing an alternating current of at least 30 amperes from a power supply of not more than 12 volts from the grounding pin of the attachment plug cap to a point in the grounding circuit, and then measuring the resulting drop in potential between the two points. The resistance in ohms is to be determined by dividing the drop in potential in volts by the current in amperes passing between the two points.

30 Power Input

30.1 The power input to an appliance shall not be more than 105 or less than 90 percent of its marked rating.

30.2 To determine if an appliance complies with the requirement in 30.1, the power input is to be measured with the appliance at normal operating temperature under full-load conditions and while connected to a supply circuit adjusted to the highest voltage of the following:

a) The marked voltage rating; or

b) 120 V, whichever is appropriate for the appliance.

31 Leakage Current Test

31.1 The leakage current of a cord-connected appliance rated for a nominal 120-V or 240-V supply when tested in accordance with 31.1 – 31.7 shall not be more than:

a) 0.5 mA for an ungrounded (2-wire) appliance;

b) 0.5 mA for a grounded (3-wire) appliance that is easily carried or conveyed by hand; and

c) 0.75 mA for a grounded (3-wire) permanently connected appliance, or a cord connected appliance that is intended to be fastened in place or located in a dedicated space and employing a standard attachment plug rated 20 A or less.

Exception: The leakage current of an appliance incorporating a sheath type heating element, when measured in accordance with 31.3 – 31.7, shall not exceed 2.5 mA during the first 5 minutes after reaching the leakage current limit of 0.5 mA or 0.75 mA, as applicable, and at the end of this time, the leakage current shall be not more than the 0.5 mA or 0.75 mA limit as applicable– the leakage current is to be monitored during heat-up and cool-down.

31.2 Leakage current refers to all currents, including capacitively coupled currents, that may be conveyed between exposed conductive surfaces of an appliance and ground or other exposed conductive surfaces of an appliance.

31.3 All exposed conductive surfaces are to be tested for leakage currents. The leakage currents from these surfaces are to be measured to the grounded supply conductor individually as well as collectively where simultaneously accessible and from one surface to another where simultaneously accessible. Parts are considered to be exposed surfaces unless guarded by an enclosure considered acceptable for protection against electric shock as defined in 7.1 – 7.13. Surfaces are considered to be simultaneously accessible when they can be readily contacted by one or both hands of a person at the same time. These measurements do not apply to terminals operating at voltages which are not considered to involve electric shock.

31.4 If a conductive surface other than metal is used for the enclosure or part of the enclosure, the leakage current is to be measured using a metal foil with an area of 10 by 20 cm (3.9 by 7.9 inches) in contact with the surface. Where the surface is less than 10 by 20 cm, the metal foil is to be the same size as the surface. The metal foil is not to remain in place long enough to affect the temperature of the appliance.

31.5 The measurement circuit for leakage current is to be as shown in Figure 31.1. The ideal measurement instrument is defined in (a) – (d). The meter which is actually used for a measurement need only indicate the same numerical value for a particular measurement as would the ideal instrument. The meter used need not have all the attributes of the ideal instrument.

a) The meter is to have an input impedance of 1500 ohms resistive shunted by a capacitance of 0.15 µF.

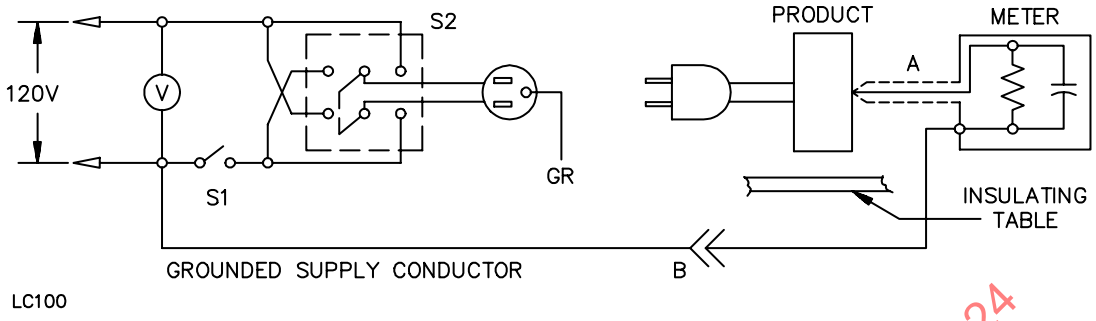
b) The meter is to indicate 1.11 times the average of the full-wave rectified composite wave-form of voltage across the resistor or current through the resistor.

c) Over a frequency range of 0 – 100 kH, the measurement circuitry is to have a frequency response (ratio of indicated to actual value of current) that is equal to the ratio of the impedance of a 1500 ohm resistor shunted by a 0.15 microfarad capacitor to 1500 ohms. At an indication of 0.5 mA, the measurement is to have an error of not more than 5 percent at 60 Hz.

d) Unless the meter is being used to measure leakage from one part of an appliance to another, the meter is to be connected between the accessible parts and the grounded supply conductor.

Figure 31.1

Leakage-current measurement circuit



A – Probe with shielded lead.

B – Separated and used as clip when measuring currents from one part of appliance to another.

31.6 A sample of the appliance is to be tested for leakage current starting with the "as received" condition with all its switches and thermostats closed, but its grounding conductor, if any, open at the attachment plug. The "as received" condition being without prior energization, except as may occur as part of the production line testing. The supply voltages is to be 120- to 240V. The test sequence, with reference to the measuring circuit (Figure 31.1), is to be as follows:

a) With switch S1 open, the appliance is to be connected to the measuring circuit. Leakage current is to be measured using both positions of switch S2.

b) Switch S1 is then to be closed, energizing the appliance, and within a period of 5 seconds, the leakage current is to be measured using both positions of switch S2, and with the appliance operated at the maximum heat setting of controls.

c) Leakage current is to be monitored until thermal stabilization under the maximum heat condition. Both positions of switch S2 are to be used. The equivalent of thermal stabilization is considered to be obtained as in the normal temperature test. If any thermostat does not cycle at the maximum heat setting, it is to be adjusted until it does cycle before the final measurements at thermal stabilization are taken. Measurements are to be made with the thermostat, if any, open and closed. Upon evidence of stabilizing readings, monitoring periods may be increased.

d) If the appliance employs a single pole switch, monitoring of leakage current is to continue until the leakage current stabilizes or decreases after the appliance is turned off.

31.7 Normally a sample will be carried through the complete leakage current test program as covered by 31.6, without interruption for other tests. With the concurrence of those concerned, the leakage current tests may be interrupted for the purpose of conducting other nondestructive tests.

32 Operational Tests

32.1 Operation of an appliance while simulating anticipated conditions of use shall not increase the risk of fire, electric shock, or injury to persons.

32.2 In conducting the test, the conditions mentioned in the manufacturer's instructions, including cleaning, maintenance, and the use of accessories may be included or omitted to simulate reasonably foreseeable actions of the user.

33 Normal Temperature Tests

33.1 General

33.1.1 An appliance, when tested under the conditions described in 33.1.3 – 33.2.4.1, shall comply with all three of the following conditions:

a) The appliance shall not attain at any point a temperature sufficiently high to constitute a risk of fire or to damage any materials employed in the appliance.

b) At any time during the test – other than as indicated in 33.1.2 – temperature rises at specific points shall not be greater than indicated in Table 33.1.

c) The appliance shall comply with the requirement in 7.1.

Table 33.1
Maximum acceptable temperature rises

	Materials and component parts	°C	(°F)
1.	Fiber used as electrical insulation or as cord bushings	65	(117)
2.	Wood or other combustible material which is a part of an appliance	65	(117)
3.	Cotton or rayon braid of a flexible cord	65	(117)
4.	Phenolic composition used as electrical insulation or where deterioration would result in a risk of fire or electric shock[a]	125	(225)
5.	Points on surface supporting an appliance other than wall-mounted and under-cabinet mounted	125	(225)
6.	Any point on a surface adjacent to a wall-mounted or under-cabinet mounted appliance including the surface on which the appliance is mounted	65	(117)
7.	Points on adjacent surfaces of the tests corner for counter-top appliances	100	(180)
8.	Flatiron or appliance plug	175	(315)
9.	Insulated wire or cord	25°C (77°F) less than its temperature rating[b]	
10.	Sealing compound	c	
11.	A. Copper, tinned or bare strands:		
	1) less than 0.015 inch (0.38 mm) in diameter	125	(225)
	2) 0.015 inch diameter and larger	175	(315)
	B. Nickel, gold, or silver platings or combinations of those platings, over copper conductors	225	(405)
12.	Termination of copper conductor and pressure terminal connector without being nickel-coated or otherwise appropriately protected	125	(225)
13.	Points likely to be contacted by hand or fingers while supporting an appliance[d]		
	A. Metal surface	30	(54)
	B. Surface of porcelain or vitreous material	40	(72)
	C. Surface of molded material, rubber, or wood	50	(90)

[a] The limitation on phenolic composition does not apply to a compound which has been investigated and found to have special heat-resistant properties.

[b] Inside an appliance, the temperature rise on a wire or cord may be greater than the specified maximum rise, provided that the insulation on each individual conductor is adequately protected by supplementary insulation (such as braid, wrap, tape, or close-fitting tubing) for the temperature and the type of insulation involved.

[c] Unless a thermosetting material, the maximum sealing compound temperature when corrected to a 25°C (77°F) ambient temperature, is 15°C (27°F) less than the softening point of the compound as determined by the Ball and Ring Apparatus, ASTM E28.

[d] Coatings or special materials are to be considered on an individual basis.

33.1.2 Initial temperature transients may be in excess of the value shown in Table 33.1 if the duration and extent of the excursion do not result in material property changes to the extent that risk of fire or electric shock results.

33.1.3 All values in Table 33.1 are based on an assumed ambient (room) temperature of 25°C (77°F), but a test may be conducted at any ambient temperature within the range of 10 – 40°C (50 – 104°F). However, if the operation of an automatic thermal control during the test limits the temperatures under observation, no temperature higher than 25°C (77°F) plus the specified maximum rise is acceptable.

33.1.4 A gasket which is depended upon to prevent the entrance of water into an appliance during cleaning shall not become hard or brittle, shall not crack, and shall show no other signs of deterioration as a result of an accelerated-aging test in which the gasket is subjected to elevated temperatures. See 34.5.

33.1.5 The temperature to which the gasket is subjected during the test, as well as the duration of the test, is to be determined in accordance with the material of the gasket, the temperature to which it is subjected during operation, and other conditions of the particular application. Normally the appliance is to be operated dry and for a period of 240 hours, except that an automatic coffee maker is to be initially filled with water.

33.1.6 Following the accelerated aging, the sample is to be immersed, tested, and examined for the entrance of water in accordance with 34.7.

33.1.7 Temperatures are to be measured by thermocouples consisting of wires no larger than 24 AWG and no smaller than 30 AWG, except that a coil temperature may be determined by the change-of-resistance method if the coil is inaccessible for mounting thermocouples. When thermocouples are used in determining temperatures in electrical equipment, it is standard practice to employ thermocouples consisting of 30 AWG iron and constantan wire and a potentiometer-type instrument, and such equipment is to be used whenever referee temperature measurements by thermocouples are necessary. The thermocouple wire is to conform with the requirements specified in the Tolerances on Initial Values of EMF versus Temperature tables in the Standard Specification and Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples, ANSI/ASTM E230/E230M.

33.1.8 For tests that are to be continued until constant temperatures are attained, thermal equilibrium is to be considered to exist only if three successive readings indicate no change when taken at the conclusion of each of three consecutive equal intervals of time, the duration of each interval being whichever of the following is longer:

a) 5 minutes; or

b) 10 percent of the total test time elapsed previous to the start of the first interval.

33.1.9 A thermocouple junction and adjacent thermocouple lead wire are to be securely held in good thermal contact with the surface of the material whose temperature is being measured. In most cases, good thermal contact will result from securely taping or cementing the thermocouple in place but, if a metal surface is involved, brazing, welding or soldering the thermocouple to the metal may be necessary.

33.1.10 To determine whether an appliance complies with the requirements in 33.1.1, the appliance is to be operated continuously until constant temperatures have been reached.

33.1.11 The test voltage is to be the highest of the following:

a) The marked voltage rating;

b) 120 V; or

c) The voltage that results in the appliance operating at rated wattage.

33.1.12 In conducting a test to determine whether or not an appliance complies with the temperature requirements, it is to be mounted or supported as in service and tested under conditions approximating those of normal operation, except as otherwise noted. Temperatures are to be observed on nearby surfaces, on the supporting surface, at points of support, on attachment plugs, and at other points as may be necessary.

33.1.13 A counter-top appliance is to be supported on two layers of white tissue paper on a softwood surface.

33.1.14 A counter-top appliance is to be tested in a test corner with the appliance located 4 inches (100 mm) away from the side and rear walls of the test corner. The 4-inch (100-mm) spacing is to be measured from the outer-most extremity of the appliance. The test corner is to consist of dull black-painted fir plywood not less than 3/8 inch (9.5 mm) thick, having such width and height that the walls extend not less than 2 ft (0.61 m) beyond the physical limits of the appliance. The vertical walls are to meet at a right angle.

Exception: An appliance such as a percolator with a relatively low surface temperature need not be tested in an alcove corner.

33.1.15 A cord-connected wall or under-cabinet mounted appliance is to be mounted on one wall or cabinet bottom of a test corner consisting of dull black-painted fir plywood not less than 3/8 inch (9.5 mm) thick, having such a width and height that the walls extend not less than 2 ft (0.61 m) beyond the physical limits of the appliance. The vertical walls are to meet at a right angle. Unless marked as described in 54.12, the appliance is to be placed as close to the corner wall as the construction will permit, and an under-cabinet appliance is to be in contact with the rear wall while a wall-mounted appliance is to be in contact with either the cabinet bottom or the counter, whichever results in the highest temperature. The cabinet bottom is to be 12 inches (300 mm) deep, located 16 inches (400 mm) above the counter top. The surface beneath the unit is to be softwood covered with a double layer of white tissue paper.

33.1.16 Thermocouples are to be mounted on wood surfaces using the method illustrated in Figure 33.2 or the equivalent. Starting in the corner, thermocouples are to be placed every 3 inches (76 mm) on each surface (Figure 33.3) so that a minimum area of 18 by 18 inches (460 by 460 mm) is covered by the thermocouples on each surface.

33.1.17 During the normal temperature test, a temperature-limiting device provided for overheating protection shall not operate.

33.1.18 An automatic temperature-regulating or -limiting control or other protective device provided as a part of an appliance is to be shunted out of the circuit, unless the device is suitable for the application as required by 49.2.1 and the control is unlikely to be defeated by the user.

Figure 33.1

Typical means of supporting coffee makers

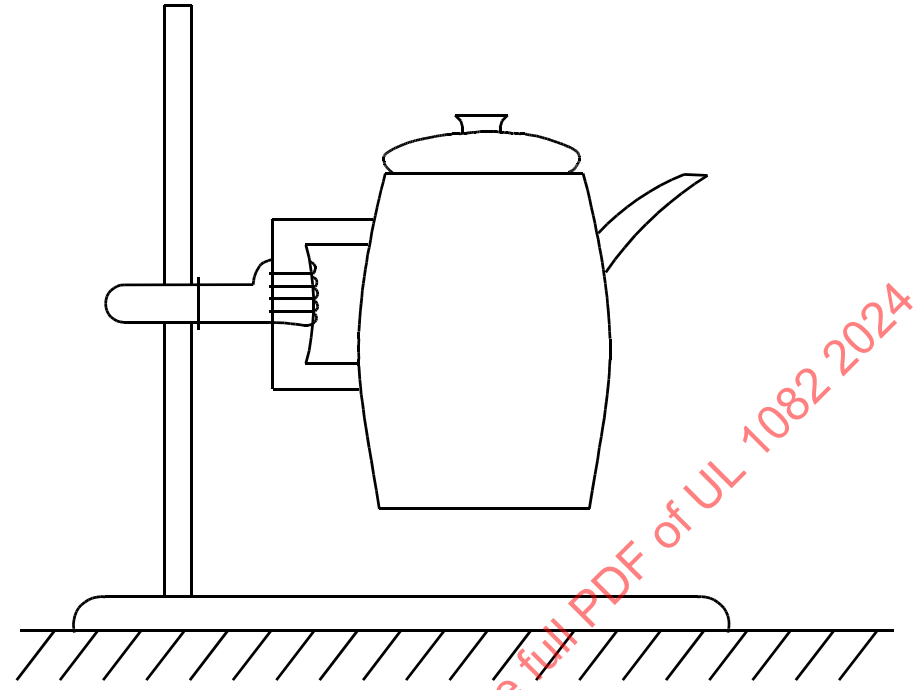


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Figure 33.2

Method of mounting thermocouples

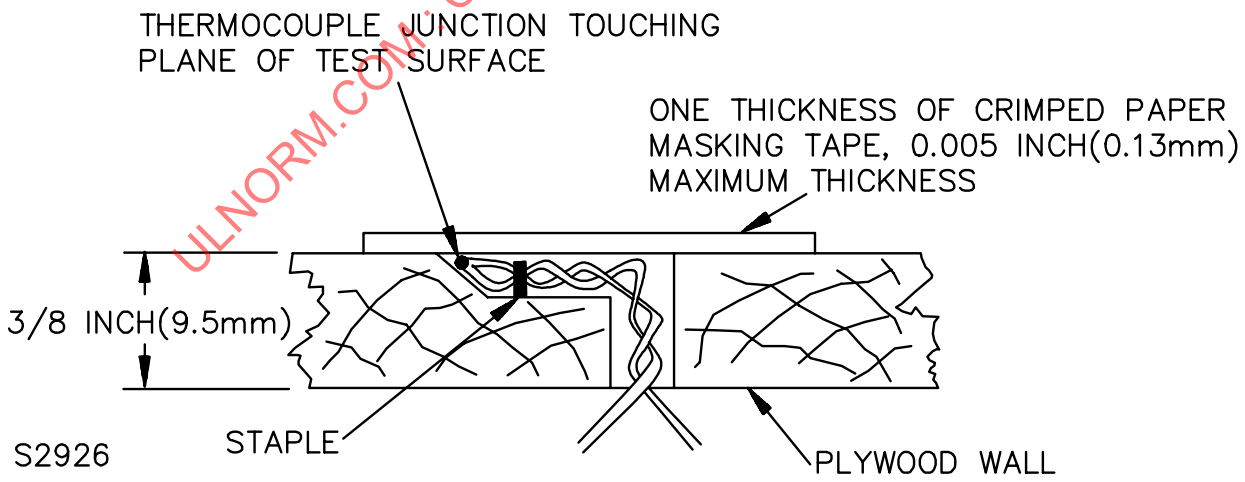

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Figure 33.3

Thermocouple spacings

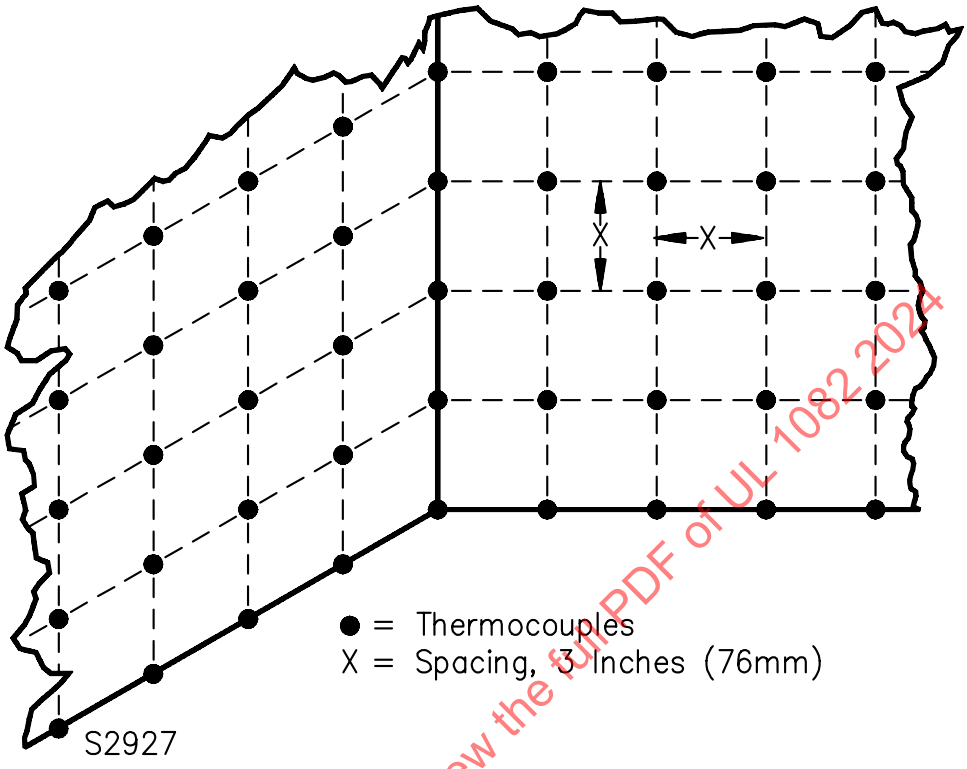
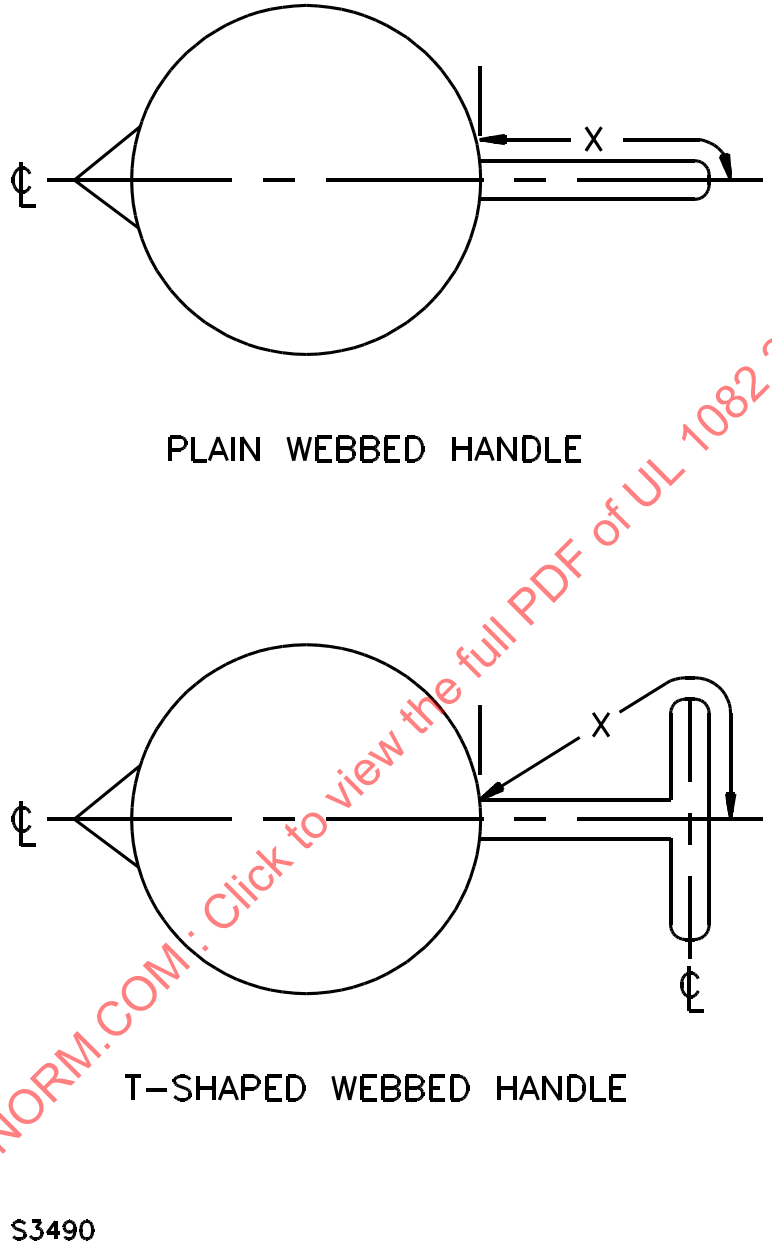


Figure 33.4

Appliance viewed from top



X = THE SHORTEST DISTANCE AROUND THE HANDLE FROM ITS POT END TO ITS CENTER LINE

33.1.19 If the construction of an appliance is such that cooking or heating of a liquid is a determining factor in the temperature attained, the intended duty of an appliance is to be taken into consideration. Accordingly, in determining whether an appliance complies with the requirements in 33.1.1, actual service conditions or an approximation thereof are to be employed. If the appliance is controlled by an adjustable thermostat, the thermostat is to be set to give maximum temperatures. If the appliance is controlled by a nonadjustable thermostat, it is to be allowed to operate at whatever temperature the thermostat permits. In each case, operation is to be continued until temperatures are stabilized.

33.1.20 With reference to Item 13 of Table 33.1, points likely to be contacted by hand or fingers include those points on the gripping surface, and adjacent surfaces close enough to be touched while supporting the appliance in the normal intended manner. See 33.1.21 – 33.1.24.

33.1.21 The length of the gripping surface of a handle is considered to be as follows:

a) Four inches (102 mm) for an open or D-shaped handle.

b) The entire handle for a webbed type handle.

33.1.22 Points on the surface of an appliance employing an open or D-shaped handle are not considered likely to be contacted if:

a) They are protected by a barrier not less than 5/8 inch (15.9 mm) wide on which the temperature rise does not exceed the value indicated in Item 13 of Table 33.1; or

b) A through-air spacing of not less than 1.5 inch (38 mm) at the index finger, tapering to 1.25 inch (32 mm) at the other end of the hand, is provided from the gripping surface to the hot part.

33.1.23 Points on the surface of an appliance employing a webbed type handle are not considered likely to be contacted if:

a) They are protected by a barrier extending not less than 1/2 inch (12.7 mm) on either side of the web on which the temperature rise does not exceed the value indicated in Item 13 of Table 33.1; or

b) The length "x" indicated in Figure 33.4 is not less than 4.25 inches.

33.1.24 If the temperature rise on a rivet or screw in a barrier or handle, which would be touched in the normal gripping or lifting action, exceeds the value given in Item 13 of Table 33.1, it is to be recessed at least half the diameter of the hole, and the hole is to be no larger than 3/8 inch (9.5 mm) in diameter.

33.1.25 To determine if the strength of a thermoplastic handle is adequate to maintain the minimum spacing to a hot surface mentioned in 33.1.22(b) or 33.1.23(b) while in a heated condition, the following test is to be conducted. The spacing is to be maintained after the vessel has been conditioned for one hour with water maintained at a temperature equal to the maximum temperature measured during the temperature test, including the "keep warm" cycle, or that temperature that occurs when a separate vessel is filled following a "brew" cycle. The spacing is to be measured while supporting the vessel with a 2 inch (51 mm) wide gripping area (centered over the intended gripping area) and after the vessel has been supported and maintained in a vertical position for one minute. See Figure 33.1.

33.1.26 For a vessel with a handle utilized to lift and tilt the vessel, the temperature of the liquid in the vessel shall be measured approximately 1 inch (25.4 mm) above the bottom of the vessel, near the center. See 41.7.2.

33.2 Specific test conditions

33.2.1 General

33.2.1.1 For most of the common types of heating appliances, standardized normal conditions for the temperature test are given in 33.2.2.1 – 33.2.4.1.

33.2.2 Vacuum-type coffee makers

33.2.2.1 The appliance is to be operated continuously, warming water in the intended decanters. As the water in the initial decanter reaches the temperature at which it is forced into the upper section of the coffee-maker, it is to be replaced by a fresh decanter of water at a temperature of 10 – 15°C (50 – 59°F).

33.2.3 Automatic type appliances

33.2.3.1 With the thermostat set in the position that results in maximum temperatures, the appliance is to be operated for 3 cycles. At the beginning of each cycle, the appliance is to be filled with the intended amount of water and the thermostat is to be set at the position which results in maximum temperature. The water temperature is not to be higher than room temperature. The cycle is considered as having ended when the thermostat automatically switches to the “low” or “off” position. The interval between cycles is to be approximately 30 seconds. Temperatures are to be measured throughout the 3 cycles, and also when the appliance has subsequently operated at low heat until temperatures have become stabilized.

Exception No. 1: A coffee maker having a capacity greater than 75 oz (2.22 L) is to be operated for one, rather than three brewing cycles.

Exception No. 2: Starting with cold water, a hot pot is to be operated for 30 minutes cooking 8 medium size eggs or the maximum number of eggs the appliance holds, whichever is less. Temperatures are to be monitored during the 30 minutes and the highest temperatures recorded.

33.2.4 Nonautomatic type appliances

33.2.4.1 The appliance is to be filled with the intended amount of water and operated until temperatures have become stabilized. Additional water is to be added during the test if the water level becomes lower than the half-full mark.

33.2.5 Capsule-type brewing appliances

33.2.5.1 With regard to 33.1.2, a transient temperature rise not exceeding the maximum temperature rise specified in Table 33.1 by more than 20 percent is acceptable.

33.2.5.2 A capsule-type coffee maker provided with a feature to keep water heated at the ready is to be operated in the pre-heat mode until temperatures stabilize. The initial water temperature is not to be greater than 40°C (104°F).

33.2.5.3 A capsule-type coffee maker is to be operated for a minimum of 5 cycles of actual brewing. After 5 cycles, the test may be discontinued when temperatures stabilize, or a total of 250 oz has been brewed, whichever occurs first. The cycles are to be accomplished back to back, with only the time that is required to add water (if the water level in the reservoir is below the minimum fill line), and the time to exchange the capsule. Water added to the reservoir is not to be greater than 40°C (104°F). The cycle is considered as having ended when all brewed material is delivered to the container.

33.2.5.4 Temperatures are to be measured throughout the necessary cycles, and also when a capsule-type coffee maker has subsequently operated at low heat, when a "keep warm" mode is provided, until temperatures have become stabilized. If a separate switch is provided to de-energize the brewing element or warming element, it is to be left in the on position for all phases of the test. During operation of the capsule-type coffee maker in the low-heat mode, temperatures are to be measured under the following conditions in the sequence given below:

a) Container full, resting on warmer surface.

b) Container empty, resting on warmer surface.

c) Container removed.

33.2.5.5 The capsule-type coffee maker is also to be tested in accordance with any operating procedure recommended in the manufacturer's instructions that could result in temperatures higher than those attained while conducting the test described in 33.2.5.2.

33.2.5.6 A counter-top capsule-type coffee maker is to be supported on a softwood surface painted flat black.

33.2.5.7 If the capsule coffee maker utilizes a mechanism to keep the water reservoir heated or keeps the brewed material heated, the temperature of a regulating thermostat's sensing surface shall not exceed its Maximum Normal Use Temperature Rating, T_{max}, as defined in SA2.2 during normal operation of the coffee maker.

33.2.5.8 If the capsule coffee maker utilizes a mechanism to keep the water reservoir heated or keeps the brewed material heated, the sensing surface of a thermal cutoff as defined in 22C.3.1(a) shall not exceed 90 percent of its established T_{H-100} temperature (stated in degrees celsius) during normal operation of the coffee maker.

33.2.5.9 To determine compliance with 33.2.5.7, thermocouples are to be secured at the periphery of the regulating thermostat's sensing surface that is in contact with the part being sensed. Temperatures are to be measured during the normal operation tests described in 33.2.5.3 and 33.2.5.4.

33.2.5.10 To determine compliance with 33.2.5.8 and 22C.3.1(b)(2) and 22C.3.1(b)(3), thermocouples are to be secured at the midpoint of the longitudinal axis of the thermal cutoff body, or at the end of the thermal cutoff body which does not contain the insulator cone, at any point along its circumference. In addition, to determine compliance with 22C.3.1(b)(2) and 22C.3.1(b)(3), a thermocouple is to be secured on the stationary contact lead of the thermal cutoff approximately 0.04 inches (1 mm) from the tip of the insulator cone. Temperatures are to be measured during the steady state condition of the keep warm stages (carafe full, carafe empty, no carafe) of the normal operation test described in 33.2.5.3 and 33.2.5.4.

34 Leakage Current as a Result of Moisture Tests

34.1 An appliance employing insulation material liable to be affected adversely by moisture under condition of normal use shall be conditioned for 48 hours in moist air having a relative humidity of 88 ±2 percent at a temperature of 32.0 ±2.0°C (89.6 ±3.6°F). After the conditioning, the appliance shall comply with the requirement in 31.1 in a repeat leakage current test, except that the test shall be discontinued when leakage current stabilizes.

34.2 An additional sample of the appliance shall be tested as follows, if glass fiber sleeving is used as electrical insulation in a rope heater assembly. The appliance is to be operated for 96 continuous hours under the condition resulting in the maximum temperature on the sleeving, as determined from the normal temperature test, following which it shall be conditioned for 48 hours in moist air having a relative humidity

of 88 ±2 percent at a temperature of 32.0 ±2.0°C (89.6 ±3.6°F). After the conditioning, the appliance shall comply with the requirement in 31.1 in a repeat leakage test, except that the test shall be discontinued when the leakage current stabilizes. Following the leakage current test, the appliance shall also comply with the dielectric voltage-withstand test requirement of 35.1.

34.3 An appliance which is likely to be immersed in water for cleaning shall show a leakage current of no more than 0.5 mA and shall be capable of withstanding a potential of 1000 V when tested in accordance with 34.4 – 34.8. The test shall not result in the entrance of water into the interior of the appliance such that the water might come into contact with uninsulated live parts.

Exception: This test does not apply to an appliance marked to indicate that it is not intended for immersion. See 54.9.

34.4 Three samples of the appliance are to be heated as described in 34.6 and are then to be immersed immediately in water at a temperature of 10 – 25°C (50 – 77°F). The immersion is to be complete unless the appliance is marked to indicate that it is intended for partial immersion only (see 54.9), in which case each appliance is to be immersed only to the extent indicated. After 1 hour of immersion, the samples are to be removed from the water, dried with a soft cloth to remove all surface moisture, including surface moisture from terminal pins, and the samples are to be tested for leakage current.

34.5 The entire procedure of immersion and leakage current measurement is to be repeated four times, immediately following which each sample is to be subjected to a 1000-V dielectric voltage-withstand test as described in 35.1. The three samples are to be used for aging tests, and are required to comply with the requirements in 33.1.4 – 33.1.6. If there is an air cavity having electrical components, the three samples are to be disassembled and the internal parts visually examined for the presence of water. (See 34.3 and Table 34.1).

Table 34.1
Immersion tests

All cooking appliances likely to be immersed				Automatic coffee makers only	
	Sample No. 1	**Sample No. 2**	**Sample No. 3**	**Sample No. 4**	**Sample No. 5**
First 5 Cycle	Conditionings for Tests Automatic coffee maker – initially filled and emptied after thermostat operates – immerse at maximum seal temperature Other than coffee maker – initially filled and through-out conditioning Immerse one hour Dry with cloth Leakage current test			Heat from dry start Immerse for one hour Leakage current test High-potential test	

Table 34.1 Continued on Next Page

Table 34.1 Continued

All cooking appliances likely to be immersed				Automatic coffee makers only	
	Sample No. 1	Sample No. 2	Sample No. 3	Sample No. 4	Sample No. 5
After 5th Cycles	High-potential test Operate 240 hours Cool to room temperature Reheat as for normal temperature test Immerse for one hour Leakage current test High-potential test				
Note: If there is an air cavity housing electrical components in the appliance, disassemble and examine for water. (Samples No. 4 and No. 5 may be used to determine seal temperature.)					

34.6 A nonautomatic coffee maker is to be operated as described in 33.2.4.1. An automatic coffee maker is to be heated in accordance with 34.9.

34.7 Two additional samples of an automatic coffee maker, initially at room temperature, are to be operated dry until the thermostat automatically switches to the “low” or “off” position, and are then to be immersed immediately in water at a temperature of 10 – 25°C (50 – 77°F). After 1 hour of immersion, the leakage current of each of the two samples is to be measured, and each sample is to be subjected to a 1000-V dielectric voltage-withstand test as described in 35.1. If there is an air cavity having electrical components, both samples are to be disassembled and the internal parts visually examined for the presence of water (see 34.3).

34.8 One of the samples tested in accordance with 34.7 (or an additional sample, if necessary) is to be reassembled, filled with the intended amount of water, and operated with the thermostat at the maximum setting until the temperature of a gasket or seal becomes stabilized. The temperature of the gasket or seal is to be noted when the thermostat automatically switches to the “low” or “off” position. Without disconnecting the appliance from the supply circuit, the utensil is to be emptied and operation without water continued until the temperature of the gasket or seal again becomes stabilized.

34.9 The three samples to be used for the tests described in 34.4 and 34.5 are to be operated, as described in 34.8, to the point at which the maximum temperature was observed.

35 Dielectric Voltage-Withstand Test

35.1 An appliance shall be capable of withstanding for 1 minute without an indication of unacceptable performance, the application of a potential applied between live parts and accessible metal parts. The appliance is to be at its maximum normal operating temperature. The test potential shall be 1000 V.

35.2 With respect to 35.1, an appliance having an enclosure constructed partly or totally of insulating material is to have accessible surfaces of the material closely wrapped in metal foil. The test potential is to be applied between live parts and the foil.

35.3 With respect to 35.1 and 35.2, a part is considered to be accessible if it can be contacted by the probe illustrated in Figure 7.2 when applied in all possible articulated positions, with and without the parts referenced in 7.13 in place.

35.4 To determine whether an appliance complies with the requirements in 35.1, the test potential is to be applied as described in 35.6, by means of test equipment having the characteristics specified in 35.5.

35.5 The test equipment for conducting the dielectric voltage-withstand test is to have the following features and characteristics:

a) A means for indicating the test voltage that is being applied to the appliance under test. This may be accomplished by sensing the voltage at the test leads or by an equivalent means.

b) An output voltage that:

1) Has a sinusoidal waveform;

2) Has a frequency that is within the range of 40 – 70 Hz; and

3) Has a peak value of the waveform that is not less than 1.3 and not more than 1.5 times the root-mean-square value.

c) A sensitivity of the test equipment that is such that when a resistor of 120,000 ohms is connected across the output, the test equipment does not indicate unacceptable performance for any output voltage less than the specified test voltage, and the test equipment does indicate unacceptable performance for any output voltage equal to or greater than the specified test value. The resistance of the calibrating resistor is to be adjusted as close to 120,000 ohms as instrument accuracy can provide, but never more than 120,000 ohms.

Exception: The sensitivity of the test equipment may be increased, a higher value of calibrating resistance may be used, if agreeable to those concerned.

35.6 The method of applying the test voltage to the appliance is to be such that there are not any transient voltages that result in the instantaneous voltage applied to the appliance exceeding 105 percent of the peak value of the specified test voltage. The applied potential is to be increased from zero at a substantially uniform rate so as to arrive at the specified test potential in approximately 5 seconds, and then is to be maintained at the test potential for one minute. Manual control of the rate of rise may be used.

36 Broken Element Test

36.1 An open-wire heating element in an appliance shall be constructed and supported so that if the wire is cut at any point there shall be no reduction of electrical spacings below the limits specified in this standard. After being cut, no portion of the heating element wire shall be accessible to contact by the articulate probe through any opening in the enclosure.

36.2 To determine compliance with 36.1:

a) The appliance is first to have been operated until fully heated as in the Power Input or Temperature Tests; and

b) After cutting the heating element, the appliance is to be rotated 360° in the direction most likely to cause contact between the heating element and accessible metal parts.

37 Strain Relief Test

37.1 The strain-relief means provided on an attached flexible cord, when tested in accordance with 37.2, shall be capable of withstanding for 1 minute, without displacement, a pull of 35 lbf (156 N) applied to the cord, with the connections within the appliance disconnected.

37.2 The specified force is to be applied to the cord and so supported by the appliance that the strain-relief means is stressed from any angle that the construction of the appliance permits. The strain relief is not acceptable if, at the point of disconnection of the conductors, there is sufficient movement of the cord to indicate that stress on the connections has resulted.

38 Push-Back Relief Test

38.1 To determine compliance with 11.2.3, a product shall be tested in accordance with 38.2 without occurrence of any of the following conditions:

a) Subjecting the supply cord or lead to mechanical damage;

b) Exposing the supply cord or lead to a temperature higher than that for which it is rated;

c) Reducing spacings (such as to a metal strain-relief clamp) below the minimum required values; or

d) Damaging internal connections or components.

38.2 The supply cord or lead is to be held 1 inch (25.4 mm) from the point where the cord emerges from the product and is then to be pushed back into the product. The cord or lead is to be pushed back into the product in 1 inch (25.4 mm) increments until the cord buckles or the force to push the cord into the product exceeds 6 pounds-force (26.7 N). The supply cord or lead within the product is to be manipulated to determine compliance with 11.2.3.

39 Metal Enclosure Impact Tests

39.1 A metal enclosure part shall comply with the tests specified in 39.2 – 39.5. For polymeric enclosure parts, see the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

39.2 A metal enclosure part shall withstand the ball impact, with the appliance restrained, as described in 39.3 without occurrence of any one of the following conditions:

a) Making live parts accessible to contact with the articulate probe, see 7.11 and 7.12.

b) Producing any other condition that results in damage of the enclosure so as to adversely affect the function of any safety or constructional feature, such as thermostats, overload-protective devices or strain relief.

c) Producing other conditions so that the appliance does not comply with the dielectric voltage-withstand requirements in Dielectric Voltage-Withstand Test, Section 35, after being subjected to the impact.

39.3 Each of three samples of the appliance is to be subjected to one impact. This impact is to be imparted by dropping or swinging a 2-inch (50.8-mm) diameter steel sphere, weighing 1.18 lbf (0.535 kg) from a height that will produce an impact of 1.5 ft-lbf (2.03 J). The sample is to be rigidly supported and the impact is to be made perpendicular to the most vulnerable spots on the appliance enclosure that are exposed to a blow during intended use. A different spot on the enclosure is to be selected for each impact. See Figure 39.2 with respect to the ball drop impact test and Figure 39.3 for the ball pendulum impact test.

Exception: If the manufacturer elects, fewer than three samples may be used for the test in accordance with Figure 39.1, wherein each series consists of one impact. The overall performance is acceptable upon completion of any one of the procedures represented in Figure 39.1.

Figure 39.1

Procedure for impact test

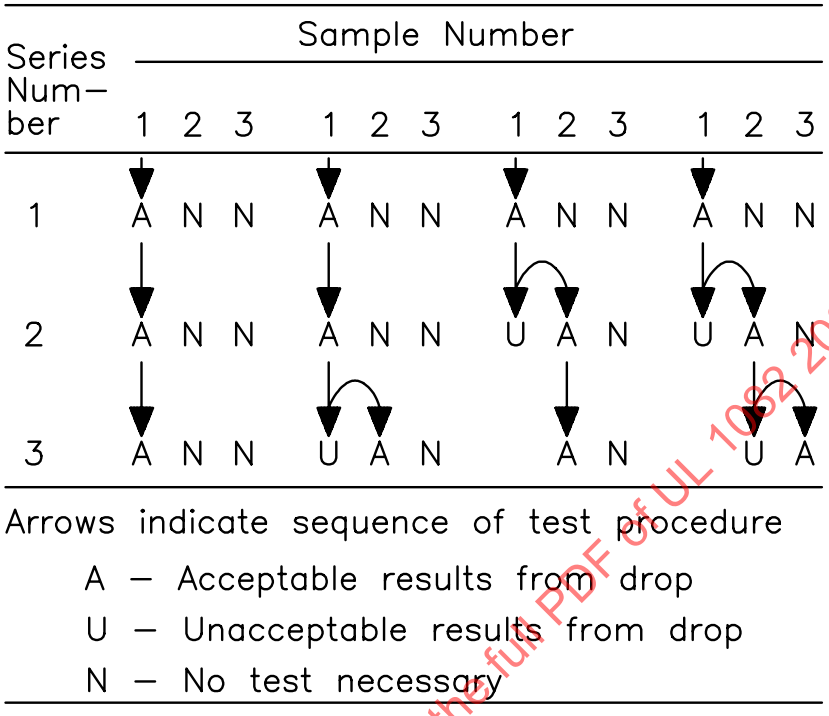


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Figure 39.2

Ball drop impact test

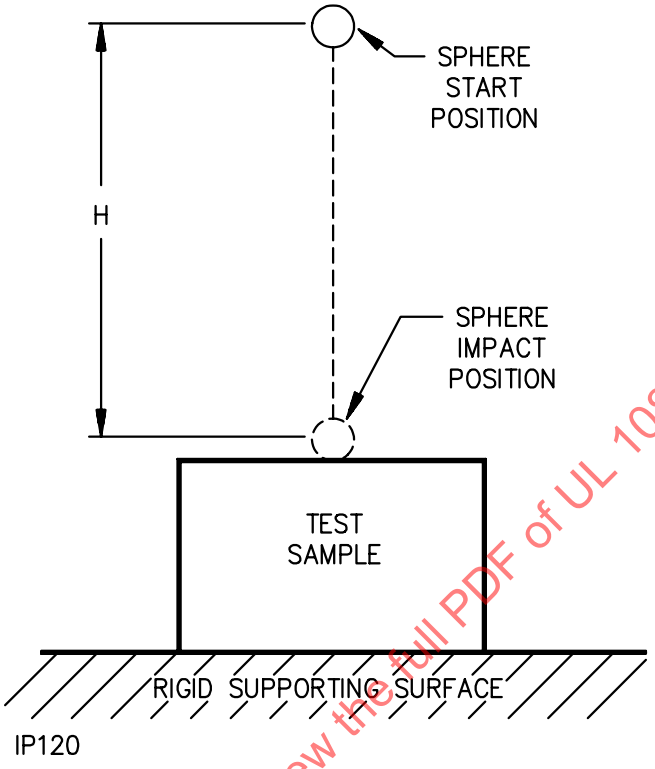
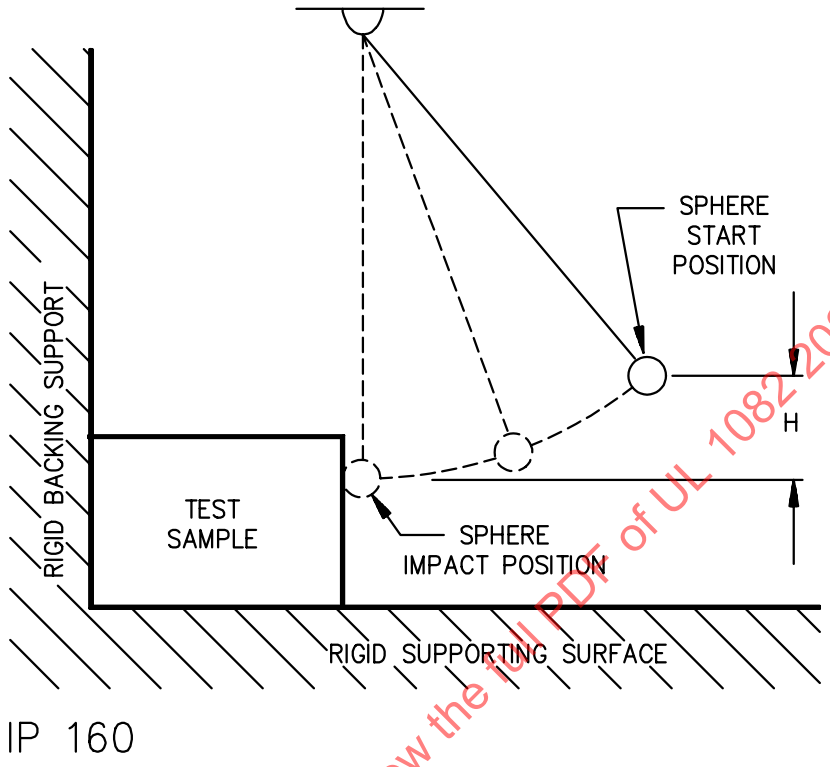


Figure 39.3

Ball pendulum impact test



39.4 With reference to Figure 39.2 and Figure 39.3, the "H" designation represents the vertical distance the sphere must travel to produce the desired impact. For the pendulum impact, the sphere is to contact the test sample when the string is in the vertical position. The supporting surface is to be as described in 39.5. The backing surface for the pendulum impact is to consist of 3/4-inch (18 mm) plywood over a rigid surface of concrete or an equivalent nonresilient backing surface may be used.

39.5 The supporting surface mentioned in 39.4 is to consist of a layer of tongue-and-groove oak flooring mounted on two layers of 3/4-inch (18-mm) thick plywood. The oak flooring is to be 3/4- by 2-1/4-inch (18- by 57-mm). The assembly is to rest on a concrete floor or an equivalent nonresilient surface.

40 Thermal Degradation

40.1 A thermoset material used for a part of an appliance where risk of fire, electric shock, or injury to persons is involved shall be resistant to thermal degradation at the maximum temperature to which it is exposed during normal use of the appliance. The thermal-aging characteristics of the material may be investigated by any one of the following procedures:

a) The material shall have a temperature index, based on historical data or a long term thermal aging program, described in the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B, which indicates acceptability for use at the temperature involved; or

b) The product shall be operated with the input voltage adjusted so that the part in question operates at the maximum temperature obtained during the normal temperature test. The test is to be conducted with all temperature controls by-passed for a period of 1000 hours. There shall be no visible degradation of parts at the conclusion of the 1000 hours.

41 Handle Securement Tests

41.1 General

41.1.1 A handle assembly shall not deteriorate so as to increase the risk of potential injury as a result of being subjected to the test described in 41.2.1 – 41.6.3. Three samples are to be subjected to each test unless otherwise specified in accordance with Figure 41.4.

41.1.2 A handle shall not break, loosen, crack, or be rendered incapable of supporting the vessel, or expose live parts as a result of the tests in 41.7.1, and 41.7.2. Three previously untested samples shall be subjected to the test.

41.2 Oven conditioning

41.2.1 Prior to conducting any of the tests in this Section, three samples of a vessel and handle assembly incorporating thermoplastic parts shall be conditioned in a full-draft circulating-air oven maintained at the maximum handle temperature recorded during the normal temperature test or the maximum handle temperature reached on a nonheated vessel within 5 minutes after it is filled following the brew cycle. The samples are to remain in the oven for 168 hours. Following the conditioning and after the samples have cooled to room temperature, the samples are to be tested in accordance with 41.3.1 – 41.6.3.

41.2.2 If the temperature of the handle assembly exceeds the maximum assigned temperature rating of the material during the normal temperature test, the test in 41.2.3 is to be conducted in lieu of the test in 41.2.1.

41.2.3 Three vessels with handle assemblies are to be placed in a full-draft circulating-air oven for a period of 240 hours maintained at the maximum temperature recorded on the handle during the Normal Temperature Test or at the maximum temperature reached on a non-heated vessel within five minutes after it is filled following the brew cycle. During this time period, the vessels are to be removed from the oven and allowed to cool for five separate one-hour periods, at intervals not less than 24 hours. The 240-hour period is actual in-oven time and does not include the cool down periods. During each of the cool down periods, the vessels are to be supported by the handle assembly in the intended manner while loaded with No. 7 or No. 7-1/2 shot having a weight of the maximum intended capacity of water. Following the conditioning and after the vessels have cooled to room temperature, the vessels are to be tested in accordance with 41.3.1 – 41.6.3.

41.3 Dishwashing

41.3.1 Following the test of 41.2.1, an immersible vessel incorporating thermoplastic parts shall be conditioned as follows to simulate dishwasher cleaning. It shall be immersed in a commercially available dishwasher detergent solution using 25 g/L of water for 1 hour at 150°F. Following this, it is to be removed, kept at room temperature for 1 hour, oven aged at 160°F for 1 hour, and then cooled to room temperature for 1 hour.

41.4 Flexing test

41.4.1 The three samples of the vessel are to be supported in the intended manner by the handle assembly while loaded with a mixture of water and gelatin having a weight equivalent to its maximum intended capacity of water. The test load is to be distributed such that the normal center of gravity is not changed. The handle assemblies are then to be flexed for 12,000 cycles in the normal plane of pouring, forward 45 degrees from the vertical and backwards 45 degrees from the vertical. Each cycle consists of tipping the vessel forward 45 degrees, back to the vertical position, then back 45 degrees and then forward to the vertical position. Following the above, the test is to be repeated for an additional 12,000

cycles with the flexing being performed from side to side, that is, 45 degrees to the left and 45 degrees to the right of the normal vertical position. The cycle rate is to be 6 – 8 cycles per minute.

41.5 Static load

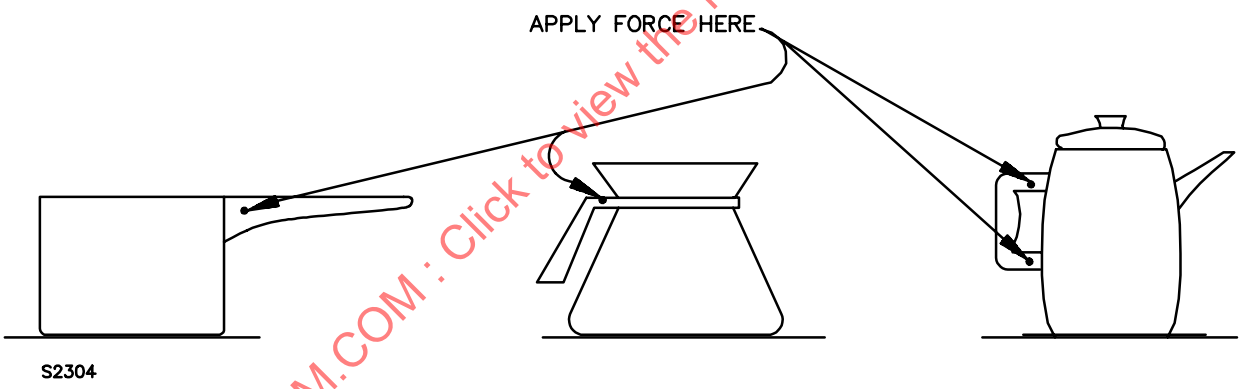
41.5.1 Each vessel is then to be supported for 1 minute in the intended manner by the handle assembly while loaded with a mixture of silica sand and water (80/20 percent by weight) having a weight equivalent to two times the weight of the maximum intended capacity of water. The lid is to be in place, but is not to be considered as part of the test weight. The test weight is to be distributed so that the normal center of gravity is not changed. The handle is to be gripped over a 2- to 4-inch (51- to 102-mm) wide gripping area (centered over the intended gripping area) for these tests.

41.6 Static force

41.6.1 A force equal to two times the force exerted by the maximum intended capacity of water is to be applied for 1 minute to the handle at an angle perpendicular to the side of the handle and parallel to the bottom of the vessel at a point as close to the point of securement as possible. The vessel is to be prevented from rotating while the force is applied. The force is to be applied with a 1/2 inch (12.7 mm) diameter rod terminating in a hemispherical end. See Figure 41.1.

Figure 41.1

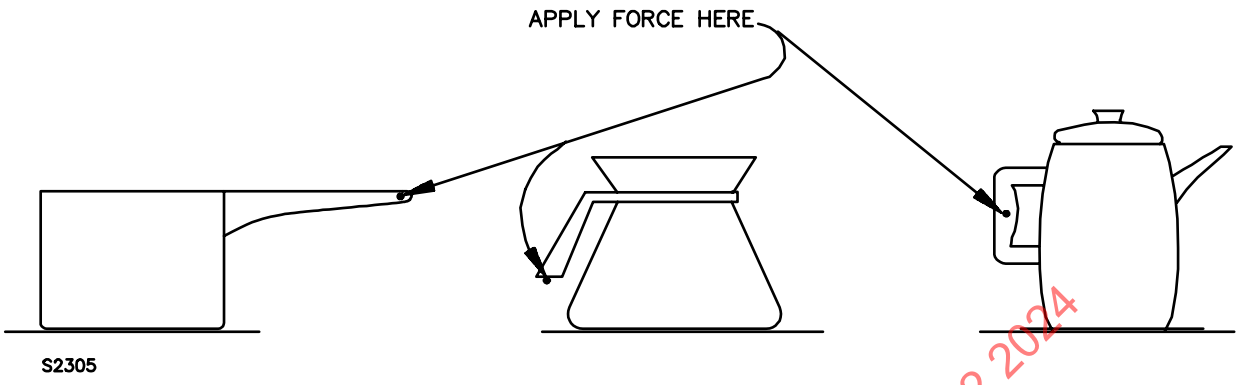
Static force application near points of securement



41.6.2 The test indicated in 41.6.1 is to be repeated with the force being applied in the same manner except that the point of application shall be such that the greatest torque is at the point of securement, or at two securement points for a "D" handle, see Figure 41.2.

Figure 41.2

Static force application points for torque



41.6.3 A force equal to two times the force exerted by the maximum intended capacity of water is to be applied for 1 minute at the farthest extremity of the handle in a horizontal direction first pulling away from the vessel, and then repeated pushing toward the vessel. The vessel is held for each test. See Figure 41.3.

Exception: For a horizontal handle, the force is to be applied by first pulling up on the handle and then repeated, pushing down on the handle.

Figure 41.3

Pulling and pushing force application points

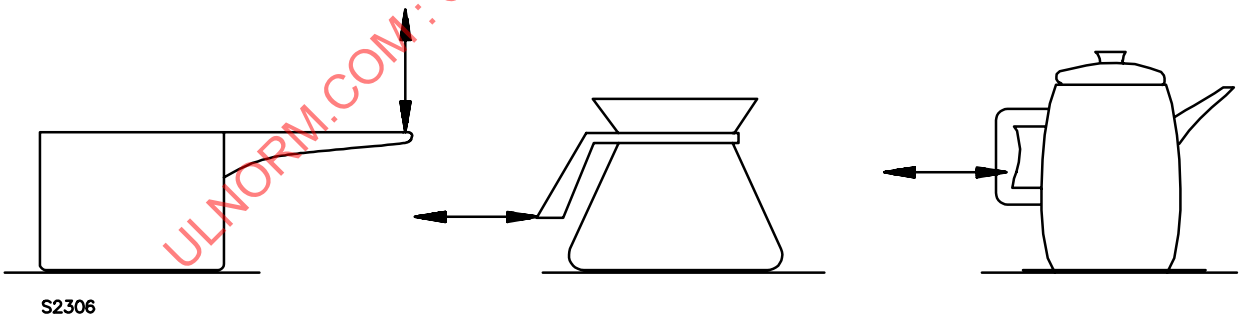
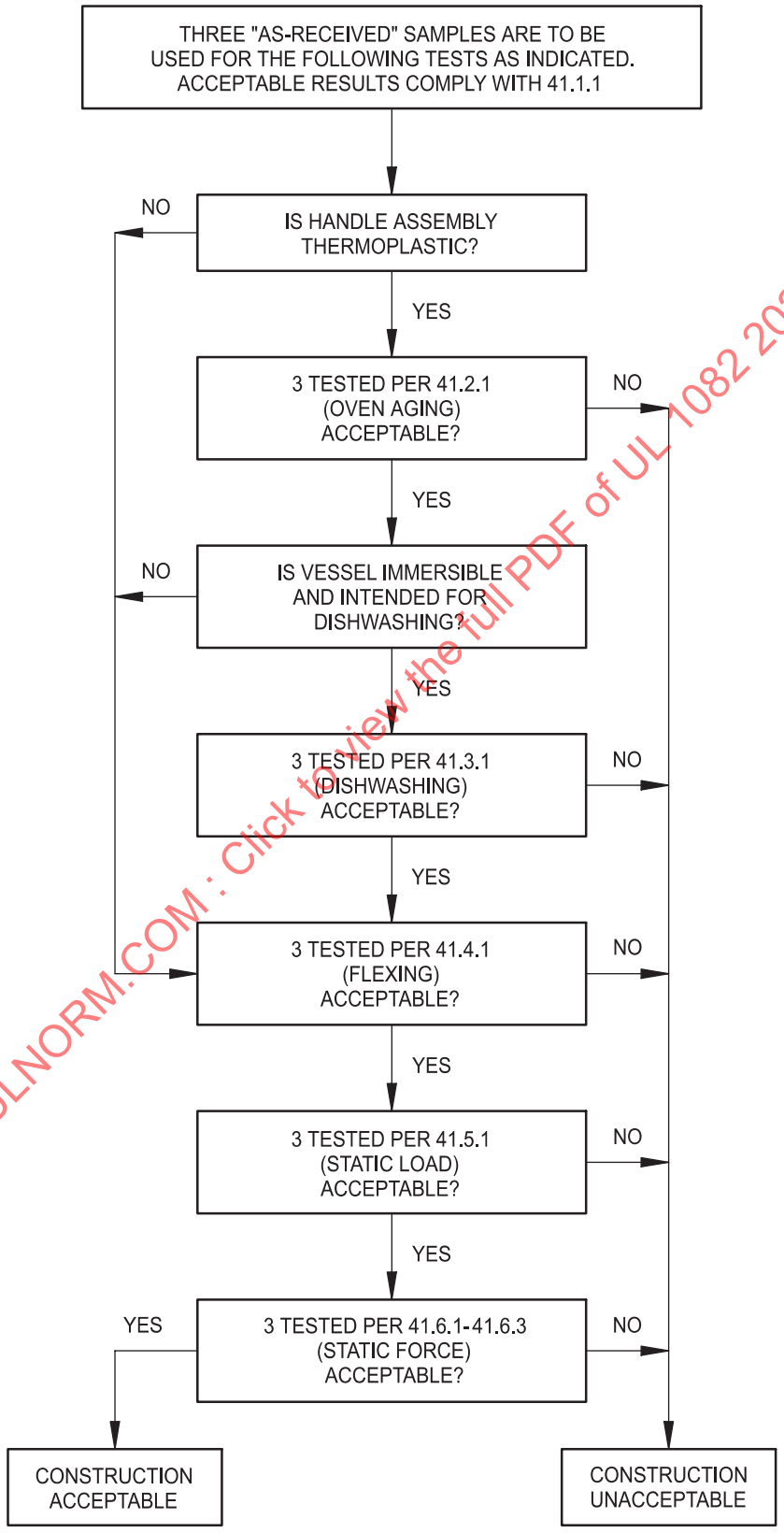


Figure 41.4

Handle strength test procedure



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41.7 Dynamic load

41.7.1 Each vessel is to be loaded with water and a weight (such as ball shot) distributed evenly across the bottom of the vessel. The load shall be equivalent to two times the weight of the maximum intended capacity of water. The lid is to be in place, but is not to be included when calculating the test weight. The water level shall be between 0.25 inch (6.35 mm) and 1 inch (25.4 mm) from the vessel rim. If the water level is reduced due to splashing or evaporation, the vessel shall be refilled to the original level.

41.7.2 The water shall be heated and maintained at the maximum liquid temperature recorded during the normal temperature test, ±4°F (±2°C), or 194°F (90°C), whichever is lower. See 33.1.26. If an additional heater is used to heat the water, and is supported by the handle, the heater weight should be included as part of the test weight.

41.7.3 The weighted vessel is to be mounted to a test fixture such that the handle is held over a 2- to 4-inch (51- to 102-mm) wide gripping area and held such that the bottom of the vessel is horizontal. Due to limitations of handle design, a smaller width gripping area may be used. The test fixture shall provide a dynamic load upon the handle by lifting the vessel for a total of 10,000 cycles. Each cycle shall consist of lifting the vessel with weight, to a height of 0.50 inches (12.7 mm) in no more than 0.75 seconds of time, holding the vessel at this height for at least 3 seconds, and then returning to the original position.

42 Under-Cabinet and Wall Mounted Appliances-Impact Test

42.1 The impact test of 42.2 shall be conducted on all under-cabinet and wall mounted appliances without occurrence of any of the following conditions:

a) Making live parts accessible to contact with the articulate probe, see 7.10 and 7.11.

b) Producing any other condition that results in damage of the enclosure so as to adversely affect the function of any safety or constructional feature, such as thermostats, overload-protective devices or strain relief.

c) Producing other conditions so that the appliance does not comply with the dielectric voltage-withstand requirements in Dielectric Voltage-Withstand Test, Section 35, after being subjected to the impact.

d) Dislodging of the appliance or separable parts of the appliance.

42.2 A 1.5 ft-lbf (2.03 J) impact is to be performed on all exposed sections of the enclosure, while the unit is installed under a cabinet or on a wall. Each of three samples is to be subjected to one impact on each surface. The impact is to be imparted by swinging a 2-inch (50.8 mm) diameter steel sphere, weighing 1.18 lb (0.535 kg) from a height that will produce an impact of 1.5 ft-lbf (2.03 J).

Exception: This test does not apply to glass surfaces.

43 Loading Test

43.1 A loading test is to be performed on the mounting brackets of an under-cabinet or wall mounted appliance with the appliance mounted in accordance with the manufacturer's installation instructions, using the hardware and construction as described. A bracket shall not break, loosen, or pull out of the wall nor shall any portion of the unit attached to the mounting means be adversely affected as a result of this test.

43.2 The test load is to consist of the weight of the appliance plus three times the maximum normal load (food load, water, grounds, basket, and the like, based on cavity size and maximum recipe book weight recommendations). A gradually increasing force is to be applied to act vertically through the center of the

gravity of the unit. The force is to be increased in a 5 to 10 second interval until the test load is applied to the mounting system and is to be sustained for a period of 1 minute. For this test, an under-cabinet unit is to be mounted on a wood board with a minimum thickness as specified by the manufacturer and a wall unit is to be mounted on 3/8 inch (4.8 mm) thick wall board.

43.3 If the mounting brackets are constructed of a thermoplastic material, they are to be conditioned for 7 hours in an air circulating oven maintained at 70°C (158°F) or 10°C (18°F) higher than that measured during the normal temperature test, whichever is higher, prior to performing the loading test.

44 Stability Test

44.1 To determine compliance with 26.4, the appliance is to be placed on a plane inclined at an angle of 15 degrees to the horizontal. The appliance is to be positioned and loaded with whatever combination of separable components, liquid, saturated grounds, or other media (material) that results in the maximum tendency to overturn under conditions of normal use. Saturated grounds are to be obtained from a normal brewing cycle. The appliance is to contain a minimum of 5 oz (148 mL) of liquid. The volume of liquid in the unit is to be increased from the minimum 5 oz (148 mL) of liquid in the reservoir to its full capacity, as marked on the unit or then as indicated in the user manual. The appliance shall reduce the risk of sliding on the inclined surface. The appliance shall not overturn as a result of this test.

45 Tip Over Test

45.1 To determine compliance with 26.6 or 26.8, a total of three samples are to be tested and each sample is to be tested three times. Each sample of the appliance, while in the well-heated condition, is to be placed on a horizontal surface of laminated thermosetting counter-top-type material. The appliances are to be oriented in a position that is likely to occur in normal use, and are to contain whatever combination of separable components, liquid, saturated grounds, or other media that results in the most adverse condition for this test. The sample is then to be tilted such that, when released from its critical angle of balance, it will tip over due only to the force of gravity (that is, free fall). For the first test, the volume of liquid in the unit is to be at its full capacity, as marked on the unit or then as indicated in the user manual. Each unit is to be subjected to two additional tipovers without refilling or adjusting the lid.

45.2 Compliance with the tip over test, described in 45.1, shall be determined based on the following results:

a) The lid, if provided, shall stay in place;

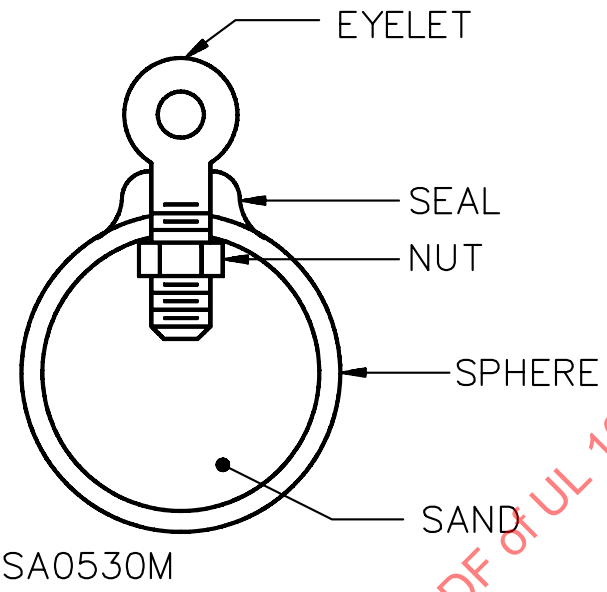
b) The average rate of liquid emitted during the first 5 seconds from the appliance during any tip over shall not be more than 4-1/2 oz (133 mL)/s. The average of the average rates of liquid emitted for all tip overs shall not be more than 3-1/2 oz (104 mL)/s. The rate shall be computed by using the time period of 5 seconds.

46 Dynamic Stability Test

46.1 To determine compliance with Exception No. 2 to 26.8, an appliance, container, and the like is to be subjected to the impact of 0.75 ft-lbf (1.02 N·m) on a horizontal surface consisting of laminated thermosetting counter-top-type material adhered to a wood base surface rigidly fixed for the intended use. A 1/8-inch (3.2-mm) thick (uncompressed) polyurethane foam material, such as that used for packing, is to be placed under the bottom of the appliance to prevent sliding. The appliance is to be positioned and loaded to full capacity with the combination of materials specified in 44.1. If a lid is provided, it is to be placed on the appliance in the intended manner. A sphere, illustrated in Figure 46.1, is to be suspended from a cord and allowed to swing as a pendulum in such a manner as to strike the appliance with an impact of 0.75 ft-lbf (1.02 N·m) at a point most likely to cause tip-over. See Figure 46.2 and Figure 46.3.

Figure 46.1

Ball for dynamic stability test



Eyelet – 1-1/2 inches (38 mm) long No. 10, steel

Seal – Silicone rubber

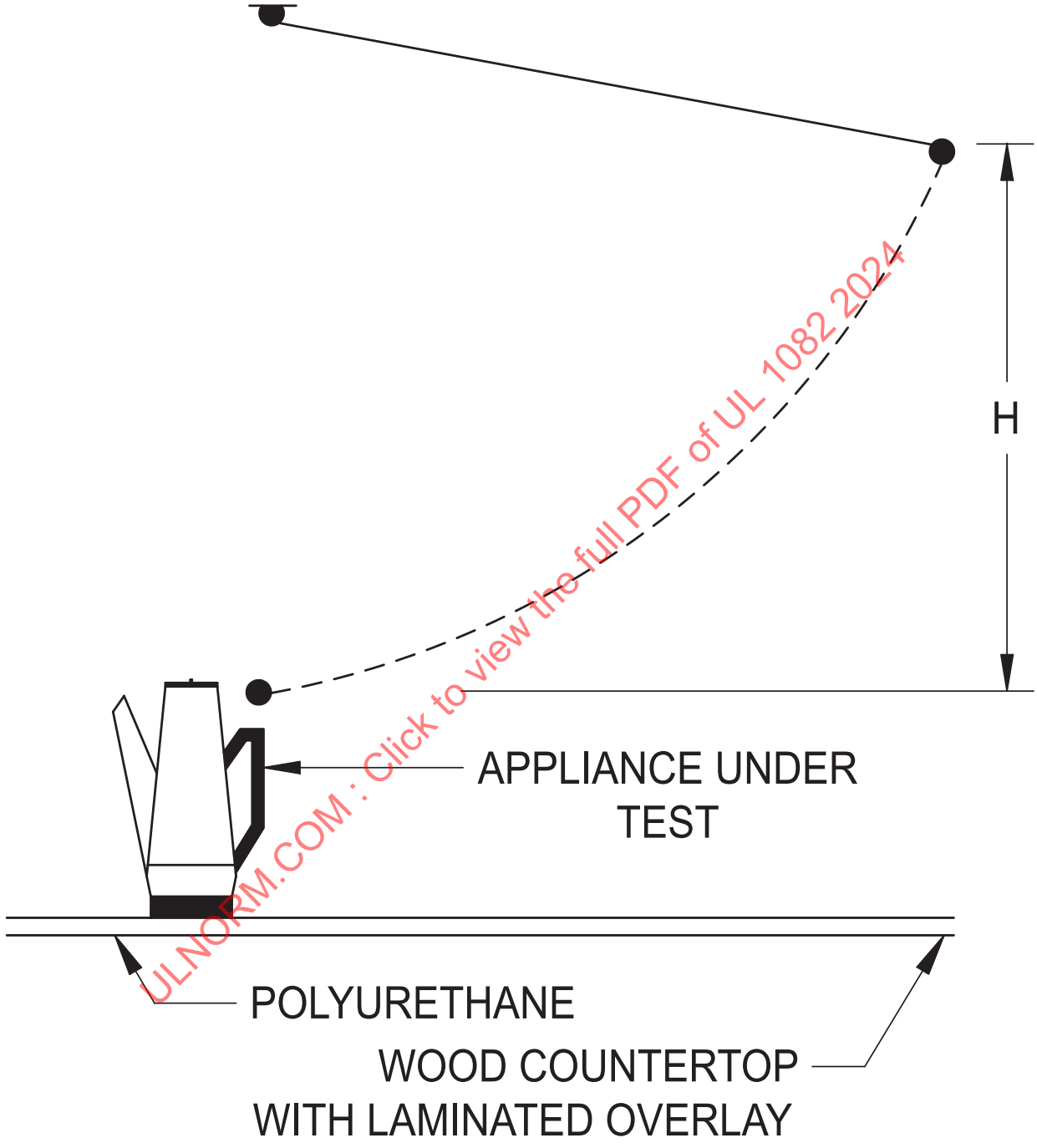
Sphere – Natural rubber or neoprene. Hollow with 1/32 – 3/32 inch (0.8 – 2.4 mm) thick wall. 2-1/8 – 2-3/8 inch (54 – 60 mm) diameter.

Sand – No. 60 core

Total Weight – 0.30 – 0.36 pounds (136.1 – 163.3 g)

Figure 46.2

Dynamic stability test

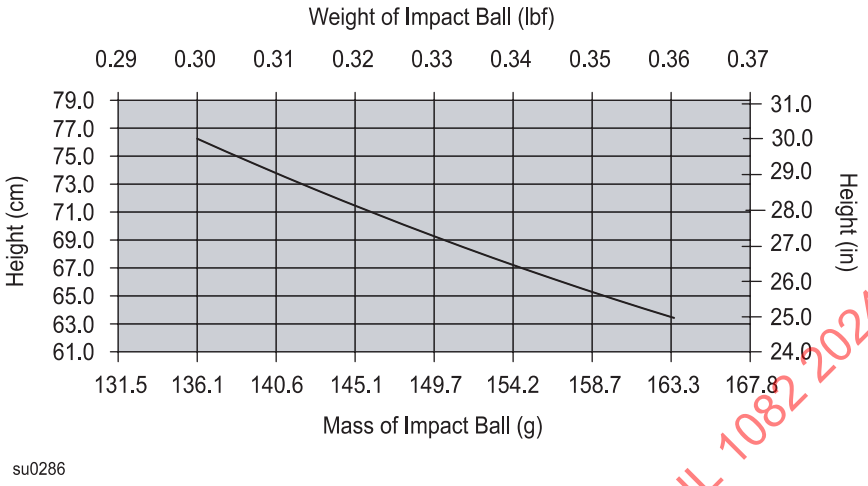


1) The point at which the sphere impacts the appliance is to cause the most adverse condition for this test.

2) H is the height required to produce a 0.75 ft-lbf (1.02 N·m) impact on the appliance when the sphere is at its lowest point of travel.

Figure 46.3

Pendulum Drop Height (H)



46.2 Compliance of the dynamic stability test, described in 46.1, shall be determined based on compliance with either (a) or (b) as follows:

a) If tip-over does not occur, the appliance, container, and the like is not to emit more than 3-1/2 oz (104 mL) of liquid as a result of any one impact.

b) If tip-over occurs, the appliance or separate vessel shall comply with the requirements in 45.2 (a) and (b), oriented in the position that caused the tip-over.

46A Hydrostatic Pressure Tests for Parts Subject to Pressure

46A.1 An appliance is to be operated until maximum pressure is attained, by any combination of functional controls, at rated voltage or at the upper limit of a rated voltage range, with the inlet of the brewing chamber both un-blocked and blocked and the steam valve, if provided, closed, except that, during the period that steam is produced, the supply voltage shall be such that the input is equal to the maximum rated input. If the steam valve is linked to the switch used for starting the production of steam, this link must not be disturbed during determination of maximum pressure. The maximum pressures are to be noted.

46A.2 The appliance is then to be subjected for five minutes, to a pressure equal to twice the maximum pressure noted with the inlet of the pressurized brewing chamber blocked, as measured in 46A.1. The over pressure may be supplied from an external source; the appliance shall be at its intended operating temperature for starting the brewing period.

46A.3 If the appliance is provided with a steam system that is normally open to ambient pressures, the steam system of an appliance, shall be subjected for five minutes, to a pressure equal to twice the maximum pressure noted with the inlet of the pressurized brewing chamber not blocked as measured in 46A.1. During the test, the system under test (pressure system) is not to be altered or modified, the steam outlet tube is to be blocked, and the steam valve is to be opened. The over pressure may be supplied from an external source; the appliance shall be at its intended operating temperature for starting the steaming period.

46A.4 During the tests described in 46A.2 and 46A.3, the appliance shall not rupture and there shall be no leakage other than at places intended for that purpose and shall not result in an increased risk of fire,

electric shock, or injury to persons. If provided, leakage is only acceptable through a self-resetting overpressure relief device.

46A.5 Following the test specified in 46A.2, the appliance is to be subjected to the same pressure as described in 46A.2, except with any means for limiting the pressure during determination of the maximum pressure made inoperative. During this test the steam outlet, if provided is blocked, as it is regarded as the limiting device during determining the maximum pressure. The appliance shall withstand this test without exploding or emitting fluid and/or media as described in 47.1.10.

46A.6 If a part that is intended to reduce pressure ruptures during the test in 46A.5, a second sample is to be tested and should provide equivalent (or comparable) results. Rupture of a part that is intended to reduce pressure shall render the appliance incapable of delivering a brewed beverage and not pose a risk of personal injury, electrical shock, or fire hazard.

46B Open Brew Chamber Test – Pressure Brewing Appliances

46B.1 To determine compliance with the exception to 26.12, the appliance shall not emit fluid and/or media as described in 47.1.10 when tested as described in 46B.2 and 46B.3. The test is to be conducted on 3 samples, with the applied voltage, method of mounting, and thermostat connection in accordance with 33.1.10 – 33.1.18.

46B.2 Each sample is to be filled to normal capacity with liquid and grounds or other media as described in the manufacturer's instructions. The sample shall be energized and the brew cycle shall be started. While the brew chamber is being pressurized, the brew chamber shall be opened to the full extent.

46B.3 The test in 46B.2 is to be repeated on each sample, but without grounds or other media in place.

46C Brew Chamber Blockage Following Mold Stress Test for Capsule-Type Brewing Appliances

46C.1 Following the mold-stress test of Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, the appliance shall be operated for one cycle, with the outlet of the brewing chamber or the brewing capsule blocked and shall not emit fluid and/or media as described in 47.1.10.

47 Abnormal Operation Tests

47.1 General

47.1.1 If the conditions of normal operation are not representative also of abnormal conditions likely to be obtained in actual service, an appliance shall not involve a risk of fire or electric shock when operated continuously under such abnormal conditions.

47.1.2 The appliance shall have its voltage selector switch set in any supply circuit voltage position being connected to any one of the rated supply circuits. The combination of selector settings and supply circuit to which the equipment is connected is to be that which develops the most severe operating conditions.

47.1.3 If provided, an externally operable input voltage selector is to be operated for 25 cycles with the appliance operating at the minimum rated voltage and for 25 cycles with the appliance at the maximum rated voltage. Each cycle consisting of moving the voltage selector to its alternate position and back at the rate of six cycles per minute with the voltage selector in each position for 5 seconds. The operating and temperature controls are to be set to result in the most adverse operating conditions.

Exception: If an externally operable voltage selector switch interlocks with the power switch and cannot be operated with the power switch in the "on" position, the test procedure shall be as described in 47.1.4.

47.1.4 For an externally operable voltage selector switch that interlocks with the power switch and cannot be operated with the power switch in the “on” position, the voltage selector is to be operated for 25 cycles each at the maximum and minimum voltages. Each cycle is to consist of the following steps:

a) With the power switch in the “off” position, move the voltage selector to the alternate position;

b) Turn the power switch “on” and operate the appliance for 5 seconds;

c) Turn the power switch “off”;

d) Move the voltage selector to the original position; and

e) Turn the power switch on and operate the appliance for 5 seconds.

47.1.5 To determine whether a risk of fire or electric shock actually exists, a separate burnout or abnormal test is to be conducted with the appliance operating continuously until the ultimate result has been observed. Unless otherwise indicated, the test is to be conducted on one sample with the applied voltage, method of mounting, and thermostat connection in accordance with 33.1.10 – 33.1.18. Accessible metal parts, those that can be contacted by the probe in Figure 7.2, and metal parts accessible during user servicing are to be connected to ground through a 3-A fuse. In most cases, continuous operation for 7 to 8 hours will be necessary to determine that the ultimate result has been observed.

47.1.6 An appliance is to be located as close to the walls of the test corner as the construction permits. The test corner is also to be provided with a 12-inch (340-mm) simulated cabinet bottom, located 16 inches (400 mm) above the counter top. The cabinet bottom is to consist of a dull black-painted fir plywood 3/8 inch (9.5 mm) thick.

Exception No. 1: The test corner need not be used if temperatures obtained are not a factor affecting the result.

Exception No. 2: When an appliance is more than 16 inches (400 mm) high and not more than 22 inches (559 mm) high, the cabinet bottom is to be just over the appliance. When the appliance is more than 22 inches (559 mm) high, the cabinet bottom is to be omitted.

47.1.7 When operated under such abnormal conditions, an appliance is considered to involve a risk of fire if there is any emission of flame or molten metal (other than drops of melted solder), or if the operation of the appliance results in the glowing or flaming of combustible material upon which the appliance may be placed, or that may be adjacent to the appliance.

47.1.8 An appliance is considered to involve a risk of electric shock if the 3-A fuse connected from accessible metal parts of the appliance to ground opens during the test.

47.1.9 After having been subjected to an abnormal test, the appliance is considered to involve a risk of electric shock if the current measured through a 500 ohm resistor between an accessible part and ground is more than 5 mA. A solution of hard water (1/2 g of calcium sulphate $CaSO_4 2H_2O$ per liter of distilled water) in an amount equal to the capacity of the container, is to be poured into the container and the current is to be measured as quickly as possible thereafter. Liquid need not be added if it is obviously apparent that the appliance will not hold liquid.

47.1.10 Fluid or media shall not be emitted greater than 3.0 inches (76.2 mm) from the perimeter of the base of the appliance and shall not be emitted in areas of intended user interaction during normal brewing operation of the appliance.

Exception No. 1: If emission is found beyond 3.0 inches (76.2 mm) or in areas of intended user interaction during normal brewing operation, the test shall be repeated with a thermocouple placed to measure the

emission as it leaves the appliance. If fluid or media is emitted from more than one location, the temperature of the fluid shall be measured at all locations. The maximum temperature shall not exceed 75°C.

Exception No. 2: Small volumes of fluid or media which create an area of less than or equal to 0.59 inches (15 mm) diameter when measured on tissue paper are not prohibited.

47.2 Specific test conditions

47.2.1 General

47.2.1.1 For most of the common types of heating appliances, standardized abnormal test conditions are given in 47.2.4.1 – 47.3.1.

47.2.2 Appliances with breakable exterior surfaces

47.2.2.1 If an appliance has an exterior surface of glass, ceramic, or comparably brittle material in or on which the heating element is mounted or that is an essential part of the enclosure of live parts, the material shall be capable of withstanding the stresses to be encountered in actual service.

47.2.2.2 Certain specific tests are described in 47.2.2.3 but other tests may be necessitated by the construction or intended operation of the appliance.

47.2.2.3 The glass or ceramic surface shall withstand without cracking or breaking the application of a cloth fully saturated with water (the hard water solution described in 47.1.9) at room temperature, with the appliance in the fully heated condition. The quantity of water involved shall be sufficient to wet the surface completely. The appliance shall then comply with the requirement in 31.1 in a repeat leakage current test, except that the test shall be discontinued when leakage current stabilizes.

47.2.3 Dry operation

47.2.3.1 The appliance shall be tested as follows, with all temperature controls or protective devices shunted out of the circuit, except as noted in 33.1.18.

a) An appliance that incorporates a device to limit temperatures shall be tested in accordance with 47.2.3.3.

b) An appliance that does not incorporate a device to limit temperatures shall be tested in accordance with 47.2.3.4.

47.2.3.2 If the appliance breaks, melts, or is otherwise damaged during the heating described in 47.2.3.3, 47.2.3.4 or 47.2.5.2 to the extent that it would be obvious to the user that the appliance is no longer useable and thereby likely to be discarded, the test is to be discontinued. The appliance is then to be tested for risk of electric shock in accordance with 47.1.9.

47.2.3.3 One sample of an appliance that incorporates a device to limit temperatures is to be operated dry for one hour. After one hour of operation, (or less if heating element burnout or other cease-to-operate condition occurs), the appliance shall be disconnected from the source of supply and immediately filled with 10 – 20°C (50 – 68°F) tap water, then emptied and wiped dry simulating a cleaning operation. If the appliance utilizes a detachable power-supply cord, the plug is to be removed and replaced on the pin terminals five times. The appliance is then to be half-filled with hard water and tested for risk of electric shock in accordance with 47.1.9. If the sample is still operable and the leakage current did not exceed 5.0 mA, the sample is to be emptied, let cool to room temperature and the entire test procedure repeated, until a maximum of five such operations has been completed. After the fifth operation, the sample shall also be

subjected to the dielectric voltage-withstand test described in Dielectric Voltage-Withstand Test, Section 35.

47.2.3.4 Three samples of an appliance that does not incorporate a device to limit temperatures are to be tested in accordance with 47.2.3.3 except that one sample is to be operated dry for 5 minutes, the second sample for 15 minutes and the third sample for 30 minutes for each cycle rather than one hour.

47.2.3.5 The appliance is to be filled to normal capacity with liquid and saturated grounds or other media, and operated at 110 percent of the voltage as determined from 33.1.11. All automatic controls shall be shunted out of the circuit except as noted in 33.1.18. The result is not acceptable if the container is pressurized so as to spit liquid from any opening including the spout.

47.2.3.6 A handle assembly that is utilized to lift and tilt a vessel to dispense a liquid shall be tested in accordance with 47.2.3.1 while being supported by the handle. The handle is to be gripped with a 2-inch (51-mm) gripping area (centered over the intended gripping area) for this test. The handle assembly shall not loosen, break, soften, deform, warp or otherwise deteriorate so as to increase the risk of injury to persons. This test is not applicable to a carafe or other nonintegrally heated vessel.

47.2.4 Overfill

47.2.4.1 An appliance not intended to be immersed in water, shall not present a risk of electric shock after being subjected to the test described in 47.2.4.2.

47.2.4.2 To determine that an appliance complies with the requirement in 47.2.4.1, it is to be tested as follows:

a) A detachable power-supply cord provided with the appliance is to be removed;

b) The appliance is to be supported normally on a horizontal surface unless filling requires another position; and

c) A liquid-level gauge, vent or other opening, and the pouring spout or lip are to be sealed or otherwise modified to induce a uniform overflow of liquid around the top perimeter of the appliance.

A hard water solution (see 47.1.9) is to be poured into the container through an orifice 3/8 inch (9.5 mm) in diameter. The appliance is to be first filled with the maximum amount of liquid the container will hold. An additional amount of the solution equal to 50 percent of the volume just mentioned [but not more than 1 pint (473 mL)] is then to be poured into the filled container. Any equivalent method which provides the same rate and amount of uniform flow of liquid around the top perimeter may be employed. Immediately following the test, the appliance is to be emptied, the exterior dried with a soft cloth to remove all surface moisture, including surface moisture from exposed terminal pins, refilled to the normal level and tested for risk of electric shock. To determine whether a risk of electric shock exists, the current is to be measured through a 500 ohm resistor between accessible parts and ground, with the appliance connected to a 120 V supply circuit. A risk of electric shock is considered to exist if the current exceeds 5.0 mA. The current is to be again measured with reverse polarity of the supply circuit.

47.2.5 Boil dry operation

47.2.5.1 An appliance shall not involve a risk of electric shock when operated as described in 47.2.5.2.

Exception: An appliance that incorporates a control that operates to prevent boiling of the liquid (such as the thermostat of a percolator) need not be tested.

47.2.5.2 A sample shall be filled with just enough water (hard-water solution described in 47.1.9) to cover the heating element. The appliance shall then be operated until all the water has been boiled off – or heating element burnout or other cease-to-operate condition occurs – at such time it shall be 3/4 filled with 10 – 20°C (50 – 68°F) hard water and tested for risk of electric shock in accordance with 47.1.9.

47.2.6 Gaskets and seals

47.2.6.1 An insulating washer, gasket, or the like used as a seal or barrier between uninsulated current-carrying parts and the liquid chamber of a liquid heating appliance shall be such that there is no leakage current of more than 0.5 mA between liquid in the appliance and ground after an appliance has been operated as described in 47.2.6.2.

47.2.6.2 The appliance is to be operated continuously for 168 hours after having been filled with the liquid normally used in the appliance. Sufficient liquid is to be added from time to time to prevent the liquid chamber from becoming less than half full. The appliance is then to be subjected to a repeat leakage-current test (see 31.1) except that the test is to be discontinued when the leakage current stabilizes.

47.2.6.3 An insulating washer, gasket, or hose as described in 47.2.6.1 shall not show any visible signs of deterioration, such as cracking, deformation, and the like, after being conditioned in accordance with Table 47.1.

Table 47.1
Test for materials used for gaskets, seals, hoses, or the like

Temperature on component during normal temperature test	Conditioning procedure
60°C (140°F) or less	Air circulating convection oven for 70 hours at 100 ±1°C (212±2°F)
61 – 75°C (142 – 167°F)	Air circulating convection oven for 168 hours at 100 ±1°C (212 ±2°F)
76 – 90°C (169 – 194°F)	Air circulating convection oven for 168 hours at 121 ±1°C (250 ±2°F)
91 – 105°C (196 – 221°F)	Air circulating convection oven for 168 hours at 136 ±1°C (277 ±2°F)
Above 105°C (221°F)	Air circulating convection oven for 168 hours at 31.0°C (55.8°F) higher than normal use temperature

47.2.6.4 An identifiable gasket, seal, or similar protection shall be provided to reduce the risk of the entrance of water into wiring and electrical component spaces in products that are likely to be held under a tap-water faucet for filling or cleaning. Examples of these products are percolators, urns, hot pots, teapots and the like.

47.2.6.5 Where the gasket, seal or similar protection mentioned in 47.2.6.4 cannot be determined as providing the protection necessary to comply, the design shall be evaluated following the overfill test described in 47.2.6.6, in place of the overfill test described in 47.2.4.2.

47.2.6.6 The appliance is to be subjected to the overfill test described in 47.2.4.2 a total of ten times. Prior to the initial overfill test, the appliance is to be subjected to one heating cycle. The tests are to be conducted over a period of 15 days. The time between the tests are to be not less than 24 hours. Only one leakage current test and dielectric voltage-withstand test are to be performed, following the last overfill test.

47.3 Dual voltage appliances

47.3.1 In addition to the applicable tests described in 47.2.3.1 – 47.2.6.6, a dual voltage appliance shall be subjected to the tests described in 47.1.6 – 47.1.8. These tests are subject to the test conditions

described in 47.1.5 – 47.1.7 and to the acceptance criteria described in 47.1.9 – 47.2.2.2. There shall be no electrical or mechanical breakdown of the voltage selector switch.

47.4 Fusible devices test

47.4.1 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 all other operating control devices in the appliance are short-circuited. At the start of the test, the appliance shall not contain liquid in the reservoir. Each thermal 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.

Exception: A single sample may be tested five times with the thermal cutoff being replaced after each test if agreeable to those concerned.

47.5 Surge test

47.5.1 Appliances having a device with an off position obtained by electronic disconnection, or a device that can be placed in the stand-by mode, are subjected to the tests of 47.5.4. The test is to be carried out with the appliance supplied at rated voltage, the device being set in the off position or in the stand-by mode.[a]

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47.5.2 Appliances incorporating a protective electronic circuit are subjected to the tests of 47.5.4. The test is to be carried out before the protective electronic circuit has operated and is to be repeated after the protective electronic circuit has operated during the applicable Fusible Devices Test [see 47.4 and SA20.4.3].[a]

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47.5.3 The test of 47.5.4 is to be carried out with surge protective devices disconnected, unless they incorporate spark gaps. Surge protective devices that comply with the Standard for Surge Protective Devices, UL 1449, shall not be removed from the circuit during this test. If the appliance has several modes of operation, the test is to be carried out with the appliance operating in each mode.[a]

NOTE – Appliances incorporating electronic controls complying with the IEC 60730 series of standards are not exempt from the test.[a]

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47.5.4 The power supply terminals of the appliance are subjected to voltage surges in accordance with Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test IEC 61000-4-5, five positive impulses and five negative impulses being applied at the selected points. Test level 3 is applicable for the line-to-line coupling mode, a generator having a source impedance of 2 Ω being used. Test level 4 is applicable for the line-to-earth coupling mode, a generator having a source impedance of 12 Ω being used. If a grounding-type attachment plug is provided, grounded heating elements are disconnected during this test.[a]

NOTE – If a feedback system depends on inputs related to a disconnected heating element, an artificial network may be needed.[a]

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47.5.5 For appliances having surge arresters incorporating spark gaps, the test in 47.5.4 is repeated at a level that is 95 percent of the flashover voltage.[a]

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47.5.6 Following the test in 47.5.4, any normal or abnormal test which resulted in the operation of the protective electronic circuit shall be repeated. There shall be no increased risk of fire or electric shock.

47.6 Pressure brewing appliances

47.6.1 General

47.6.1.1 An appliance shall not cause an increased risk of fire, electric shock, or personal injury after being subjected to the tests in 47.6.2 – 47.6.4. The appliance shall not emit fluid and/or media as described in 47.1.10 when subjected to the tests in 47.6.2 – 47.6.4. Unless specifically stated, all operating and protective controls not under test shall remain in the system. During the test, the enclosure is to be connected through a 3-A fuse to a supply conductor not containing the thermal cutoff.

Exception: If the fault test creates a test condition that has already been evaluated, the test need not be repeated.

47.6.2 Operating controls fault test

47.6.2.1 The test in 47.4.1 is to be repeated on one sample, except with the reservoir filled to the minimum fill line. If the appliance has a user-selectable function to heat a specific amount of water, the smallest amount of water shall be selected. The appliance shall have a normal load of brewing media.

47.6.2.2 The test in 47.6.2.1 shall be repeated on one sample, except the reservoir shall be filled to the maximum fill line. If the appliance has a user-selectable function to heat a specific amount of water the largest amount of water shall be selected. The test shall be discontinued after 1 hour of operation or if the appliance ceases to operate.

47.6.2.3 The tests in 47.6.2.1 and 47.6.2.2 shall be repeated on one sample, except with the outlet of the brewing chamber or sealed capsule is to be blocked.

47.6.2.4 The tests in 47.6.2.1 and 47.6.2.2 shall be repeated on one sample, except with the inlet of the brewing chamber blocked.

47.6.3 Pump fault test

47.6.3.1 An appliance with a pump is to be operated for one complete cycle. The pump shall be set to remain on during the cycle. If the appliance is provided with more than one pump, only one pump shall be set to remain on during the cycle, all other pumps shall operate normally. The test shall be repeated as many times as necessary to evaluate the operation of each pump. At the start of the test, the reservoir shall be filled to the maximum fill line, and the appliance shall have a normal load of brewing media.

47.6.3.2 The test in 47.6.3.1 shall be repeated on a new sample, except with the pump set to remain off during the cycle.

47.6.3.3 The tests in 47.6.3.1 and 47.6.3.2 shall be repeated on a new sample for each test, except with the outlet of the brewing chamber or sealed capsule chamber when provided is to be blocked.

47.6.3.4 The tests in 47.6.3.1 and 47.6.3.2 shall be repeated on a new sample for each test, except with the inlet of the brewing chamber or sealed capsule when provided is to be blocked.

47.6.4 Valve fault test

47.6.4.1 An appliance with a solenoid valve is to be operated for one complete cycle. The valve shall be set to remain open during the cycle. If the appliance is provided with more than one solenoid valve, only one valve shall be set to remain open during the cycle, all other valves shall operate normally. The test shall be repeated as many times as necessary to evaluate the operation of each solenoid valve. At the start of the test, the reservoir shall be filled to the maximum fill line, and the appliance shall have a normal load of brewing media.

47.6.4.2 The test in 47.6.4.1 shall be repeated on a new sample, except with the solenoid valve set to remain closed during the cycle.

47.6.4.3 The tests in 47.6.4.1 and 47.6.4.2 shall be repeated on a new sample for each test, except with the outlet of the brewing chamber or sealed capsule chamber when provided is to be blocked.

47.6.4.4 The tests in 47.6.4.1 and 47.6.4.2 shall be repeated on a new sample for each test, except with the inlet of the brewing chamber or sealed capsule when provided is to be blocked.

47.7 Abnormal operation reused sealed capsule test

47.7.1 A brewing appliance intended for use with sealed capsules that is capable of being punctured in more than one location if reused, whether intended or not intended by the manufacturer, shall not result in any of the following conditions when tested in accordance with 47.7.2 – 47.7.7:

a) Emission of fluids and/or media as described in 47.1.10.

b) Result in the opening of a 3 A-fuse with the fuse connected to accessible dead metal parts and ground.

47.7.2 All operating and protective controls shall remain in the system.

47.7.3 The test shall be performed with sealed capsules consisting of a "regular" caffeinated grind.

47.7.4 The appliance shall be loaded with a sealed capsule and filled to its maximum intended capacity with water and operated for one brew cycle.

47.7.5 Upon completion of the first cycle, the brew chamber shall be opened and then resealed without removing or replacing the sealed capsule and operated for a second cycle in accordance with 47.7.4.

47.7.6 If the sealed capsule is capable of being rotated or inserted in more than one orientation, the test conditions of 47.7.4 – 47.7.5 are to be repeated using a new sealed capsule. Upon completion of the first cycle, the test shall be repeated using the same sealed capsule per 47.7.5, except the sealed capsule shall be oriented such that a puncture is made in a new location.

47.7.7 The testing of 47.7.1 – 47.7.6 shall be repeated using sealed capsules consisting of a "decaffeinated" grind.

48 Component Failure Test

48.1 If an appliance employs one or more rectifiers, transistors, or similar solid-state components in a secondary circuit, a risk of fire or electric shock shall not develop when the circuit between any two

terminals of any such component is open-circuited or short-circuited. If the appliance employs a capacitor in combination with one or more of the above-mentioned components, a risk of fire or electric shock shall not develop when the capacitor is short-circuited. Only one of the simulated fault conditions described above is to be imposed at one time. See 48.2 – 48.5.

Exception: Components located on the secondary of a Class 2 transformer need not comply with these requirements.

48.2 If a semiconductor rectifier is employed, three appliances are to be tested with the rectifier terminals connected together. Three additional appliances are to be tested with the terminals of the electrolytic capacitor connected together.

48.3 Three complete tests are to be made under each of the conditions described in 48.2 using new components in each test. The appliance to be tested is to be connected as indicated in 47.1.5.

48.4 An unacceptable condition exists if flame is emitted from the overall enclosure of the appliance or if a permanently conductive path is established between live parts and exposed dead metal.

48.5 The tests described in 48.1 – 48.3 may be omitted if one or both of the following conditions exist:

a) There is 10,000 ohms or more of additional series impedance in a circuit in which the voltage does not exceed 125 V; or

b) There is 20,000 ohms or more of additional series impedance in a circuit in which the voltage may be more than 125 but is no more than 250 V.

49 Automatic Controls Test

49.1 General

49.1.1 An automatic control for temperature regulating or temperature limiting shall be capable of performing successfully for 50 cycles of operation, when the appliance is connected to a supply circuit having a potential of 120 percent of the voltage specified in 33.1.11. There shall be neither electrical nor mechanical malfunction of the control, nor undue burning, pitting, or welding of the contacts.

49.1.2 In tests to determine an automatic control complies with the requirements in 49.1.1, the appliance is to be connected to a grounded supply circuit; the enclosure of the appliance, if of metal, is to be connected to ground through a 3-A fuse; and the control, if single-pole is to be connected in an ungrounded conductor of the circuit. The device is to be operated at the rate of 10 cycles per minute, except that a faster rate of operation may be employed if agreeable to all concerned. The performance is unacceptable if the fuse in the grounding connection opens during the test.

49.2 Endurance

49.2.1 A thermostat shall be capable of withstanding an endurance test which shall consist of the minimum number of cycles indicated in Table 49.1. Unless it is specified that the test be made without load, the thermostat shall make and break the rated current of the appliance while connected to a circuit of rated voltage. There shall be neither electrical nor mechanical malfunction of the thermostat, nor undue burning, pitting, or welding of the contacts.

Table 49.1
Minimum number of cycles of operation for endurance test

Type of thermostat	Automatically reset thermostat	Manually reset thermostat
Temperature regulating	A number of cycles equivalent to 1000 hours of intended operation under load of the appliance but not less than 6000 cycles. See footnote a) for exception.	6000 cycles under load. See footnote a) for exception.
Temperature-limiting	A number of cycles equivalent to 100 hours of operation of the appliance under any condition which caused the thermostat to function, or 100,000 cycles, whichever is greater. See footnote b) for exception.	1000 cycles under load and 5000 cycles without load. See footnote b) for exception.
Combination temperature-regulating and -limiting	100,000 cycles under load. See footnote c) and d) for exception.	Each function of the thermostat shall be subjected to the following: Regulating: 1000 cycles under load and 5000 cycles without load. Limiting where the function may be reset by the user during normal operation, including dry operation: 100,000 cycles with load. See footnote e). Limiting per 23.3 where the thermostat and its reset means are inaccessible to the user without the use of tools and contacts are separate from the regulating function: 1000 cycles under load and 5000 cycles without load. See footnote f). See Notes c) and d) for exceptions.

a) The test may be omitted if, with the thermostat short-circuited, no temperature higher than the limits given in Table 33.1 are attained during the normal-temperature test of the appliance.

b) The test may be omitted if, with the thermostat short-circuited, there is no evidence of risk of fire as described in 47.1.1 – 47.1.9 during the continuous abnormal operation of the appliance.

c) If, with the regulating and limiting functions of the thermostat short-circuited, there is no evidence of risk of fire as described in 47.1.1 – 47.1.9, the thermostat is to be tested as a temperature-regulating thermostat.

d) The test may be omitted if, with all functions the thermostat short-circuited, there is:

1) No temperature higher than the limits given in Table 33.1 are attained during the normal-temperature test of the appliance; and

2) No evidence of risk of fire as described in 47.1.1 – 47.1.9 during the continuous abnormal operation of the appliance.

e) The temperature sensing and mechanical reset assembly is permitted to be cycled a minimum 6,000 cycles provided the electrical contacts of the limiting function are cycled for a minimum 100,000 cycles.

f) 100,000 cycles are required of the contacts if the regulating and limiting functions use common contacts. The individual functions for regulating and limiting, other than the contacts, are only required to be a minimum 6000 cycles each when contacts are shared.

50 Permanence of Marking Tests

50.1 A required marking shall be molded, die-stamped, paint-stenciled, stamped or etched metal that is permanently secured, or indelibly stamped lettering on a pressure-sensitive label secured by adhesive that upon investigation is found to be acceptable for the application. Ordinary usage (including the likely exposure to weather and other ambient conditions), handling, storage, and the like of the equipment is to be considered in the determination of the acceptability of the application.

50.2 Unless it has been investigated and found to be acceptable for the application, a pressure-sensitive label or label that is secured by cement or adhesive shall comply with the adhesion requirements in the Table for Exposure Conditions for Indoor Use, and the Table for Additional Exposure Conditions for Indoor Use and Outdoor Use in the Standard for Marking and Labeling Systems, UL 969.

50.3 Unless otherwise indicated, a required cautionary marking shall be located on a part that would require tools for removal or that cannot be removed without impairing the operation of the product.

MANUFACTURING AND PRODUCTION-LINE TESTS

51 Dielectric Voltage-Withstand Test

51.1 Each appliance shall withstand without an indication of unacceptable performance as a routine production-line test, the application of a potential between:

a) The primary wiring, including connected components, and accessible metal parts that are likely to become energized; and

b) Between primary wiring and accessible low voltage (42.4 V peak or less) metal parts, including terminals. The test potential shall be:

1) 1200 V (sinusoidal waveform) or 1700 V (DC waveform) applied for 1 second; or

2) 1000 V (sinusoidal waveform) or 1414 V (DC waveform) applied for 1 minute.

51.2 The appliance may be in a heated or unheated condition for the test.

51.3 The test shall be conducted with the appliance complete – fully assembled. It is not intended that the appliance be unwired, modified, or disassembled for the test.

Exception No. 1: A part, such as a snap cover or a friction-fit knob, that would interfere with performance of the test need not be in place.

Exception No. 2: The test may be performed before final assembly if such a test represents testing the complete appliance.

51.4 If the appliance employs a solid-state component that can be damaged by the test potential, the test on each appliance may be conducted before the component is electrically connected. In such a case, additional testing is to be made of a random sampling of each day's production with the circuitry rearranged to reduce the likelihood of damage to any solid-state component but retaining representative dielectric stress of the circuit.

51.5 The test equipment, when adjusted for production-line testing, is to produce an output voltage that is not less than the factory test value specified, nor is the magnitude of the test voltage to be greater than 120 percent of the specified test potential when the tester is used in each of the following conditions:

a) If the test duration is one second, the output voltage is to be maintained within the specified range:

1) When only a voltmeter having an input impedance of at least 2 megohms and a specimen of the product being tested are connected to the output terminals; and

2) When a relatively high resistance is connected in parallel with the voltmeter and the product being tested, and the value of the resistance is gradually reduced to the point where an indication of unacceptable performance just occurs.

b) If the test duration is one minute, the output voltage is to be maintained within the specified range, by manual or automatic means, throughout the one minute duration of the test or until there is an indication of unacceptable performance.

51.6 The specified control of the applied voltage, manual or automatic, shall be maintained under conditions of varying line voltage. Higher test potentials may be used if higher dielectric stress is not likely to adversely affect the insulating systems of the product.

51.7 In addition to the characteristics indicated in 51.5, the test equipment is to have the following features and characteristics:

a) A means of indicating the test voltage that is applied to the product under test. This may be accomplished by sensing the voltage at the leads or by equivalent means.

b) An output voltage that:

1) Has a sinusoidal waveform or DC waveform;

2) In case of sinusoidal waveform:

i) Has a frequency that is within the range of 40 – 70 Hz; and

ii) Has a peak value of the waveform that is not to be less than 1.3 and not more than 1.5 times the root-mean-square value.

3) In case of DC waveform, the applied output voltage corresponds to the peak value of sinusoidal waveform.

c) A means of effectively indicating unacceptable performance. The indication is to be:

1) Auditory, if it can be readily heard above the background noise level;

2) Visual, if it commands the attention of the operator; or

3) A device that automatically rejects an unacceptable appliance.

If the indication of unacceptable performance is auditory or visual, the indication is to remain active and conspicuous until the test equipment is reset manually.

d) When the test equipment is adjusted to produce the test voltage and a resistance of 120,000 ohms is connected across the output, the test equipment is to indicate an unacceptable performance within 0.5 second. A resistance of more than 120,000 ohms may be used to produce an indication of unacceptable performance, if the manufacturer elects to use a tester having a higher sensitivity.

51.8 There is not to be any transient voltage applied to the appliance under test that results in the instantaneous voltage applied to the product exceeding 120 percent of the peak value of the test voltage that the manufacturer elects to use for this test. This requirement applies for the entire duration of the test, including the time that the voltage is first applied to the product and the time that the voltage is removed from the product.

51.9 During the test, a sufficient number of primary switching components shall be in the "on" position so that all primary circuitry will be stressed. Both sides of the primary circuit of the appliance are to be connected together to one terminal of the test equipment. The second equipment terminal is to be connected to accessible dead metal.

Exception: Resistive-type appliances and appliances utilizing motors, relays, coils or transformers, having circuitry not subject to excessive secondary build-up in case of indication of unacceptable performance during the test, may be tested with only one side of the primary circuit connected to the dielectric test equipment.

51A Insertion/Withdrawal Test for Electric Kettles

51A.1 A cordless kettle shall withstand the stresses likely to occur during normal use. Compliance with the requirement is assessed as follows:

a) The two live pins of the kettle are connected together.

b) An external resistive load is connected in series with the supply. The external load is such that the current is 1.1 times the rated current.

c) The kettle is placed on its stand and withdrawn 10,000 times at a rate of approximately 10 times per minute without electrical contact rotation.

d) The test is continued for an additional 10,000 times without current flowing.

Exception: For kettles with a mechanism for de-energizing the appliance when it is lifted of its base, thus ensuring that the connection contacts cannot make or break current on load, the test is carried out without current flowing.

e) After the test, the kettle shall be functioning and shall still comply with Spacings, Section 24, the Resistance of Grounding Test, Section 29, and the Dielectric Voltage-Withstand Test, Section 35 of this standard.

f) Live parts shall not be accessible by the probe in Figure 7.2.

g) The test is carried out without current flowing if the connection contacts cannot make or break on load.

52 Polarization and Grounding Continuity Tests

52.1 Polarization test

52.1.1 Each appliance provided with a polarized attachment plug (2-wire plug with one blade wider than the other) shall be tested for electrical-continuity between the grounded supply-circuit conductor of the attachment plug (wide blade of a 2-wire plug) and the part of the appliance that is intended to be connected to the grounded supply-circuit conductor. If the continuity cannot be readily determined by visual inspection and component checking, an electrical-continuity test is to be made.

52.2 Continuity of grounding connection

52.2.1 Each cord-connected appliance having provision for grounding shall be tested, as a routine production-line test, to determine that grounding continuity exists between the ground blade of the attachment plug and the accessible dead metal parts of the appliance that are likely to become energized.

52.2.2 Only a single test need be conducted if the accessible metal selected is conductively connected by design to all other accessible metal.

52.3 Electrical indicating device

52.3.1 Any indicating device, such as an ohmmeter, a battery and buzzer combination, or the like, may be used to determine compliance with the tests described in 52.1.1 – 52.2.2.

RATINGS

53 Details

53.1 A heating appliance shall be rated in amperes, volt-amperes, or watts, and also in volts, and may be rated for alternating current only. The rating shall include the frequency if necessary because of control devices.

MARKINGS

54 Details

54.1 A warning or caution marking shall comply with all of the following requirements:

a) The marking shall be permanently attached.

b) The marking shall not be attached to parts removable by hand.

c) The marking shall be attached to parts that cannot be removed without impairing the operation of the appliance or left off the appliance without being readily apparent.

d) The marking shall have lettering that complies with the following requirements:

1) The precautionary signal word (such as "DANGER", "WARNING", OR "CAUTION") shall be in letters not less than 3/32 inch (2.4 mm) high.

2) If contrasting color is used, lettering other than signal words can be a minimum of 1/16 inch (1.6 mm) high.

54.2 All other markings required in this Section shall be such that the marking is clear and legible under conditions of intended use of the appliance.

54.3 An appliance shall be legibly and permanently marked with:

a) The manufacturer's name, trade name, trademark, or other descriptive marking by which the organization responsible for the product may be identified;

b) The date or other dating period of manufacture not exceeding any three consecutive months, which may be abbreviated or in a nationally accepted conventional code, or, in a code affirmed by the manufacturer;

c) A distinctive (catalog) (model) number or the equivalent; and

d) The electrical rating.

A date code repetition time cycle shall not be less than 10 years.

54.4 An appliance shall be marked, where readily-visible, to indicate that the appliance is intended for household type usage, such as, "Household Use Only", "Household Type", and the like. Lettering shall be not less than 3/32 inch (2.4 mm) high.

54.5 If a manufacturer produces or assembles appliances at more than one factory, each finished appliance shall have a distinctive marking – which may be in code – by which it may be identified as the product of a particular factory.

54.6 If the construction of an appliance contemplates disassembly by means of a tool for the purpose of cleaning or similar servicing by the user (including replacement of a thermal cutoff) and, if such disassembly involves the exposure of persons to unintentional contact with any normally enclosed or protected live part, the appliance shall be plainly marked with a warning that such servicing should be done only while the appliance is disconnected from the supply circuit. See also 7.13.

54.7 An appliance with an attached cord or detachable power-supply cord 4-1/2 ft (1.4 m) or longer in length shall be provided with specific instructions, which are not part of Important Safeguards, that state: "To reduce the risk of injury, do not drape cord over the counter top or table top where it can be pulled on by children or tripped over unintentionally" or an equivalent wording.

54.8 An appliance with an attached cord or detachable power-supply cord less than 4-1/2 ft (1.4 m) in length shall be provided with instructions, which are not part of Important Safeguards, that include the following information:

a) A short power-supply cord (or detachable power-supply cord) is provided to reduce risks resulting from becoming entangled in or tripping over a longer cord.

b) Longer detachable power-supply cords or extension cords are available and may be used if care is exercised in their use.

c) If a long detachable power-supply cord or extension cord is used:

1) The marked electrical rating of the detachable power-supply cord or extension cord should be at least as great as the electrical rating of the appliance;

2) If the appliance is of the grounded type, the extension cord should be a grounding-type 3-wire cord; and

3) The longer cord should be arranged so that it will not drape over the counter top or table top where it can be pulled on by children or tripped over.

Exception: Statements in items (b) and (c) above may be omitted if the product complies with all of the following:

a) The instruction manual includes a statement prohibiting the use of a longer detachable power supply cord or extension cord.

b) The appliance is provided with a cord tag marked "CAUTION: Do not use an extension cord" or equivalent. The tag shall be permanently attached to the power supply cord, and located within 2 inches (51 mm) of the plug when shipped from the factory. The tag material and means of attachment to the power supply cord shall comply with the requirements in Test for Permanence of Cord Tag, Section SB8.

54.9 An appliance that is likely to be lifted and handled for cleaning purposes and has not been subjected to the Immersion Tests, in accordance with 33.1.4 and 34.3 shall be marked "Do not immerse in water" or with an equivalent wording. If the appliance is intended for partial immersion but not for complete immersion, it shall be marked "Do not immerse beyond this point" or with an equivalent wording to show the point beyond which it should not be immersed.

54.10 An appliance that utilizes a detachable power-supply cord shall be provided with the following:

a) The appropriate detachable power-supply cord as indicated in Supply Connections, Section 11; or

b) Instructions that:

1) Advise the consumer that the appropriate detachable power-supply cord is not provided; and

2) Specify which detachable power-supply cord or cords are appropriate. If long and short detachable power-supply cords are available, the instructions shall include information regarding the problems attendant with each.

54.11 The instructions in 54.10(b) shall be marked on the outer packaging material of the product, and in the instruction manual provided with the appliance.

Exception: The outer packaging material alone may carry the information from the instructions in 54.10(b) provided that the instruction manual supplied with the appliance contains a reference to the location of the information.

54.12 If a specific spacing between a cord-connected wall or an under-cabinet mounted appliance and an adjacent surface is necessary so that temperatures higher than 90°C (194°F) are not obtained when the appliance is operated as intended, the appliance shall be marked "Do not install closer than ____ inches (____ mm) to a (vertical, horizontal, and the like) surface" or the equivalent. The value of the spacing to be used in the statement or the diagram shall not be less than that necessary so that temperatures higher than 90°C (194°F) are not obtained on the wall when the appliance is tested in the corner as described in 33.1.15. The statement or the diagram shall be legible and located so that it will be clearly visible during installation.

54.13 An under-cabinet or wall mounted appliance shall be permanently marked with the following or equivalent "CAUTION – To reduce the risk of fire, do not place any heating or cooking appliance beneath this unit". The marking is to be in lettering minimum 3/32 inch (2.4 mm) high, on the front of the appliance, or the front leading edge of the mounting bracket and shall be visible after the appliance is mounted. The lettering is to be on a contrasting background, or the letters are to be raised, or the equivalent so that the marking is readily readable.

54.14 A pressure brewing appliance shall include a distinctive marking, such as an arrow, vertical bar, dot, or other equivalent marking, or the word "lock", which clearly indicates the proper position to secure the brewing chamber during the brewing cycle. This marking shall be readily visible during positioning of the brew chamber and during operation of the appliance.

Exception No. 1: An appliance that meets the requirements of the Open Brew Chamber Test in Section 46B is not required to comply with this requirement.

Exception No. 2: An appliance that cannot be provided with a lock marking, such as a drawer or latched lid and which includes instructions in accordance with 58.7 is not required to comply with this requirement.

55 Carton Marking

55.1 A carton (individual marketing container) for an appliance shall be marked to indicate that the appliance is intended for household type usage, such as, "Household Use Only", "Household Type", and the like. The marking shall:

a) Be located on at least one outside surface; and

b) Appear in lettering not less than the height specified in Table 55.1.

Table 55.1
Lettering height

Smallest dimension of the carton panel to be marked in inches (mm)		Minimum height of lettering in inches (mm)
More than	Less than or equal to	
0	6 (152)	1/8 (3.2)
6 (152)	10 (254)	3/16 (4.8)
10 (254)	–	1/4 (6.4)

INSTRUCTION MANUAL

56 General

56.1 An instruction manual or the equivalent shall be provided with the appliance. The manual shall specifically warn the user against each potential risk and state the precautions that should be taken to guard against each risk. The safety instructions shall be a permanent part of the manual but separated in format from the other instructions, and shall appear before the operating instructions in the manual.

56.2 The instruction manual shall include instructions or illustrations to identify important safety features.

56.3 The height of lettering in the text and illustrations of the safety instructions shall be as follows:

a) Upper case letters shall be not less than 1/12 inch (2.1 mm) in height;

b) Lower case letters shall be not less than 1/16 inch (1.6 mm) in height;

c) The phrases "IMPORTANT SAFEGUARDS" and "SAVE THESE INSTRUCTIONS" shall be in letters no less than 3/16 inch (4.8 mm) in height.

56.4 The instruction manual shall include the safety instructions in All Appliances, Section 57, and the appropriate text from Specific Appliances, Section 58.

56.5 Unless otherwise indicated, the text of the instructions shall be verbatim to, or in equally definitive terminology as All Appliances, Section 57, and Specific Appliances, Section 58, except where specific conflict exists in the application of the text to a product or where the risk alluded to has been reduced. The items may be numbered, and the phrases "Read all Instructions" and "Save these Instructions" shall be first and last, respectively, in a list of items. Other important and safety instruction items considered appropriate by the manufacturer may be inserted.

56.6 For a dual voltage rated appliance, procedures to be followed in changing the voltage selector, if provided and providing the correct supply connection means for each voltage setting shall be provided. In addition, the following wording or equivalent shall be provided: "For use in the U.S.A., the voltage selector switch should be placed in the 120 V position. For use in several countries overseas, the voltage selector may need to be placed in the 240 V position. Confirm the voltage available at each overseas location before using the appliance. For connection to a 240 V supply, use an attachment plug adapter of the proper configuration for the power supply receptacle."

56.7 An appliance provided with a 2-wire polarized attachment plug shall include the following or equivalent wording: "This appliance has a polarized plug (one blade is wider than the other). To reduce the risk of electric shock, this plug is intended to fit into a polarized outlet only one way. If the plug does not fit fully into the outlet, reverse the plug. If it still does not fit, contact a qualified electrician. Do not attempt to modify the plug in any way."

57 All Appliances

57.1 The following applies to all appliances:

IMPORTANT SAFEGUARDS

When using electrical appliances, basic safety precautions should always be followed, including the following:

1. Read all Instructions.

2. Do not touch hot surfaces. Use handles or knobs.

3. To protect against fire, electric shock and injury to persons do not immerse cord, plugs, or (state specific part or parts in question) in water or other liquid.

4. Close supervision is necessary when any appliance is used by or near children.

5. Unplug from outlet when not in use and before cleaning. Allow to cool before putting on or taking off parts, and before cleaning the appliance.

6. Do not operate any appliance with a damaged cord or plug or after the appliance malfunctions, or has been damaged in any manner. Return appliance to the nearest authorized service facility for examination, repair or adjustment.

7. The use of accessory attachments not recommended by the appliance manufacturer may result in fire, electric shock or injury to persons.

8. Do not use outdoors (this item may be omitted if the product is specifically designed for outdoor use).

9. Do not let cord hang over edge of table or counter, or touch hot surfaces.

10. Do not place on or near a hot gas or electric burner, or in a heated oven.

11. Always attach plug to appliance first, then plug cord into the wall outlet. To disconnect, turn any control to "off," then remove plug from wall outlet.

12. Do not use appliance for other than intended use.

13. Save these Instructions.

58 Specific Appliances

58.1 Coffee makers, liquid heaters

1. (Special instructions covering lid placement and removal. Wording may vary.)

2. Scalding may occur if the lid is removed during the brewing cycles.

58.2 Appliances with detachable handles

1. Be sure that handles are assembled and fastened properly.

2. (The manufacturer shall supply explicit instructions detailing the proper assembly of the handles.)

3. (The manufacturer shall explain how improper assembly of the handles can be determined.)

Exception: Items 2 and 3 may be located in any part of the instruction manual provided that the Important Safeguards state "See instructions regarding Handles on Page ___" or the equivalent wording.

58.3 Under cabinet and wall mounted appliances

a) To reduce the risk of fire, do not place any heating or cooking appliance beneath the appliance.

b) To reduce the risk of fire, do not mount unit over or near any portion of a heating or cooking appliance.

c) To reduce the risk of electric shock, do not mount over a sink.

d) To reduce the risk of fire, do not store anything directly on top of the appliance surface when the appliance is in operation.

58.4 A cautionary marking that is required to be on an appliance shall be repeated in its entirety or with an equivalent wording in the instruction manual. The marking may be included in the Important Safeguards.

58.5 Dual voltage rated appliances

a) Be sure dual voltage selector, if provided, is in correct voltage position before operating. Before plugging in, read the information about the dual voltage contained in instruction section of this manual.

b) "This appliance was set at the factory to be operated at ____ V. Refer to operating instructions section of this manual for conversion to ____ V operation" or equivalent. The blanks are to be filled in with the appropriate voltage information.

Exception: This construction does not apply if an appliance operates over a range of voltages and requires no adjustment by the user, such as an appliance that employs a positive temperature coefficient (PTC) heating element intended for use over a range of voltages and requiring no adjustment by the user.

58.6 Pressure brewing appliances

a) Only use capsules intended for this appliance. If the capsule does not fit, do not force the capsule into the appliance.

b) WARNING: To avoid the risk of injury, do not open the brew chamber during the brew process.

Exception: The marking in 58.6(a) does not apply to an appliance that is not intended to be used with sealed capsules.

58.7 To comply with Exception No. 2 to 54.14, the manufacturer shall supply explicit instructions detailing proper closure of the brew chamber.

Exception: May be located in any part of the instruction manual provided that the Important Safeguards state "See instructions regarding closing the Brew Chamber on Page ____" or the equivalent wording.

59 User Maintenance

59.1 The instruction manual shall include appropriate instructions and caution statements for cleaning, user-maintenance (such as lubrication or nonlubrication) operations recommended by the manufacturer, and shall warn a user that any other servicing should be performed by an authorized service

representative. The manual or other literature packaged with the product shall also indicate that the product is for household use.

59.2 Instructions for mounting an under-cabinet or wall mounted appliance shall be provided. The actual instructions shall be located on the appliance, or in the literature packed with the appliance. The actual instructions shall not be in the Important Safeguards, however, there may be a reference to them in the Important Safeguards. (Such as "Wall or under-the-cabinet mounting should follow the directions in the installation instructions").

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

SA1 Scope

SA1.1 The requirements in this supplement cover household electric drip-type coffee makers and other similar drip-type brewing appliances that are to be cord-connected to a nominal 120 V supply in accordance with the National Electrical Code. These requirements are in addition to or modify the applicable requirements in Sections 1 – 59.

SA1.2 The appliances covered by this standard are automatic (temperature-regulated) and are used to heat water to a temperature greater than 46°C (115°F) as part of the intended brewing function. The coffee or other beverage brewed by these appliances are dispensed automatically or manually.

SA1.3 In the text of this supplement, reference to drip-type coffee makers is to be understood to apply to all drip-type appliances covered by this supplement. Reference to containers is to be understood to apply to the carafe or other container provided as part of the appliance to hold the brewed beverage.

SA2 Glossary

SA2.1 MAXIMUM DRY OPERATION TEMPERATURE RATING (T_{dry}) – The maximum temperature permitted on the thermostat's sensing surface during abnormal (dry) operation of the coffee maker. This temperature is equal to or greater than T_{max}.

SA2.2 MAXIMUM NORMAL USE TEMPERATURE RATING (T_{max}) – The maximum temperature permitted on the thermostat's sensing surface during normal operation of the coffee maker. This temperature is equal to or greater than T_{s-p}.

SA2.3 SET-POINT TEMPERATURE RATING (T_{s-p}) – The temperature at which the thermostat's electrical load switching contacts change state upon temperature rise.

SA3 Assembly

SA3.1 A drip-type coffee maker carafe shall be completely assembled before shipping and not require any assembly by the user.

SA4 Corrosion Protection

SA4.1 Iron, steel, or aluminum parts shall be protected against corrosion as determined by compliance with SA13.3 and SA13.4 where deterioration would increase the risk of fire or electric shock.

SA4.2 The effects of severe humidity and moisture resulting from the test in Operation Degradation, Section SA13, and the humidity conditioning test in Leakage Current as a Result of Moisture, Section SA16, shall be evaluated. There shall be no visible degradation that would result eventually in unacceptable performance of the appliance.

SA5 Supply Connections

SA5.1 The length of an attached flexible cord or a detachable power supply cord provided with an under-cabinet or wall-mounted drip-type coffee maker shall be minimum 3 ft (0.9 m) and maximum 4.5 ft (1.4 m) long.

Exception: The cord length may be a maximum of 7.0 ft (2.1 m) if a means is provided for storing the excess length of cord.

SA6 Gaskets and Seals

SA6.1 An identifiable gasket, seal, or similar protection shall be provided to reduce the risk of the entrance of water and steam into wiring and electrical component spaces as determined by examination following the test in Operation Degradation, Section SA13.

SA6.2 Where the gasket, seal or similar protection mentioned in SA6.1 cannot be determined as providing the protection necessary to comply, the design shall be evaluated following the test in Operation Degradation, Section SA13.

SA7 Water Connections

SA7.1 Each water connection of elastomeric-type tubing, whose failure could result in an increase in the risk of fire or electric shock, shall be secured by an adhesive which meets the requirements in the Adhesives – Specialized Applications Section in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, a clamp, or friction alone, and shall comply with one of the following:

a) A means of retaining the elastomeric-type tubing at a water connection that can be subjected to increased pressures, is acceptable if there is no water leakage as the result of the hydrostatic pressure test described in SA7.2 or SA7.5. If the elastomeric-type tubing is secured by friction alone, it shall additionally comply with the elongation and tensile strength properties test described in SA7.4.

b) A means of retaining the elastomeric-type tubing at a water connection that can only be subjected to the normal head pressure by its position, is acceptable if there is no water leakage as the result of the hydrostatic pressure test in SA7.3 or SA7.5. If the elastomeric-type tubing is secured by friction alone, it shall additionally comply with the elongation and tensile strength properties test in SA7.4.

SA7.2 One drip-type coffee maker with water connections, as described in SA7.1(a), is to be subjected to a hydrostatic–pressure test. The coffee maker is to be filled with water so as to exclude air and is to be connected to a hydraulic pump. The pressure is to be raised gradually to a gauge pressure of 15 psi (103 kPa) and held at that value for 1 minute. The results are not acceptable if the water connections of the coffee maker burst or leak.

SA7.3 One drip-type coffee maker with water connections, as described in SA7.1(b), is to be subjected to a hydrostatic pressure test. The coffee maker is to be filled with water so as to exclude air and is to be connected to a hydraulic pump. The pressure is to be raised gradually to a gauge pressure equivalent to 10 times the maximum head pressure that the connection would be subjected to at overflow conditions, and held at that value for 1 minute. The results are not acceptable if the water connections of the coffee maker burst or leak.

SA7.4 Three samples of the elastomeric-type material used for a water connection that is secured by friction alone are to be tested for tensile strength and elongation. Three additional samples are to be artificially aged for 168 h in water maintained at 100°C (212°F). Following the aging, the samples are to be tested for tensile strength and elongation. The results are acceptable if the values following aging are at least 75 percent of the original values recorded on the unaged samples.

SA7.5 At the manufacturer's option, and as a substitute for the tests described in SA7.2 and SA7.3, three drip-type coffee makers with water connections as described in SA7.1 are to be subjected to a blocked operations test. The outlet tube of each coffee maker is to be blocked. The coffee makers are then to be filled with water and operated for a period of 1 hour. The results are not acceptable if the water connections of any of the three coffee makers burst or leak.

SA8 Thermal Conductivity

SA8.1 The assembly of a thermostat or other control that is dependent upon heat transfer through a thermal bridge or from the surface on which the control is mounted for proper operation, shall be constructed to reduce the risk of the following:

a) Loosening of the control or bridge due to corrosion or thermal cycling; and

b) Change in the properties of the thermal bridge or surface materials from electrolytic action due to use of dissimilar metals in a wet or moist environment, metal fatigue, or corrosion.

SA8.2 Compliance with the requirements in SA8.1 is to be determined following the test in Operation Degradation, Section SA13.

SA9 Grounding

SA9.1 A conductive connection between separate metal parts (accessible and inaccessible) in a drip-type coffee maker that has no provision for grounding shall be provided only if needed for functional purposes.

SA10 Operating Controls

SA10.1 An operating control device shall have a current and voltage rating not less than that of the circuit (load) it controls. The temperature rating of the materials used in such a device shall not be exceeded during the normal operation test unless the requirement for transient temperatures mentioned in SA15.1 apply.

SA10.2 A manual operating control, such as a switch, shall be provided to turn a drip-type coffee maker off when not in use.

Exception No. 1: A drip-type coffee maker with an automatic shutoff manual-reset operating control that operates in 5 minutes or less after energization of the coffee maker is acceptable.

Exception No. 2: A drip-type automatic coffee maker with an automatic shutoff manual reset operating control that operates in more than 5 miniutes after energization need not be provided with an additional manual on-off control if the product complies with all of the following:

a) No keep warm feature after brewing is provided.

b) Automatic operation of the manual reset system will cause disconnection of all ungrounded conductors from the supply to all heating assemblies at the end of one brewing cycle.

c) The manual reset operating control shall be trip free; that is, the automatic tripping shall be independent of the manipulation or position of the reset button, handle, lever, or the like. A manual reset control designated type M1 or M2 in accordance with the Standard for Temperature-Indicating and -Regulating Equipment, UL 873, is considered to comply with these requirements. Compliance with the Standard for Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements, UL 60730-1, and/or the applicable Part 2 standard from the UL 60730 series fulfills these requirements.

d) The manual reset operating control shall not reset automatically as a result of changes in environmental temperature at temperatures above minus 35°C (minus 31°F).

e) The manual reset operating control shall be capable of withstanding an endurance test consisting of 6000 cycles under load.

SA10.3 The operating control mentioned in SA10.2 shall disconnect or cause disconnection of the ungrounded conductor from the supply to the heating assembly. When the ungrounded conductor cannot

be identified, such as with products provided with a nonpolarized attachment plug, the control is to be of a double-pole type to open both circuit conductors.

Exception: If the warming plate is the only exposed metal part and is coated with an acceptable thickness of insulating material or isolated (not likely to become energized), the operating control need not disconnect the ungrounded conductor.

SA10.4 In a drip-type coffee maker provided with a polarized attachment plug, all additional operating controls with single-pole switching capability shall be wired in the ungrounded conductor.

Exception: See SA12.3.4.

SA11 Power-On Indicator

SA11.1 A drip-type coffee maker shall be provided with a power-on indicator that is readily visible and distinguishable from the “off” position.

Exception: A drip-type coffee maker with an automatic shutoff manual-reset operating control that operates in 5 minutes or less need not be provided with a power-on indicator.

SA11.2 The power-on indicator shall be significantly different from any indicator that may be used to indicate "off" on the product. Indicators, such as an illuminated switch, pilot light and colored flag, are means of complying with SA11.1. An ordinary on-off position marking is unacceptable.

SA12 Temperature Controls

SA12.1 General

SA12.1.1 A separate temperature limiting-type device is required only if the short-circuiting of a temperature-regulating control during abnormal operation (see Abnormal Operation, Section SA20) increases the risk of fire or electric shock. A single combination regulating-limiting control is unacceptable for this purpose.

SA12.1.2 Operating (regulating) controls shall be evaluated in accordance with the applicable component standard requirements specified in SA12.2, if applicable, and the parameters in Controls – End Product Test Parameters, Section 22B, unless otherwise specified in this end product Standard; see SA12.1.7.

SA12.1.3 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.

SA12.1.4 Protective (limiting) controls shall be evaluated in accordance with the applicable component standard requirements specified in SA12.3, and if applicable, the parameters in Controls – End Product Test Parameters, Section 22B, unless otherwise specified in this end product Standard.

SA12.1.5 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.

SA12.1.6 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.

SA12.1.7 An electronic 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.

SA12.2 Temperature regulating

SA12.2.1 An automatic reset temperature-regulating thermostat that operates more than once during a complete cycle of brewing and warming shall comply with the applicable requirements for drip-type coffee maker thermostats in the Standard for Temperature-Indicating and -Regulating Equipment, UL 873. Compliance with 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, fulfills these requirements.

SA12.2.2 An automatic reset temperature-regulating thermostat that operates only once during a complete brewing cycle and does not cycle in the "keep warm" mode shall comply with the applicable requirements in the Standard for Temperature-Indicating and -Regulating Equipment, UL 873, and be tested for 100,000 cycles at rated current and voltage. Compliance with 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, fulfills these requirements.

SA12.2.3 The insulating material of a temperature regulating control shall have a Comparative Tracking Index of 175 or more. The Comparative Tracking Index (CTI) is referenced in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

SA12.2.4 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:

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.

SA12.3 Limiting-type devices

SA12.3.1 A limiting-type device shall consist of one of the following:

a) A single thermal cutoff with an established T_{H-100} rating (which includes having a Conductive Heat (CH) rating) as described in the Standard for Thermal-Links – Requirements and Application Guide, UL 60691, and as tested per SA15.8 and SA15.10;

b) Two thermal cutoffs such that one of the following conditions is met:

1) Each of the thermal cutoffs has a Conductive Heat (CH) rating as described in the Standard for Thermal-Links – Requirements and Application Guide, UL 60691; or

2) One thermal cutoff has a Conductive Heat (CH) rating:

i) and temperature on the stationary contact lead of the thermal cutoff without a CH rating is greater than or equal to the temperature on its case, as tested per SA15.10; or

ii) the CH rated thermal cutoff has a set-point temperature equal to or higher than the thermal cutoff without a CH rating; or

3) The temperature on the stationary contact lead of both thermal cutoffs without a CH rating is greater than or equal to the temperature on their respective cases as tested per SA15.10.

c) A single-operation thermostat; or

d) A manual-reset thermostat that is inaccessible to the user without the use of tools.

Exception: A drip-type coffee maker that does not include a "keep warm" feature, and is provided with an automatic shut-off manual reset operating control (see Operating Controls, Section SA10) need only be provided with a single thermal cutoff. The thermal cutoff need not have a T_{H-100} or a Conductive Heat (CH) rating.

SA12.3.2 A single-operation thermostat or a manual-reset thermostat that is provided as the thermal limiting device shall comply with the applicable requirements in the Standard for Temperature-Indicating and -Regulating Equipment, UL 873, for limiting controls. Compliance with 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, fulfills these requirements.

SA12.3.3 A thermal cutoff shall comply with the applicable requirements in the Standard for Thermal-Links – Requirements and Application Guide, UL 60691.

SA12.3.4 If a grounding-type attachment plug is provided or the enclosure of the drip-type coffee maker has metal parts that are likely to become grounded, such as a metal bottom with bumped-out metal feet, the limiting-type device shall be located in the ungrounded supply conductor (if it can be identified) and the temperature-regulating control shall be in the other conductor. If the ungrounded supply conductor cannot be identified, the limiting-type device shall be located in one supply conductor and the temperature-regulating control shall be located in the other supply conductor.

SA13 Operation Degradation

SA13.1 A drip-type coffee maker shall be operated to represent all of the intended functions in accordance with the Use and Care Literature provided with the coffee maker. Such operation shall not result in an electrical or mechanical condition that might impair compliance with the requirements in the Standard.

SA13.2 To determine compliance with SA13.1, three samples are each to be operated for 100 cycles of normal use. Each cycle is to simulate making a full container of brew followed by a keep-warm period of 30 minutes. The first 80 cycles are to be conducted using water only, without coffee or other brewing material. The remaining 20 cycles are to be conducted using water and fresh coffee or other brewing material of a type recommended by the manufacturer. Each cycle is to be conducted so as to rapidly follow the previous cycle, unless the manufacturer's operating instructions indicate some other acceptable procedure is to be followed. The water used shall be a solution of 1/4 g of sodium chloride per liter of distilled water or water having an equivalent conductivity at 25°C. If necessary, the test samples may be cleaned between cycles in accordance with the manufacturer's instructions. The basket and filter are to be in place for all cycles.