UL 859

STANDARD FOR SAFETY

Household Electric Personal Grooming Appliances

UL Standard for Safety for Household Electric Personal Grooming Appliances, UL 859

Eleventh Edition, Dated June 20, 2012

Summary of Topics

This revision oof ANSI/UL 859 dated July 14, 2021 includes the following changes in requirements:

– Addition of Cord Tag Evaluated to UL 969A; 58.1.1, Section 63, 72.1.4, 72.4.2, 72.4.4, 72.5.2, 72.5.4, and 83.5

– Replacement of reference to UL 508C, Standard for Power Conversion Equipment with the reference to UL 61800-5-1, Standard for Adjustable Speed Electrical Power Drive Systems – Part 5-1: Safety Requirements – Electrical, Thermal and Energy; 28.3.7

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

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated May 7, 2021.

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UL 859

Standard for Household Electric Personal Grooming Appliances

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The most recent designation of ANSI/UL 859 as an American National Standard (ANSI) occurred on July 14, 2021. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

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

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INTRODUCTION

1 Scope

1.1 These requirements cover electric personal grooming appliances intended for household use, such as hair curlers and dryers, combs, brushes, and similar appliances to be used in accordance with the National Electrical Code, NFPA 70.

1.2 These requirements do not cover appliances rated more than 250 volts nor appliances covered in the following Standards for Safety:

a) The Standard for Medical Electrical Equipment, Part 1: General Requirements for Safety, UL 60601-1;

b) The Standard for Personal Hygiene and Health Care Appliances, UL 1431;

c) The Standard for Household and Similar Electrical Appliances, Part 2: Particular Requirements for Shavers, Hair Clippers, and Similar Appliances, UL 60335-2-8;

d) The Standard for Motor-Operated Massage and Exercise Machines, UL 1647;

e) The Standard for Electric Heating Pads, UL 130; and

f) The Standard for Commercial Electric Personal Grooming Appliances, UL 1727.

2 Components

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

a) Comply with the requirements for that component as indicated in the individual section(s) covering that component;

b) Be used in accordance with its rating(s) 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 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 of the National Electrical Code, ANSI/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.

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

2.3 A component that is also intended to perform other functions, such as:

a) Overcurrent protection;

b) Ground-fault circuit-interruption;

c) Surge suppression;

d) Any other similar functions; or

e) Any combination thereof.

shall comply additionally with the requirements of the applicable UL standard(s) 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(s) need not be applied.

2.4 A component not anticipated by the requirements of this 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 2.1 (b) – (e).

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

3 Units of Measurement

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

3.2 Unless otherwise indicated, all voltage and current values mentioned in this standard are root-mean-square (rms).

4 Undated References

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

5 Glossary

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

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

5.3 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.

5.4 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.

5.5 AUTOMATIC CONTROL – A device intended for automatic control of operating time, temperature, or pressure under conditions of intended operation and not for protection against conditions resulting from abnormal operations.

5.6 AUTOMATICALLY CONTROLLED APPLIANCE – An appliance that complies with one or more of the following conditions:

a) The repeated starting of the appliance is independent of any manual control if, after one complete cycle of operation, a limit device or similar component opens the circuit;

b) During any single preset cycle of operation, the motor is caused to stop and restart;

c) When the appliance is energized, the initial starting of the motor may be intentionally delayed beyond intended, conventional starting; and

d) For an appliance using a motor with a separate starting winding, during any single predetermined cycle of operation, automatic changing of the mechanical load reduces the motor speed sufficiently to re-establish starting-winding connections to the supply circuit.

5.7 BODY-SUPPORTED APPLIANCE – An appliance that is physically supported by any part of the body, other than the hand of the user, during the performance of its intended functions (such as a shoulder-, body-, or head-supported hair dryer). Reference is to be made to the user manual of the appliance in establishing the intended functions of the appliance.

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

5.9 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.

5.10 CONTROL, MANUAL – A device that requires direct human interaction to activate or reset the control.

5.11 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 mitigate the potential hazard, is considered an operating control. Operating controls are also referred to as “regulating controls”.

5.12 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 reasonably anticipated abnormal operation of the appliance. Protective controls are also referred to as “limiting controls” and “safety controls.”

Note – During the evaluation of the protective control/circuit, the protective functions are verified under normal and single-fault conditions of the control.

5.13 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.

5.14 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.

5.15 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.

5.16 COUNTER-SUPPORTED APPLIANCE – An appliance that is physically supported by a counter, table, or bench during the performance of its intended functions (such as a bonnet-type hair dryer). Reference is to be made to the user manual of the appliance in establishing the intended functions of the appliance.

5.17 DIRECT PLUG-IN APPLIANCE – An appliance, without a power supply cord, that is physically supported by direct insertion of its integral blades into a receptacle.

5.18 DUAL-VOLTAGE APPLIANCE – An appliance rated for use at 120 or 240 volts and provided with a means to change from one voltage to the other.

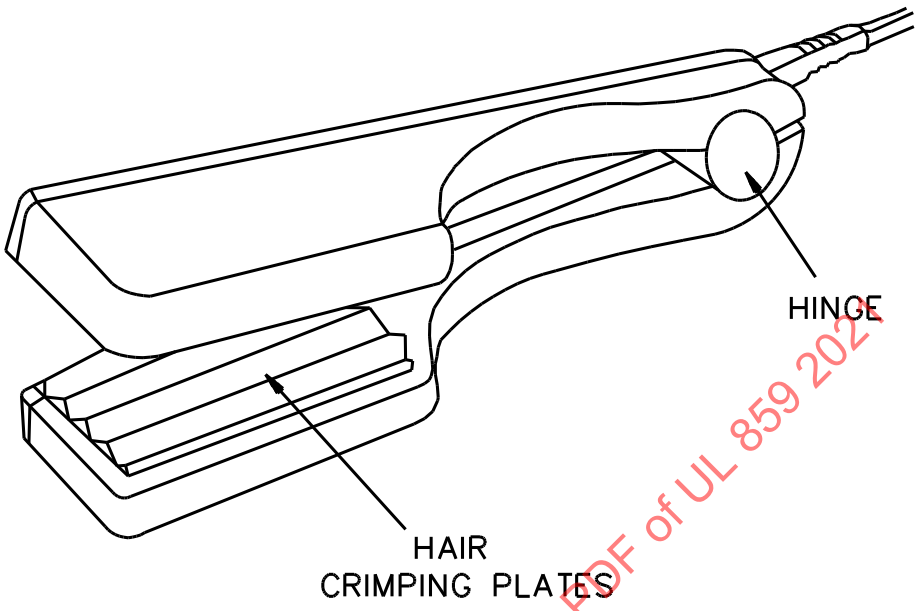
5.19 FIXED APPLIANCE – An appliance intended to be permanently connected electrically.

5.20 FLOOR-SUPPORTED APPLIANCE – An appliance that is physically supported by the floor during the performance of its intended functions (such as hair dryers with roll-about stands). Reference is to be made to the user manual of the appliance in establishing the intended functions of the appliance.

5.21 HAIR CRIMPING IRON – A hand-supported hair curling appliance having hinged arms and ridged or wavy surfaced electrically heated tongs between which hair is placed. A typical construction is shown in Figure 5.1.

Figure 5.1

Typical hair crimping iron



5.22 HAIR CURLER HEATER (HAIR SETTER) – A counter-supported appliance having posts or wells on or in which hair curling devices (such as rollers) are heated before being applied to the hair. The term also applies to a construction that has individual electrical hair curlers (rollers) with built-in heating elements and male electrical fittings which plug into female contacts in the appliance.

5.23 HAIR STRAIGHTENING IRON – An appliance similar to a hair crimping iron described in 5.21 except that the hair crimping plates are replaced with flat plates.

5.24 HAND-HELD APPLIANCE/HAND-GUIDED APPLIANCE – A portable appliance that during intended use is contacted by the hand of the user for purposes of electrical or physical control but not for complete support.

5.25 HAND-SUPPORTED APPLIANCE – An appliance that is physically supported by the hand of the user during the performance of its intended functions (such as a curling iron). Reference is to be made to the user manual of the appliance in establishing the intended functions of the appliance.

5.26 HEATED AIR CURLING IRON (or BRUSH) – A curling iron (or brush) in which a fan included in the appliance blows air over the heating elements and out through openings in the barrel of the appliance.

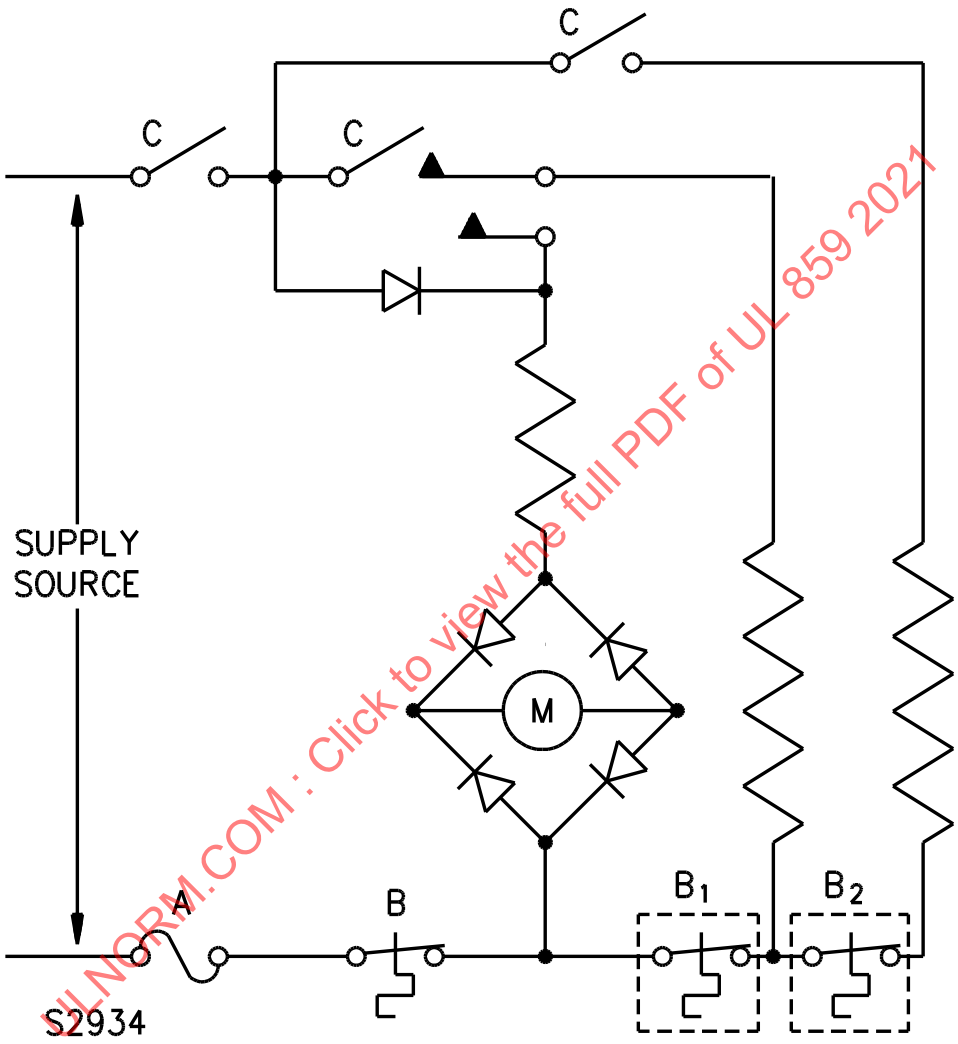
5.27 HIGH-VOLTAGE CIRCUIT – A circuit involving a potential of more than 600 volts.

5.28 INPUT VOLTAGE SELECTOR – The means provided on an appliance to adjust for the available input voltage.

5.29 LIMIT CONTROL – As applicable to hand-supported hair dryers, a limit control, as shown in item A of Figure 5.2, is a non-resettable control (a control intended to operate only once) that operates to open all electrical circuits to reduce the risk of fire or electric shock.

Figure 5.2

Typical hair dryer circuit



A – Limit control (a non-resettable device, as defined in 5.28).

B – Temperature control (a calibrated automatic-reset device, as defined in 5.36).

B_1, B_2 – Temperature control shown at two other locations.

C – Switches.

M – Motor.

5.30 LIMITED ENERGY PRIMARY CIRCUIT – A line voltage circuit that incorporates a limiting impedance in series with the supply circuit so that:

a) The circuit potential on the load side of the limiting impedance does not exceed 42.4 volts peak (30 volts rms) under intended conditions; and

b) The maximum energy available at the load side of the limiting impedance circuit is 100 volt-amperes under any condition, including abnormal operation.

5.31 LINE VOLTAGE CIRCUIT – A circuit involving a potential of not more than 250 volts and having circuit characteristics in excess of those of a low-voltage circuit or a limited primary energy circuit.

5.32 LOW-VOLTAGE CIRCUIT – A circuit supplied by a primary battery, by a Class 2 transformer, or by a combination of a transformer and fixed impedance that, as a unit, complies with all performance requirements for Class 2 transformers and that does not involve an open circuit potential of more than 42.4 volts peak (30 volts rms).

5.33 PORTABLE APPLIANCE – An appliance capable of being carried or conveyed.

5.34 PREHEAT CYCLE – A cycle of operation, intended for rapid heating, in which the heating element operates at an initial higher level of energy for a period of time. The energy level then declines to a lower normal use temperature-maintenance level. It may fluctuate between the high and low levels during a use of the appliance. The energy level may be controlled by varying the amount of wattage, the duration or duty cycle, or a combination thereof. The change in the energy level may be initiated by a timer, a temperature controller, or a combination of the two. Appliances having a preheat cycle of operation are commonly known as "Instant Heat" type. The temperature transient condition associated with the operation of a positive temperature coefficient (PTC) heating element or a thermostat is not considered to be a preheat cycle.

The following are some examples of preheat type appliances:

a) The appliance operates at the higher preheat wattage level for a length of time determined by a timing device or circuit. The wattage then drops to a constant lower temperature-maintenance level for the remainder of operation.

b) The appliance operates at a higher preheat wattage level initially for varying lengths of time depending upon temperature. The wattage varies with time in response to the temperature controller to maintain normal operating temperature.

c) The appliance operates at a fixed wattage level for a predetermined length of time. Then the same amount of wattage is applied on a pre-programmed duty cycle by means of a switching mechanism to maintain normal operating temperature.

d) The appliance operates at a fixed wattage level for a predetermined length of time. Then the same amount of wattage is applied on a duty cycle that adjusts depending upon temperature by means of a switching mechanism and a temperature controller.

5.35 STATIONARY APPLIANCE – A cord-connected appliance intended to be fastened in place or located in a dedicated space.

5.36 TEMPERATURE CONTROL – As applicable to hand-supported hair dryers, a temperature control, as shown in item B of Figure 5.2, is an automatic-reset temperature-sensing control that opens an electrical circuit to limit temperatures during Abnormal Operation Tests described in Section 46 and/or Normal Temperature test (except no fabric condition) described in 44.5.3. A temperature control is calibrated and endurance tested for at least 6,000 cycles of operation and complies with all other requirements in the Standard for Limit Controls, UL 353, or 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/or the applicable Part 2 standard from the UL 60730 series fulfills the UL 873 requirements. See 24.2.1 – 24.2.2.

5.37 TEMPERATURE-REGULATING CONTROL – A control that functions only to regulate the temperature under conditions of intended use.

5.38 THERMAL CUT-OFF – A temperature- or temperature- and current-sensitive device that is replaceable but not resettable. It is intended to reduce the risk of fire, electric shock, or injury to persons due to overheating of an appliance during abnormal operation.

5.39 WALL-HUNG APPLIANCE – A cord-connected appliance that is provided with keyhole slots, hanger holes, similar feature for hanging on a wall during the performance of its intended function. A wall-hung appliance may consist of two interconnected units where one is intended to hang on a wall and the other is intended to be supported by hand during use. Reference is to be made to the user manual of the appliance in establishing the intended functions of the appliance.

5.40 WAX DEPILATORY APPLIANCE – An appliance intended for melting a wax-like material (hereafter referred to as wax) that is first applied to and then stripped from the body for the purpose of removing unwanted hair.

CONSTRUCTION

6 General

6.1 In the following text, a requirement that applies only to a specific type or types of appliances, such as a hand-supported hair dryer and a curling iron, is so identified by specific reference in that requirement to the type or types involved. Absence of such specific reference or use of the term "appliance" indicates that the requirement applies to all appliances covered by this standard.

6.2 An appliance that is a combination of two or more types (for example, an appliance having a hand-supported part and a counter-supported part), or an appliance that fits the definition of two or more types (for example, an appliance that can be used while supported by hand or while supported by a counter top), is to be investigated in accordance with the applicable requirements for the types of appliances involved. If two requirements that address the same condition differ, the appliance is to be investigated to the more severe requirement.

6.3 A heated air curling iron or brush, as defined in 5.25, shall comply with the requirements applicable to hand-supported hair dryers and curling irons.

6.4 A container for liquid intended for use with the appliance, and supplied as part of the appliance, shall comply with applicable construction requirements.

6.5 A curling iron that is likely to be laid on combustible material shall be provided with a stand made of material resistant to combustion upon which it may be placed when not in use.

Exception: A stand need not be provided if the temperature attained by the appliance is not sufficiently high to cause the ignition of the combustible material.

6.6 A curling iron that attains a temperature higher than 100°C (212°F) when operated continuously shall be provided with an integral stand. A stand provided for other types of appliances may be a separate device or integral with the appliance.

6.7 With respect to 6.6, an integral stand provided for a curling iron shall be of such design or shape that any surface of the curling iron exceeding 150°C (302°F) will not contact the supporting surface when the curling iron is supported in its intended manner by the stand.

6.8 A polymeric material used as an integral stand in compliance with the requirements in 6.7 shall be rated for the temperature it is subjected to during use.

7 Hair Dryer Immersion Protection

7.1 A hand-supported hair-drying appliance (such as a hair dryer, blower-styler, styler-dryer, heated air comb, heated-air hair curler, curling iron-hair dryer combination, a wall-hung hair dryer or the hand unit of a wall-mounted hair dryer, or a similar appliance) shall be constructed to reduce the risk of electric shock when the appliance is energized, with its power switch in either the "on" or "off" position, and immersed in water having an electrically conductive path to ground.

7.2 Compliance with 7.1 may be accomplished with the use of an:

a) Integral ground-fault circuit-interrupter (GFCI) or

b) Integral protective device of another type that de-energizes all current-carrying parts (hereafter referred to as a protective device) when the hand-supported hair-drying appliance is immersed in water having an electrically conductive path to ground.

7.3 If a hand-supported hair-drying appliance is provided with a GFCI, the GFCI shall comply with the requirements for Class A cord-connected GFCIs in the Standard for Ground-Fault Circuit-Interrupters, UL 943.

Exception: A GFCI located in the wall unit of a wall-mounted permanently-connected hair dryer shall comply with the requirements for Class A permanently-connected GFCIs in UL 943.

7.4 If a hand-supported hair-drying appliance is provided with a protective device other than a GFCI, the protective device shall be investigated and determined to be acceptable for the application. Investigation of the protective device shall include, but need not be limited to, consideration of:

a) Electrical rating,

b) Operating temperatures,

c) Reliability of operation,

d) Resistance to the effects of abnormal operating conditions,

e) Resistance to mechanical abuse,

f) Resistance to electrical transients, and

g) Resistance to moisture.

The combination of hair-drying appliance and protective device shall comply with the test described in the Immersion-Protection Trip Time Measurement Test, Section 40.

Exception No. 1: A protective device is deemed acceptable for the application if it complies with the requirements for Class A cord-connected GFCIs in the Standard for Ground-Fault Circuit-Interrupters, UL 943, except that it is not required to:

a) Have a grounding conductor;

b) Have the same type of power supply cord;

c) Comply with the high-resistance ground faults test under the condition that any power conductor is open-circuited; or

d) Provide grounded neutral protection by compliance with the high-resistance ground faults test, under the test condition that the neutral conductor is grounded at a point in the load circuit.

Exception No. 2: A protective device is deemed acceptable for the application if it complies with the requirements in the Standard for Appliance Leakage-Current Interrupters, UL 943B.

The combination of a hand-supported hair-drying appliance and such a protective device is not required to be subjected to the test described in the Conductive Coating Test, Section 35.

7.5 A GFCI or other protective device shall be integral with the attachment plug of the hand-supported hair-drying appliance power supply cord.

Exception No. 1: For a wall-mounted permanently-connected hair dryer, the GFCI or other protective device may be located in the wall unit.

Exception No. 2: A GFCI or other protective device may be located in the power supply cord as a through-cord construction or in the hair dryer enclosure, after additional investigations with regard to acceptability after immersion, resistance to mechanical abuse, and similar considerations.

7.6 A user-resettable protective device shall incorporate a supervisory circuit as described in the Standard for Ground-Fault Circuit-Interrupters, UL 943, for GFCIs.

Exception: A user-resettable protective device may be provided with a reset feature not having a test function based on all of the following:

a) The protective device complies with the Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991. If the computational investigation is conducted, the maximum predicted failure rate (λp) shall not exceed 1.5 failures per million hours predicted. If the demonstrated method is conducted, the test acceleration multiplier shall be 5763.

b) The instructions provided with the appliance alert the user to the reset feature and how and when to use it.

c) The instructions provided with the appliance alert the user to not reset and reuse the appliance should the protective device trip as a result of immersion.

7.7 A switch included for testing a user resettable protective device shall be permanently marked "Test" and "Reset" on or adjacent to the switch actuators.

7.8 After a protective device de-energizes current-carrying parts, it shall not automatically reset.

7.9 A protective device that is integral with the attachment plug of a hand-supported hair-drying appliance may be provided with a single outlet convenience receptacle when all of the following requirements are met:

a) The convenience receptacle is:

1) Of the same configuration as the attachment plug,

2) Wired on the load side of the protective device, and

3) Wired so that the same polarization as the attachment plug is maintained.

b) The convenience receptacle has a rating of 15 amperes, 125 volts and complies with the Standard for Attachment Plugs and Receptacles, UL 498.

c) The face of a convenience receptacle that is less than 5/8 inch (15.9 mm) wide or 7/8 inch (22.2 mm) long complies with the mounting clearance requirements specified in 22.8.

d) The area surrounding the convenience receptacle is free of any projections that might interfere with full insertion of the blades of an attachment plug having a face size as specified in Figure 7.1.

e) When an attachment plug, as shown in Figure 7.1, is fully inserted into the convenience receptacle, the test and reset buttons of a user-resettable protective device are accessible for testing and resetting the protective device without the use of a tool.

f) The protective device complies with the requirements for cord-connected GFCIs specified in the Standard for Ground-Fault Circuit-Interrupters, UL 943.

Exception No. 1: Flexible cord acceptable for use with hand-supported hair dryers as specified in Table 13.2 may be used.

Exception No. 2: Means for grounding need not be provided.

g) The convenience receptacle contact slots and grounding hole, if any, are located so that the line blades of a grounding-type plug cannot be mated by deliberate manual force, including manipulation, to deflect the grounding pin to the outside of the body of the protective device. An obstruction provided to comply with this requirement is to have minimum size and shape indicated by the shaded area in Figure 7.2. The obstructions are to be coplanar with the face or recessed by no more than 3/32 inch (2.4 mm). Constructions having rigid bodies, which are materials having a minimum hardness of 90 when measured on the "A" scale of a Shore Durometer, may have the indicated "A" dimensions reduced to 0.531 inch (13.5 mm).

h) The hair dryer immersion protective device complies with the abnormal operation test described in 46.10.1 – 46.10.5.

i) A permanent and legible marking is provided near the convenience receptacle to:

1) Specify the maximum current and wattage rating of an appliance intended to be plugged into the convenience receptacle as specified in 72.1.7,

2) Indicate that the appliance is to be unplugged immediately after use as specified in 72.10.1, and

3) Indicate that a direct plug-in (cordless) appliance is not to be used as specified in 72.10.1.

j) The instruction manual includes the operating instructions specified in 76.10.

Figure 7.1

Plug-face dimensions for determining acceptable convenience receptacle insertion clearance

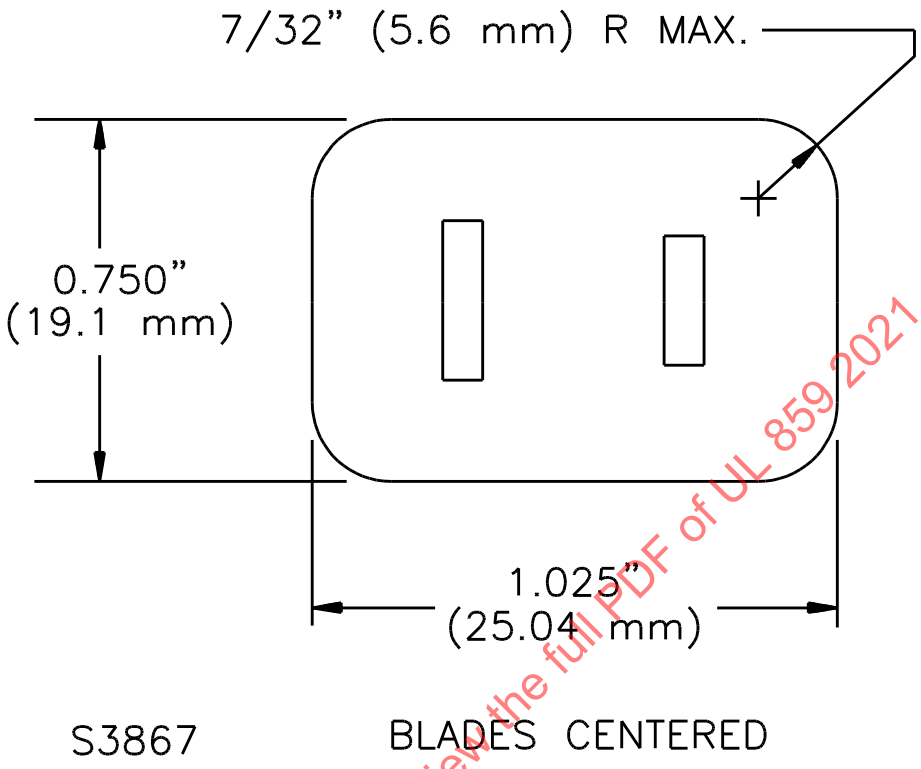
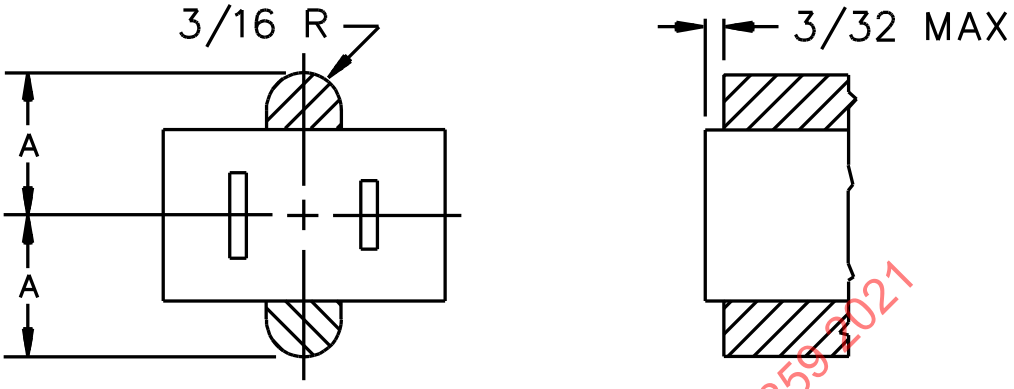
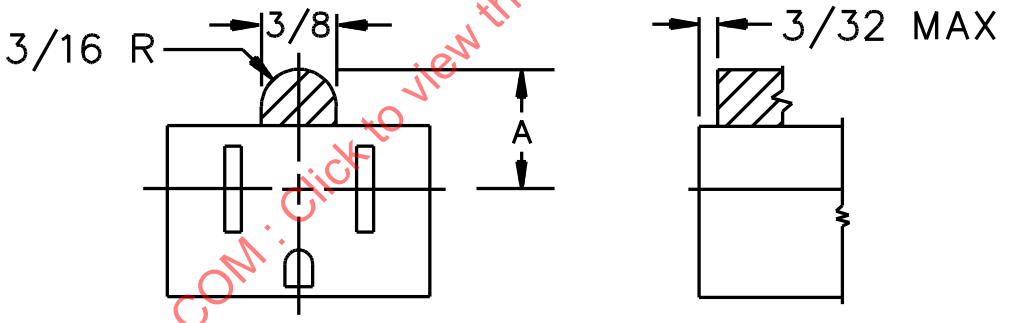


Figure 7.2

Face of a 15-ampere, 125-volt convenience receptacle showing the smallest acceptable obstruction (shown shaded) for the grounding pin on the mating plug



Obstruction for a 2-Pole, 2-Wire (Nongrounding) Receptacle



Obstruction for a 2-Pole, 3-Wire (Grounding) Receptacle

Inch	3/32	3/16
mm	2.4	4.8

Dimension A		Shore Durometer Hardness
Inch	mm	(Scale A)
0.625	15.9	less than 90
0.531	13.5	90 or more

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7.10 With regard to 7.9(f), each output circuit shall be considered if one is not representative of the other. For example, the short circuit test shall be conducted with each output short-circuited one at a time. The dielectric voltage-withstand test between line-connected circuits and load circuits shall include both load circuits. The temperature test shall be conducted with:

a) The hair dryer load circuit and the convenience receptacle each loaded to rated value and

b) The convenience receptacle loaded to 15 amperes with no load connected to the hair dryer load circuit.

8 Frame and Enclosure

8.1 General

8.1.1 The frame and enclosure of an appliance shall be sufficiently strong and rigid to resist the abuses likely to be encountered during 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 conditions which alone or in combination constitute an increase in the risk of fire, electric shock, or injury to persons.

8.1.2 Among the factors taken into consideration in evaluating an enclosure for acceptability are its:

a) Physical strength,

b) Resistance to impact,

c) Moisture absorptive properties,

d) Combustibility,

e) Resistance to corrosion, and

f) Resistance to distortion at temperatures to which the enclosure may be subjected under conditions of normal or abnormal use.

For a nonmetallic enclosure, all these factors are to be considered with respect to thermal aging.

8.2 Polymeric enclosures and parts

8.2.1 A polymeric enclosure shall comply with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

Exception: The Abnormal Operation Tests, Section 46, shall be applied in lieu of the abnormal and severe conditions requirements specified in UL 746C. For the polymeric enclosure of an appliance other than a hand-supported hair dryer, the use of HB material may require additional abnormal or severe conditions tests.

8.3 Metal enclosures

8.3.1 The minimum thickness of a metal enclosure shall be as indicated in Table 8.1.

Table 8.1
Minimum thickness of enclosure metal

Metal	Thickness at small, flat, unreinforced surfaces and at surfaces that are reinforced by curving, ribbing, and the like (or are otherwise of a shape or size) to ensure adequate physical strength,		Thickness at surfaces to which a wiring system is to be connected in the field,		Thickness at relatively large unreinforced flat surfaces,	
	inch	(mm)	inch	(mm)	inch	(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)	0.032	(0.81)	0.026	(0.66)
Galvanized sheet steel	0.029[a]	(0.74)	0.034	(0.86)	0.029	(0.74)
Nonferrous sheet metal	0.036[a]	(0.91)	0.045	(1.14)	0.036	(0.91)

[a] Thinner sheet metal may be used if determined to be acceptable when the enclosure is evaluated under considerations such as those specified in 8.1.2.

8.4 Corrosion resistance

8.4.1 Iron and steel parts shall be made corrosion resistant by painting, galvanizing, plating, or other equivalent means if the malfunction of such unprotected parts would result in a risk of fire, electric shock, or injury to persons.

Exception No. 1: In constructions in which the oxidation of iron or steel due to the exposure of the metal to air and moisture will not be appreciable – thickness of metal and temperature also being factors – surfaces of sheet steel and cast-iron parts within an enclosure not required to be made corrosion resistant.

Exception No. 2: Bearings, lamination, or minor parts of iron or steel, such as washers, screws, and similar parts are not required to be made corrosion resistant.

8.4.2 A container for liquid shall be made resistant to the possible corrosive effect of the liquid intended to be used in the container.

8.5 Accessibility of live parts

8.5.1 An electrical part of an appliance shall be located or enclosed so that unintentional contact with any uninsulated live part and internal wiring will be prevented.

8.5.2 A part of the outer enclosure that is capable of being opened or removed by the user without using a tool (to attach an accessory, to make an operating adjustment, to replace a fuse, or for other reasons) is to be opened or removed when determining compliance with 8.5.1.

8.5.3 The enclosure of an appliance shall have no opening that permits a probe, as illustrated in Figure 8.1, to touch any part that involves a risk of electric shock.

Figure 8.1

Articulate probe with web stop

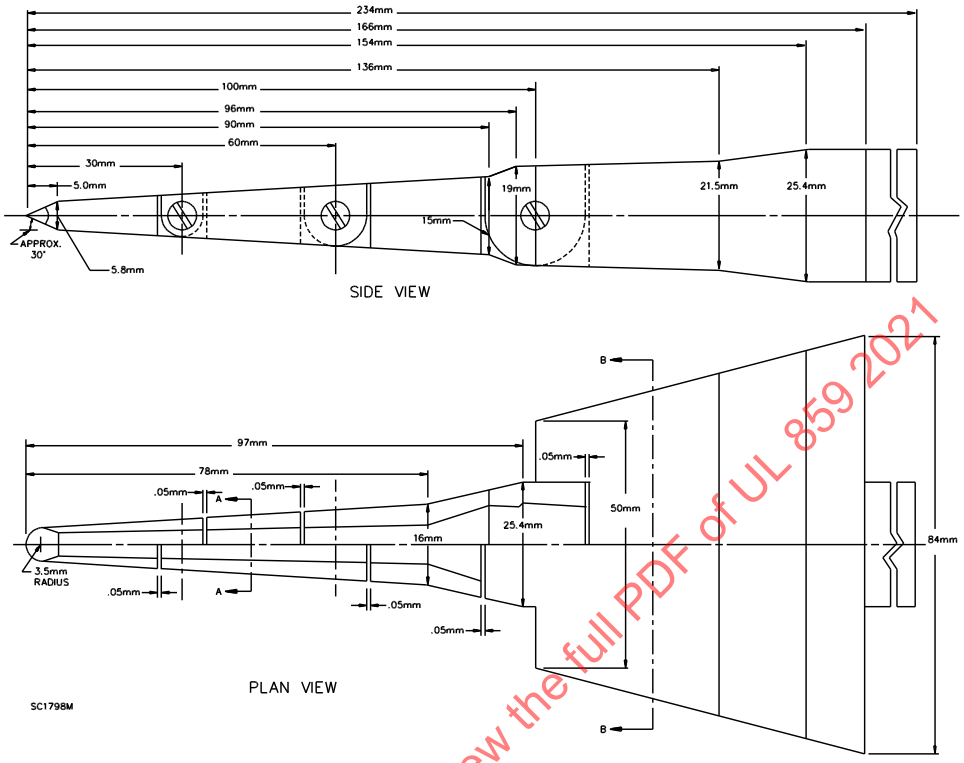
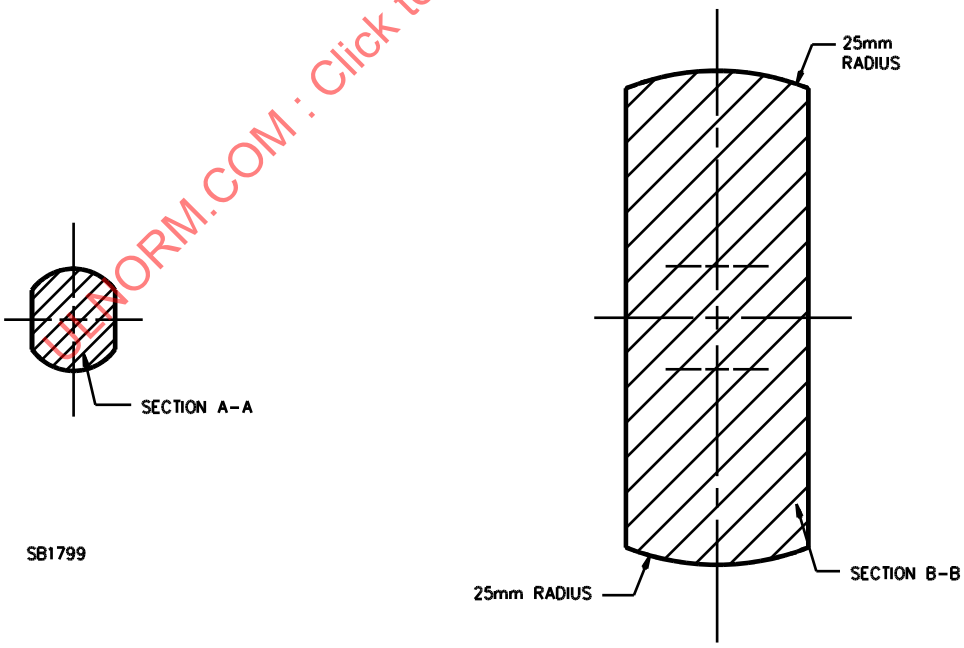


Figure 8.1 (Cont'd)

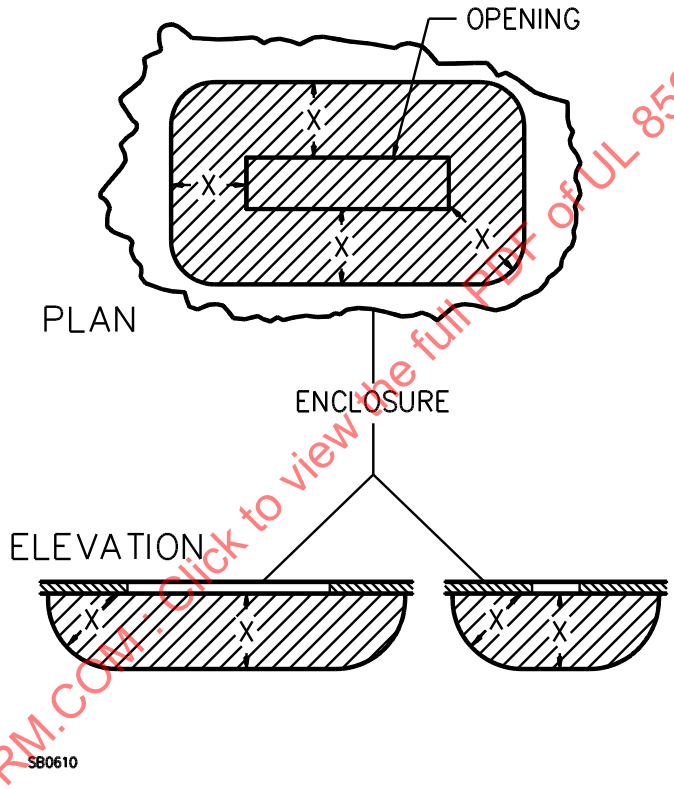


8.5.4 With regard to 8.5.3, the probe is to be articulated into any configuration and rotated or angled to any position before, during, or after insertion into the opening. The penetration shall be to any depth allowed by the opening size, including minimal depth combined with maximum articulation. The probe shall be applied with the minimum force required to determine accessibility and not as an instrument to evaluate the strength of a material.

8.5.5 An opening that will permit entrance of a 1-inch (25.4-mm) diameter rod is permitted when it complies with the conditions shown in Figure 8.2.

Figure 8.2

Opening in enclosure



NOTE – The opening is acceptable if, within the enclosure, there is no uninsulated live part or film-coated wire:

a) Less than X distance from the perimeter of the opening, as well as

b) Within the volume generated by projecting the perimeter X distance normal to its plane.

X equals five times the diameter of the largest diameter rod that can be inserted through the opening, but not less than 6-1/16 inches (154 mm).

8.5.6 A live part of a limited-energy circuit in 5.30 requires the same degree of protection against unintentional contact as a live part of a line voltage circuit.

8.5.7 Insulated brush caps do not require additional enclosure.

8.5.8 An area of an enclosure that is provided with a group of openings or with a guarded opening (such as a grille, louver, or screen) is to be subjected to the strength of enclosure test described in 35.1.

8.5.9 The enclosure of a remotely or automatically controlled appliance shall reduce the risk of molten metal, burning insulation, or flaming particles, from falling on combustible materials, including the surface upon which the appliance is supported.

8.5.10 The requirement in 8.5.9 will necessitate the use of a barrier of material that is resistant to combustion:

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) Main winding opened;

ii) Starting winding opened;

iii) Starting switch short-circuited; and

iv) For a permanent split capacitor motor, the capacitor short-circuited (the short circuit is to be applied before the motor is energized, and the rotor is to be locked);

or

3) The motor is provided with a thermal motor protector (a protective device that is sensitive to temperature and current) that will prevent the temperature of the motor windings from exceeding 125°C (257°F) under the maximum load under which the motor will run without causing the protector to cycle, and from exceeding 150°C (302°F) with the rotor of the motor locked.

b) Under wiring, unless the wiring is provided with flame-retardant rating VW-1 (FR-1), or wiring contained within sleeving rated VW-1, or the equivalent.

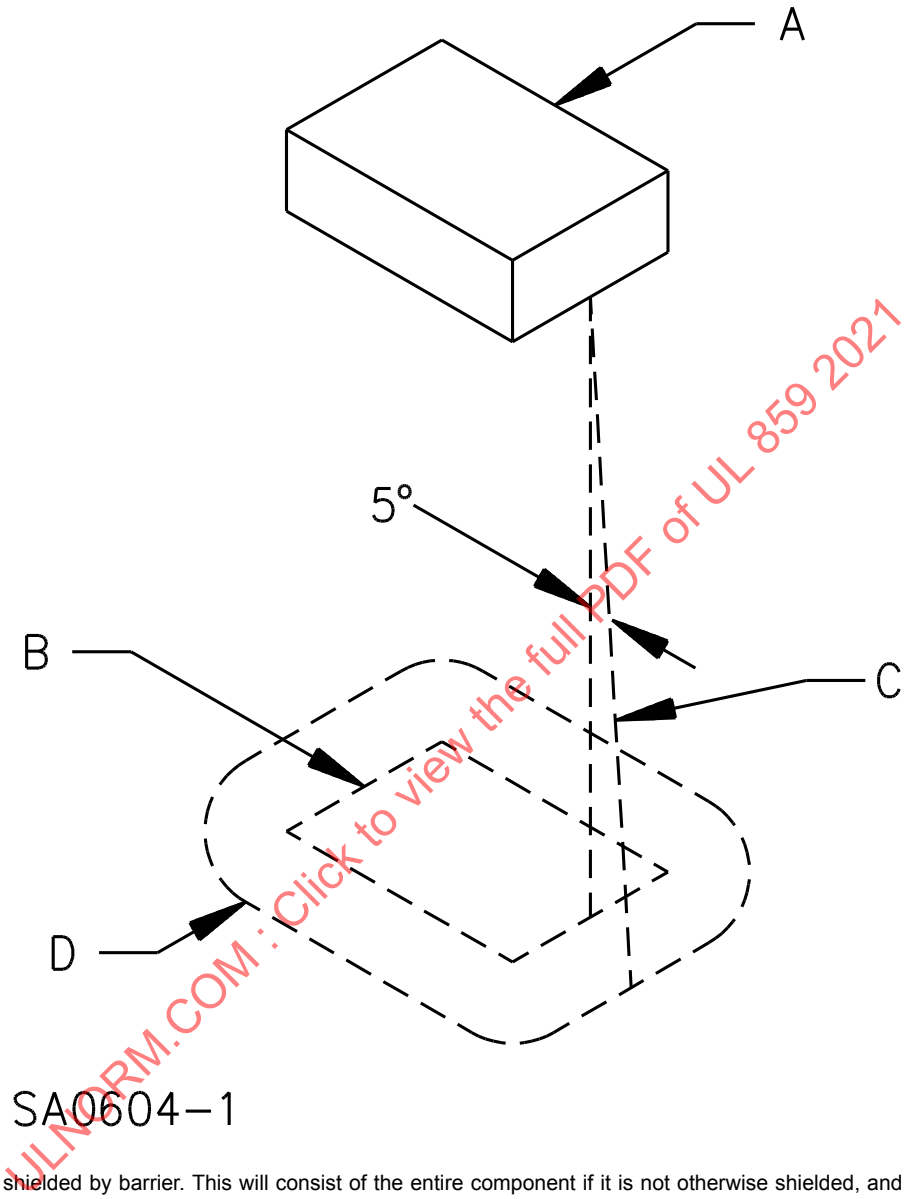
8.5.11 The requirement in 8.5.9 will also necessitate that a switch, relay, solenoid, or the similar part be individually and completely enclosed unless there is no opening in the bottom of the appliance enclosure, or it can be shown that malfunction of the component would not result in a risk of fire.

Exception: Terminals of a switch, relay, solenoid, or the like are not required to be individually and completely enclosed.

8.5.12 The barrier specified in 8.5.10 shall be horizontal, shall be located as indicated in Figure 8.3, and shall have an area no less than that described in Figure 8.3. An opening such as for drainage or ventilation, is permitted in the barrier if such an opening would not permit molten metal, burning insulation, or flaming particles to fall on combustible material.

Figure 8.3

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 which is partially shielded by the component enclosure or equivalent.

B – Projection of outline of component on horizontal plane.

C – Inclined line which traces out minimum area of barrier. When moving, the line is always:

1) Tangent to the component,

2) 5 degrees from the vertical, and

3) Oriented so 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.

8.6 Doors and covers

8.6.1 The door or cover of an enclosure shall be provided with means for holding it in the closed position.

8.6.2 The door or cover of an enclosure shall be hinged (or similarly attached) if it gives access to any overload protective device, the functioning of which requires renewal, or if it is necessary to open the cover in connection with the operation of the protective device. Such a door or cover shall be provided with a latch or similar device and shall be tight-fitting or shall overlap the surface of the enclosure around the opening.

9 Reduction of Risk of Injury to Persons

9.1 General

9.1.1 Materials that are relied upon to reduce the risk of injury to persons shall have such properties as to meet the demand of intended loading conditions.

9.1.2 Asbestos shall not be used.

9.1.3 A moving part that can result in a risk of injury to persons shall be enclosed or provided with other means to reduce unintentional contact.

9.1.4 With respect to the requirement specified in 9.1.3, the construction and intended use of the appliance are to be considered in investigating a guard or enclosure. Among the factors to be evaluated in evaluating the acceptability of an exposed moving part are:

a) The degree of exposure;

b) The sharpness of the moving part; and

c) The possibility of fingers, arms, hair, or clothing being drawn into the moving part (such as at points where gears mesh, where belts travel onto a pulley, or where moving parts close in a pinching or shearing action).

9.1.5 An appliance, or any item furnished with an appliance, shall have no sharp edge, burr, point, or spike inside or outside the appliance that results in injury to persons during intended use and maintenance.

9.1.6 On an appliance adjustable for height, means shall be provided for holding the upper parts securely in position. Means shall also be provided to prevent the upper part from descending rapidly if the securing means loosens or fails to operate as intended.

9.1.7 A hand-supported hair dryer shall have each air intake opening provided with a screen or equivalent means so that there are no openings larger than 0.004 square inch (0.03 cm^2).

9.2 Appliances with reservoirs

9.2.1 An appliance in which liquid reaches a temperature greater than 46°C (114.8°F) shall comply with the requirements specified in 9.2.2 – 9.2.4, 36.1 – 36.3, and 37.2.

Exception No. 1: An electrode-type appliance is not required to comply with these requirements. For requirements for an electrode-type appliance, see Sections 78 – 84.

Exception No. 2: A wax depilatory appliance is not required to comply with the requirements specified in 9.2.3, 9.2.4, and 36.1 – 36.3.

9.2.2 The construction of the appliance shall reduce the risk of injury to persons under conditions of intended use. Openings through which liquid can be emitted shall not be provided unless such openings are needed to perform an operating function.

9.2.3 An appliance with a vessel or container with a capacity of more than 32 fluid ounces (946 mL) shall be provided with a fully inserting or a lock-on lid.

9.2.4 If any part of an appliance requires assembly (for example, engagement of a twist-lock part), then improper assembly that results in a risk of injury to persons shall be clearly visible to the user.

9.3 Wax depilatory appliances

9.3.1 The maximum temperature of the wax, measured as described in 44.2.1 – 44.2.3, shall not exceed 75°C (167°F).

9.3.2 The maximum temperature rise of surfaces that may be contacted by the user shall be as specified in Table 44.2.

9.3.3 When there are multiple heat settings (for example, a setting for maintaining molten wax at the intended temperature for application to all of the skin and a higher heat setting for quick melting of solid wax), the appliance shall comply with all of the following:

a) If the wax is capable of being heated above 75°C (167°F) for quick melting, the reservoir in which the wax is so heated shall be provided with a nonremovable, self-closing lid or cover.

b) A visible overheat condition indicator shall be provided. Such an indicator shall indicate when the wax temperature exceeds 75°C. This indicator shall be separate and independent of any other temperature indicator (for example, an indicator light whose functioning depends upon the setting of an adjustable thermostat) which may be provided. See 44.2.3, 74.7(l)(13), and 76.8(e).

c) A marking (such as a number or symbol) shall be provided adjacent to each heat selector position. A permanent marking shall be provided on the appliance in accordance with 72.8.1(b), and the Use and Care Instructions shall warn the user against applying wax that has been heated at a setting higher than the intended setting [see 74.7(l)(13)].

d) A part of a temperature control that is user-operated (an adjustment knob or similar part) shall be constructed so that deliberate and positive action by the operator is required to select a heat setting or to change from one heat setting to another. A construction that requires two separate and distinct motions by the user (such as push and turn) is an example of a control that complies with this requirement.

9.3.4 With reference to 9.3.3(a), a nonremovable cover is one which requires special tools (tools not available to other than service personnel) for removal. A self-closing cover is a cover that returns to its fully closed position without any action on the part of the user other than releasing it from any opened position while the appliance is supported by a flat, horizontal surface.

9.3.5 In accordance with 46.9.5 and 76.8, if the malfunction of a temperature-regulating control increases the application temperature of the wax above 75°C (167°F), visible means, such as an indicator light, shall be provided to inform the user of an overheat condition.

Exception: A visible overheat condition indicator is not required if a thermal cutoff or a trip-free manual-reset thermostat operates upon short-circuiting of the temperature-regulating control. The temperatures

attained by the wax, and surfaces of the appliance that are handled or contacted by the user during intended use, at the time the thermal cutoff or thermostat opens shall not present a risk of burn as determined by an appropriate investigation. The investigation shall include consideration of the length of time that temperatures remain above the specified limits, the thermal inertia of the materials involved, and similar factors.

10 Mechanical Assembly

10.1 An appliance that involves a motor or other vibrating part shall be assembled such that the appliance will not be affected adversely by the vibration. Brush caps shall be tightly threaded or otherwise constructed to prevent loosening.

10.2 A switch (other than a through-cord switch), lampholder, receptacle, motor-attachment plug, or similar component shall be mounted securely and shall be prevented from turning.

Exception No. 1: Turn-prevention means for a switch are not required, when all the following conditions are met:

a) The switch is of the plunger or other type that does not tend to rotate when operated (a toggle switch is subject to forces that tend to rotate the switch during intended operation of the switch);

b) The means of mounting the switch is such that the operation of the switch will not result in the switch becoming loosened;

c) The spacings are not reduced below the minimum required values, if the switch does rotate; and

d) Intended operation of the switch is by mechanical means rather than by direct contact by persons.

Exception No. 2: A lampholder in which the lamp cannot be replaced (such as a neon pilot or indicator light in which the lamp is sealed in by a nonremovable jewel) is not required to be prevented from turning if the rotation cannot reduce spacings below the minimum required values.

10.3 Friction alone shall not be relied on for turn-prevention as required in 10.2. A lock-washer, applied as intended, is a reliable means of turn-prevention of a device with a single-hole mounting means.

10.4 A positive means shall be provided to prevent parts of an appliance from turning with respect to each other if such turning would result in reduction of spacings, twisting of wires, and the like.

Exception: If such parts depend upon 3/8 inch (9.5 mm) or larger pipe threads, no additional means to prevent turning need be provided.

10.5 A fastener that secures the insulating tip of a curling iron, a heated brush, or a similar appliance shall be constructed, fastened, or located so as to prevent the fastener from becoming loosened if such loosening can result in a risk of fire or electric shock.

10.6 Compliance with the requirement specified in 10.5 may be accomplished by use of:

a) Staked and upset screws,

b) Screws with properly applied lock washers,

c) Press fitting of the insulating tip into place, or

d) Other equivalent means.

A polymeric material relied upon to prevent the fasteners from loosening shall have the required mechanical strength, resistance to heat, and dimensional stability. All of these properties are to be considered with respect to thermal aging.

10.7 If any part of a metal spring of a hair clamp of a curling iron or a similar appliance can become loose inside the enclosure of electrical parts as a result of breakage of the spring, the construction shall be such that electrical spacings will not be reduced.

10.8 Compliance with the requirement specified in 10.7 may be accomplished by

a) Locating all parts of the spring outside the enclosure of electrical parts,

b) Using barriers,

c) Using physical restraints, or

d) Using other equivalent means.

10.9 The temperature sensor of a temperature controller, a thermostat, a thermal cutoff, or a similar device shall be secured in place.

11 Stability

11.1 A floor- or counter-supported appliance shall be constructed such that it will not be overturned when tested in accordance with 37.1.

Exception: An appliance whose overturning during intended use will not present a risk of burns or injury to persons need not be tested.

11.2 With regard to 11.1, a hand-supported hair dryer provided with a stand for conversion into a counter-supported hair dryer is to be evaluated as a hand-supported appliance and is not to be subjected to the stability test.

11.3 A wax depilatory appliance shall be tested and the results shall be evaluated as described in 37.2, except that the wax may be in any combination of solid and liquid states anticipated during the intended operation of the appliance. Any movable parts or covers are to be in the positions that result in the most adverse conditions of use.

Exception: The test need not be conducted on a construction for which there is no possibility of molten wax spilling from its container under any condition of use, such as constructions in which the wax material is contained within completely enclosed wax applicators.

12 Hanging and Mounting Means

12.1 A wall-hung or a wall-mounted appliance shall withstand a force as described in 59.1 without evidence of damage to the mounting surface, to the hanging means, to the mounting means, or to the appliance that results in the risk of electric shock, fire, or injury to persons.

12.2 A cord-connected appliance that is provided with keyhole slots, notches, hanger holes, or similar feature, for hanging the appliance on a wall, shall be:

a) Provided with the necessary hardware for hanging the appliance in accordance with the installation instructions and

b) Constructed in such a manner that the hanging means (such as screws) shall not be accessible without removing the appliance from the supporting means.

12.3 When determining compliance with 12.2, any part of the enclosure or barriers that can be removed without the use of tools to gain access to the hanging means is to be removed.

12.4 A keyhole slot, notch, or hanger hole shall be located so that the supporting screws or similar hardware cannot damage any electrical insulation or reduce spacings to current-carrying parts of the appliance.

12.5 A permanently installed wall-mounted appliance shall be provided with the necessary hardware for mounting in accordance with the installation instructions.

Exception: Small parts commonly available for the mounting of the appliance need not be provided if the installation instructions refer to such parts as specified in 75.4.

13 Supply Connections

13.1 Permanently-connected appliances

13.1.1 An appliance intended for permanent connection to a power supply, either by being fastened in place, located in a dedicated space, or both, shall have provision for connection of one of the wiring systems that is acceptable for the appliance.

Exception: If an appliance is not intended for permanent connection to a power supply, but is intended to be either fastened in place, located in a dedicated space, or both, it may be provided with a short length of flexible cord in accordance with 13.3.1.1 – 13.3.1.3 and 13.3.1.6 and with an attachment plug for supply connection. The investigation of such a feature will include consideration of the utility of the appliance and the reasons for having it detachable from its supply source by means of the attachment plug.

13.1.2 The location of a terminal box or compartment in which a power supply connection to a permanently-connected appliance is to be made shall be such that the connection may be readily inspected after the appliance is installed as intended.

13.1.3 A terminal compartment intended for the connection of a supply raceway shall be attached to the appliance so as to be prevented from turning.

13.2 Wiring terminals

13.2.1 An appliance intended for permanent connection to the power supply shall be provided with wiring terminals or leads for connection of supply circuit conductors. Such wiring terminals or leads shall accommodate conductors having an ampacity of not less than 125 percent of the appliance current rating when the load is continuous (3 hours or more), and not less than the appliance current rating when the load is intermittent.

13.2.2 For the purpose of these requirements, wiring terminals are considered to be terminals to which power supply or control connections will be made in the field when the appliance is installed.

13.2.3 A wiring terminal shall be provided with a soldering lug or with a pressure terminal connector securely fastened in place (for example, firmly bolted or held by a screw).

Exception: A wire-binding screw may be used at a wiring terminal intended to accommodate a 10 AWG (5.3 mm^2) or smaller conductor if upturned lugs or the equivalent are provided to hold the wire in position.

13.2.4 A wiring terminal shall be prevented from turning or shifting in position by means other than friction between surfaces. This may be accomplished by two screws or rivets; by square shoulders or mortices; by a dowel pin, lug, or offset; by a connecting strap or clip fitted into an adjacent part; or by an equivalent means.

13.2.5 A wire-binding screw at a wiring terminal shall be no smaller than No. 10 (4.8 mm).

Exception: A No. 8 (4.2 mm) screw may be used at a terminal intended only for the connection of a 14 AWG (2.1 mm^2) conductor, and a No. 6 (3.5 mm) screw may be used for the connection of a 16 AWG (1.3 mm^2) or 18 AWG (0.82 mm^2) control-circuit conductor.

13.2.6 A terminal plate tapped for a wire-binding screw shall be of metal not less than 0.050 inch (1.27 mm) thick. There shall be two or more full threads in the metal, which may be extruded if necessary to provide the threads.

Exception: A plate less than 0.050 inch thick, but not less than 0.030 inch (0.762 mm) thick, is acceptable if the tapped threads are determined to have equivalent mechanical strength.

13.2.7 Upturned lugs or a cupped washer shall be capable of retaining a conductor of the size specified in 13.2.1, but not smaller than 14 AWG (2.1 mm^2), under the head of the screw or the washer.

13.2.8 A wire-binding screw shall thread into metal.

13.2.9 An appliance intended for connection to a grounded power supply conductor and using a:

a) Lampholder or element holder of the Edison screw shell type,

b) Single pole switch, or

c) Single pole automatic control

shall have one terminal or lead intended for connection of the grounded conductor of the supply circuit. The terminal or lead intended for grounded connection shall be the one that is connected to the screw shell of a lampholder or element holder and that has no connection to a single pole switch or single pole automatic control.

Exception: With regard to connection of a single pole automatic control, the requirements specified in 24.1 shall apply.

13.2.10 A terminal intended for the connection of a grounded circuit conductor shall be made of, or plated with, a metal substantially white in color and shall be readily distinguishable from the other terminals. If not of such metal, the identification of that terminal shall be clearly shown in some other manner, such as on an attached wiring diagram. A lead intended for the connection of a grounded circuit conductor shall be finished to show a white or gray color and shall be readily distinguishable from the other leads.

13.2.11 The free length of a lead inside an outlet box or wiring compartment shall be 6 inches (152.4 mm) or more if the lead is intended for field connection to an external circuit.

Exception: A lead may be less than 6 inches long if it is evident that the use of a longer lead will result in a risk of fire, electric shock, or injury to persons.

13.2.12 The surface of an insulated lead intended solely for the connection of an equipment-grounding conductor shall be green, with or without one or more yellow stripes, and no other lead shall be so identified.

13.2.13 A wire-binding screw intended for the connection of an equipment grounding conductor shall have a green colored head that is hexagonal shaped, slotted, or both. A pressure wire connector shall be plainly identified as such by being marked "G," "GR," "GND," "Grounding," or the like or by a marking on the wiring diagram provided on the appliance. The wire-binding screw or pressure wire connector shall be located so that it is unlikely to be removed during servicing of the appliance.

13.2.14 A terminal solely for connection of an equipment grounding conductor shall be capable of securing a conductor of the correct size for that purpose.

13.3 Cord-connected appliances

13.3.1 Cords and plugs

13.3.1.1 An appliance shall be provided with a length of flexible cord in accordance with Table 13.1 and an attachment plug for connection to the supply circuit. A coiled cord shall not be used with a floor- or counter-supported appliance where such use would present a risk of burn, fire, electric shock, or injury to persons (for example, the appliance being pulled off a table by the force of the cord). The cord length is measured from the point of cord entry into the enclosure, or into the wiring device at the appliance end of the cord, to the face of the attachment plug. The length for a coiled cord is to be measured with the cord in an uncoiled position.

Exception: When a power supply cord contains a right-angle attachment plug, the cord length shall be measured from the point of cord entry into the enclosure, or into the wiring device at the appliance end of the cord, to the edge of the line blades or grounding pin nearest the point of cord entry into the attachment plug as shown in Figure 13.1.

Table 13.1
Cord lengths for specific conditions

Type of appliance	Cord length			
	Minimum,		Maximum,	
	feet	(m)	feet	(m)
Appliance supported by hand or by table or counter top	5	(1.52)	9	(2.74)
Wall-hung appliances with attached appliance supported by hand	5[a]	(1.52)	9[a]	(2.74)
	2[b]	(0.61)	3[b]	(0.91)
Appliance usually supported by head, shoulder, or back	6	(1.83)	12	(3.66)
Any appliance having a jacketed cord	See note c		Not specified	

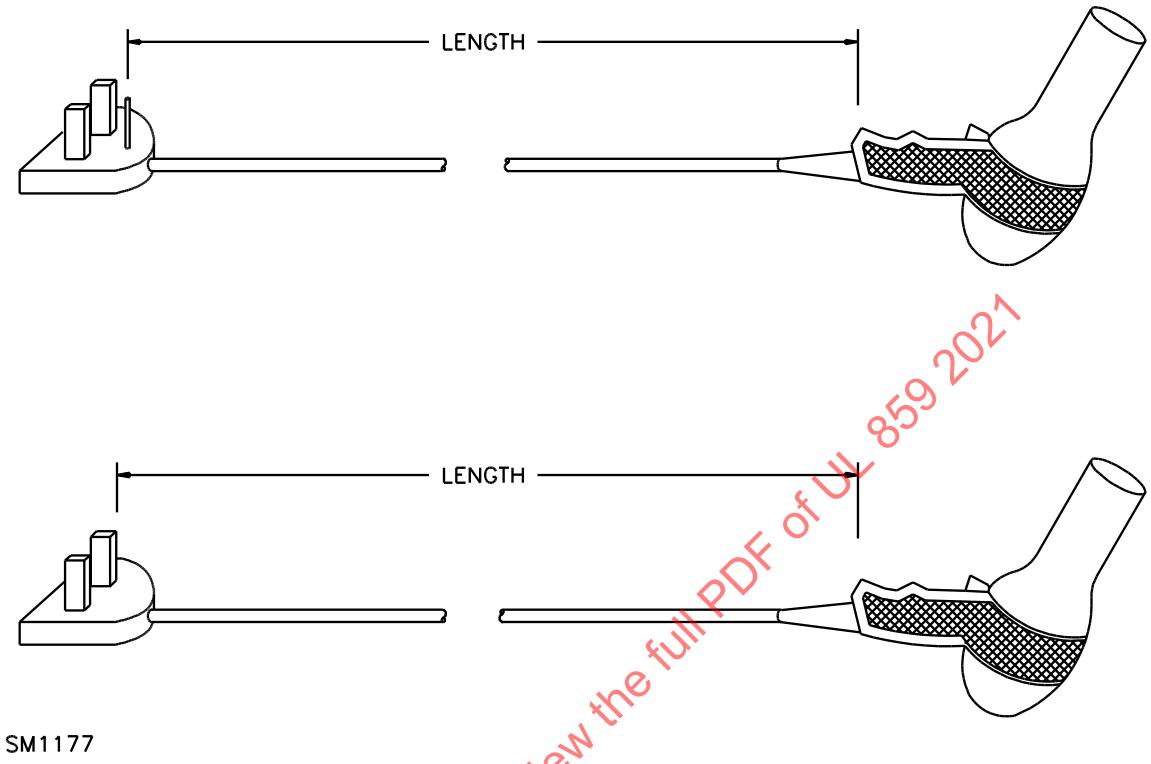
[a] Between wall unit and hand unit.

[b] Between wall unit and receptacle.

[c] As specified elsewhere in this table or in 13.3.1.1.

Figure 13.1

Power supply cord length measurement for right angle attachment plugs



13.3.1.2 The flexible cord:

a) May be permanently attached to the appliance or

b) For other than a hand-supported appliance, may be in the form of a detachable power supply cord with means for connection to the appliance.

Examples of the means for connection are an appliance plug, a flatiron plug, or a cord connector cooperating with pin or blade terminals on the appliance.

Exception: Hand-supported appliances other than appliances provided with integral GFCI or other immersion protective devices, whether required or not, may be provided with a detachable power supply cord if all the following conditions are met:

a) When inserted into the appliance, the detachable power supply cord shall be provided with a positive means to securely hold and lock it in place during normal use;

b) Disengaging the locking feature requires positive actuation by the user by means independent of normal handling and use. Friction is not considered to be an acceptable locking means;

c) While attached to the appliance, the power supply cord shall comply with construction and performance requirements applicable to non-detachable power supply cords detailed in this standard;

d) The construction of the appliance coupling shall comply with the construction requirements of 13.3.1.14 or 13.3.1.15 and with the performance requirements of 65.4 or 65.6, as applicable to the construction;

e) The appliance coupling and mating connector shall be a non-standard configuration. Flatiron, appliance (standard or jumbo), motor attachment, ANSI/NEMA WD6, Standard for Wiring Devices – Dimensional Requirements, or IEC 60320-1, Appliance couplers for household and similar general purposes – Part 1: General requirements, configurations are not considered to be acceptable;

f) In addition to the requirements detailed in this standard, the detachable power supply cord shall comply with the applicable requirements for special purpose detachable power supply cords cited in the Standard for Cord Sets and Power-Supply Cords, UL 817;

g) The detachable supply cord shall be a minimum 18 AWG (0.82 mm^2), SPT-2 cord type; and

h) The drop impact test of 65.2 is to be conducted with acceptable results.

13.3.1.3 The ampacity of the cord (as specified in Table 400.5(A) of the National Electrical Code, ANSI/NFPA 70) and of the plug shall not be less than the current rating of the appliance. The cord and the plug voltage rating shall be at least equal to the rated voltage of the appliance.

13.3.1.4 With respect to 13.3.1.3, the voltage rating of a dual voltage appliance is deemed to be that to which the appliance is set when it is shipped from the factory.

13.3.1.5 If a dual-voltage appliance is provided with an adapter for connection to an alternate supply source, the adapter shall comply with the applicable requirements in the Standard for Attachment Plugs and Receptacles, UL 498.

13.3.1.6 The flexible cord shall be of a type indicated in Table 13.2 or the equivalent.

Table 13.2
Required types of cord and applicable limitations on their use

Appliance on which the cord is to be used	Required cords where temperatures higher than 121°C (250°F) are attained on any surface the cord can touch	Required cords where 121°C (250°F) or lower temperatures are attained on any surface the cord can touch
Floor supported	HPN[a], HSJ, HSJO, HS, kHSO	SP-2[a], SPE-2[a], SPT-2[a], SV[a], SVE[a], SVO[a], SVOO[a], SVT[a], SVTO[a], SVTOO[a] SJ, SJE, SJO, SJOO, SJT, SJTO, SJTOO, S, SE, SO, SOO, ST, STO, STOO
Hand-supported hair dryers, heated air curling irons and brushes, and, except as noted in Note (b), counter-supported appliances	HPD, HPN, HSJ, HSJO	SP-2, SPE-2, SPT-2, SV, SVE, SVO, SVOO, SVT, SVTO, SVTOO, SJ, SJE, SJO, SJOO, SJT, SJTO, SJTOO, SP-1[b], SPE-1[b], SPT-1[b]
Facial saunas	–	SP-1, SPE-1, SPT-1
Combs	SP-2, SPE-2 or SPT-2, HPN	SP-2, SPE-2 or SPT-2, HPN
Curling irons and brushes, manicure and pedicure sets, hair crimping and hair straightening irons, and similar hand-supported appliances	TPT[c], SPT-1, XT[d], HPD	TPT[c], SP-1, SPE-1, SPT-1, XT[d], HPD

[a] Acceptable if the following conditions are met:

1) The unit is not provided with rollers, castors, or similar parts, and

2) The point of cord entry to the unit is at least 3 feet (0.91 m) above the floor with the unit in any operating configuration.

Table 13.2 Continued on Next Page

Table 13.2 Continued

Appliance on which the cord is to be used	Required cords where temperatures higher than 121°C (250°F) are attained on any surface the cord can touch	Required cords where 121°C (250°F) or lower temperatures are attained on any surface the cord can touch
[b] Acceptable on counter-supported appliances weighing 1/2 pound (0.23 kg) or less. The weight is to be determined without the power supply cord.		
[c] Acceptable for use with appliances rated 50 watts or less and weighing 1/2 pound (0.23 kg) or less. The weight is to be determined without the power supply cord.		
[d] Minimum 20 AWG (0.52 mm^2) parallel 2-conductor construction required.		

13.3.1.7 The attachment plug of a cord-connected appliance, and the integral blades of a direct plug-in appliance, provided with a 15- or 20-ampere general-use receptacle shall be of the 3-wire grounding type. The attachment plug and the integral blades of all other cord-connected and direct plug-in appliances provided with either a line-connected, single-pole on-off switch or overcurrent protective device, or an Edison-base lampholder shall be polarized or of the grounding type.

13.3.1.8 Attachment plugs, appliance couplers, appliance inlets (motor attachment plugs), and appliance (flatiron) plugs, shall comply with the Standard for Attachment Plugs and Receptacles, UL 498. See 16.19 for single and multipole connectors for use in data, signal, control and power applications within and between electrical equipment.

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:

a) Mechanical Assembly, Section 10;

b) Accessibility of live parts, Section 8.5;

c) Live Parts, Section 14;

d) Pin terminals, Section 13.3.2; and

e) Spacings, Section 26

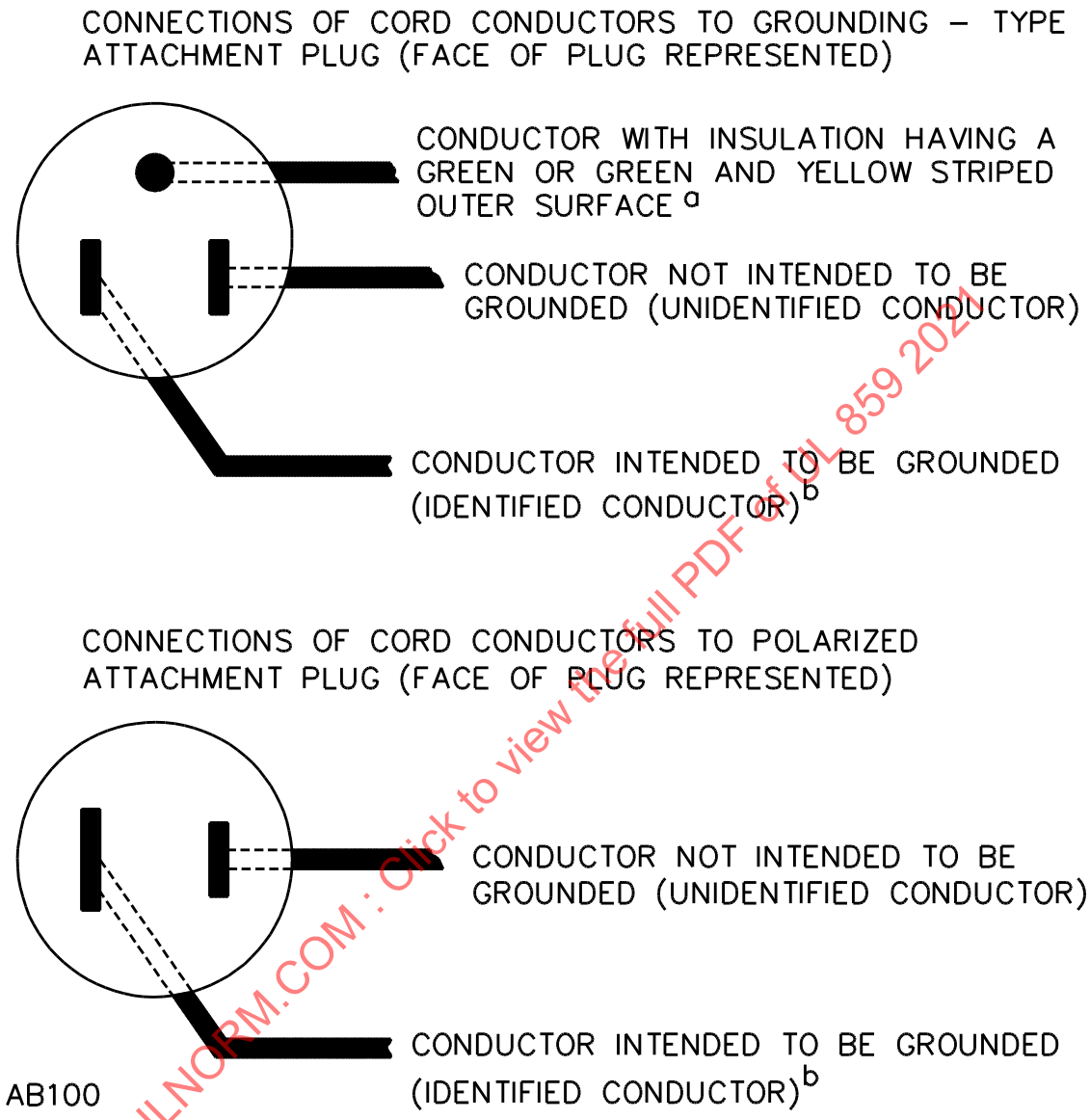
of this standard.

13.3.1.9 Female devices (such as 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.

13.3.1.10 When a 3-wire grounding-type attachment plug or a 2-wire polarized attachment plug is provided, the attachment plug connections shall comply with Figure 13.2 and the polarity identification of the flexible cord shall comply with Table 13.3.

Figure 13.2

Connection to attachment plug



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

[b] Signifies a conductor identified in accordance with Table 13.3.

Table 13.3
Polarity identification of flexible cords

Method of polarity identification	Required combinations	
	Wire intended to be grounded[a]	All other wires[a]
Colored braid	Solid white or gray	Solid color other than white or gray
Tracer in braid	Solid white or gray braid with no tracer in braid[b]	Solid white or gray braid with a colored tracer in braid[b]
	Colored tracer in braid of a color other than white or gray	No tracer in braid of solid color other than white or gray
Colored insulation[c]	Solid white or gray	Solid color other than white or gray
	Light blue[d]	Solid color other than light blue, white, or gray[d]
Colored separator[e]	White or gray	Color other than white or gray
Tinned conductors[f]	Tin or other white metal on all strands of the conductor	No tin or other white metal on the strands of the conductor
Surface marking[e]	One or more stripes, ridges, or grooves, or a combination of these on the exterior surface of the cord	

[a] A conductor having insulation finished to show a green color with or without one or more straight or helical unbroken yellow stripes or having a green braid with or without one or more yellow tracers is to be used only as an equipment grounding conductor. See also 27.4 for the description of an equipment grounding conductor and Figure 13.2 for the connection of conductors to attachment plugs.

[b] Only for Types C and PD cords.

[c] Only for a cord having no braid on any individual conductor.

[d] Only for a cord having a jacket that is not integral with the circuit conductor insulation.

[e] Only for Types SP-1, SP-2, SPE-1, SPE-2, SPT-1, and SPT-2 cords.

[f] Only for Types SPT-1 and SPT-2 cords.

13.3.1.11 Type SPT-2, SVT, or SVTO flexible cord may be used for connecting a pendant-type on-off switch, a temperature control, or both to a table- or floor-supported hair dryer.

13.3.1.12 A power supply cord shall not employ conductors smaller than 18 AWG (0.82 mm^2).

Exception: Hand-supported household appliances weighing less than 1/2 pound (0.23 kg), including facial saunas, curling irons and brushes, manicure and pedicure sets, hair crimping and hair straightening irons, may employ non-detachable power-supply cords with 20 AWG (0.52 mm^2) conductors provided that:

a) The flexible cord is type SPT-1, SP-1, SPE-1 or is a type that is, at minimum, equivalent to these types;

b) The appliance is not intended for continuous use nor for being indefinitely left "on" in stand-by mode (initial warm-up period excluded);

c) The appliance is rated 2 amperes or less and does not continuously draw more than 2 amperes under intended use conditions; and

d) The temperatures on the flexible cord are monitored during the normal temperature test and the temperatures do not exceed the temperature limit of the flexible cord.

13.3.1.13 A power supply cord with integral fittings shall comply with the requirements in the Standard for Cord Sets and Power-Supply Cords, UL 817, except that it is not required to be provided with integral overcurrent protection.

Exception: A power supply with integral swivel assembly shall comply with the applicable requirements in this standard and the following requirements in the Standard for Cord Sets and Power-Supply Cords, UL 817:

a) Normal Temperature Test, Section 87, with the temperature rise at swivel contact not more than 30°C;

b) Dielectric Voltage Withstand Test, Section 88, with dielectric voltage applied:

i) Between two individual conductors of swivel plug and; ii) between conductors of swivel plug and metal foil tightly wrapped onto surface of molded-on swivel plug (other than fitting face) and

ii) Between conductors of swivel plug and metal foil tightly wrapped onto surface of molded-on swivel plug (other than fitting face);

c) Insulation Resistance Test, Section 89; and

d) Accelerated Aging Tests, Section 90.

13.3.1.14 Hand-supported appliances provided with detachable power supply cords, including hand-supported appliances likely to be disconnected while under load, shall not pose a risk of electric shock, fire or injury when mated or disconnected under any orientation or polarity permitted by the construction. The mating connector shall be held securely in place and shall not be allowed to rotate. Compliance is determined by the test of 65.4 and 65.5.

13.3.1.15 Appliances provided with a detachable base or stand subject to repeated connection and disconnection during normal use shall not pose a risk of electric shock, fire or injury when mated or disconnected under any orientation or polarity permitted by the construction. The mating connector shall be held securely in place and shall not be allowed to rotate. Compliance is determined by the test of 65.6 and 65.7.

13.3.1.16 Appliances provided with a detachable base or stand intended to power a hand-supported appliance which may be disconnected from power during normal use shall not tip over when the hand-supported portion of the appliance is assembled as intended to the base. Compliance is determined by the stability test of 65.8 and 65.9.

13.3.1.17 Locking features provided in accordance with (a) and (b) in the Exception to 13.3.1.2 shall be formed and assembled to have the strength and rigidity required to resist the abuses to which it is able to be subjected. Compliance is determined by the test of 65.10.

13.3.1.18 Female contacts and live parts associated with connectors for appliances intended to be disconnected under load during normal use shall not have exposed contacts or terminals accessible to the probe in Figure 13.3.

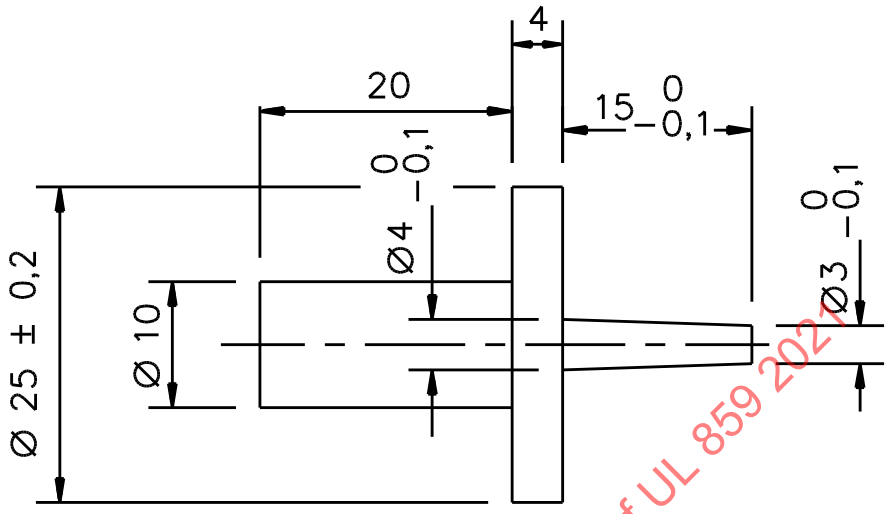
Exception: Exposed contacts or terminals are acceptable if located in a secondary circuit and all of the following conditions are met:

a) The maximum output voltage (V_{max}) does not exceed 42.4 volts peak (30 V_{rms}).

b) The output current does not exceed 8 amperes under any connection of loading including and up to short circuit for ac or dc voltages up to 42.2 V peak (30 V_{rms}).

Figure 13.3

Probe



Dimensions in millimetres

S2962D

13.3.1.19 A cord reel shall comply with "special use cord reel" requirements of the Standard for Cord Reels, UL 355. For products provided with cord tag, the cord tag shall not retract into cord reel.

13.3.2 Pin terminals

13.3.2.1 When an appliance is provided with pin terminals, the construction of the appliance shall be such that no live part will be exposed to unintentional contact both during and after the placement of the plug on the pins in the intended manner.

13.3.2.2 When an appliance is provided with pin terminals, a pin guard is required, such that:

a) A straight edge placed in any position, including 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 8.1 shall not touch any current-carrying pin while the probe is inserted through any opening with the appliance in any position.

13.3.2.3 When the pins on the appliance are of American National Standard configuration, the plug used in 13.3.2.2(b) shall consist of an appliance plug in accordance with the Standard for Wiring Devices – Dimensional Requirements, ANSI/NEMA WD6.

13.3.2.4 When the pins on the appliance are not of an American National Standard configuration, the plug used in 13.3.2.2(b) shall be the plug supplied with the appliance – 125 volts, 10 amperes, and 250 volts, 5 amperes.

13.3.2.5 When an appliance uses three or more pin terminals intended for use with a plug that covers all the pins, the terminals shall be spaced so that they will not accommodate a flatiron, appliance plug, or cord connector. These pins shall accommodate the plug required for the particular application.

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

13.3.2.7 The requirement specified in 13.3.2.6 is intended primarily to provide for the maintenance of spacings as specified in 26.1.6, and to maintain required spacings between pin terminals. Under this requirement, consideration is also to be given to the means for locking terminals in position to maintain tightness.

13.3.2.8 For a heating appliance, the dimensions of pins and their center-to-center spacings (including the corresponding spacings of the female contacts of general use plugs that these arrangements of pins will accommodate) shall be as indicated in Table 13.4.

Table 13.4
Pins

Type and rating of plug that accommodates the pins	Pin configuration				Pin diameter,		Pin length,	
	Number	Arrangement	Spacing between centers, inch	(mm)	inch	(mm)	inch	(mm)
Appliance plug rated for 5 amperes at 250 volts and for 10 amperes at 125 volts	2	In line	1/2	(12.7)	5/32 ±0.005	(4.0 ±0.13)	9/16 – 5/8	(14.3 – 15.9)
Flat-iron plug rated for 5 amperes at 250 volts and for 10 amperes at 125 volts	2	In line	11/16	(17.5)	3/16 ±0.005	(4.8 ±0.13)	3/4 – 7/8	(19.1 – 22.2)
Jumbo appliance plug rated for 10 amperes at 250 volts and for 15 amperes at 125 volts	2	In line	1-1/16	(27.0)	3/16 ±0.005	(4.8 ±0.13)	3/4 – 7/8	(19.1 – 22.2)
Reversible plug (for two-heat control) rated for 10 amperes at 250 volts and for 15 amperes at 125 volts[a]	3	In line	7/8	(22.2)	3/16 ±0.005	(4.8 ±0.13)	3/4 – 7/8	(19.1 – 22.2)
Reversible plug (for two- or three-heat control) rated for 10 amperes at 250 volts and for 15 amperes at 125 volts[a]	3	One pin at each apex of an equilateral triangle	7/8	(22.2)	3/16 ±0.005	(4.8 ±0.13)	3/4 – 7/8	(19.1 – 22.2)
[a] This plug is usually made without a contact in one of the holes.								

13.3.2.9 The material on which the pins are mounted, the proximity of any vapor outlet to the terminals, and the direction of the vapor spray shall be such that water shall be prevented from accumulating at the terminal.

13.4 Strain relief

13.4.1 Strain relief shall be provided such that stress on a flexible cord will not be transmitted to a terminal, splice, or internal wiring in the appliance or in a fitting (attachment plug, appliance plug, or similar component.

13.4.2 If a knot in a flexible cord serves as strain relief, the surface against which the knot bears or with which it contacts shall be free of any projection, sharp edge, burr, fin, results in abrasion of the insulation on the conductors.

13.4.3 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.

Exception: A bushing that is an integral part of power supply cord and a soft rubber bushing specified in the Exception to 13.5.5 need not comply with UL 635. Tests specified in this standard (e.g. Strain Relief Test) need to be performed to confirm the combination of the insulating bushing and the supporting part are suitable.

13.5 Bushings

13.5.1 At a point where a flexible cord passes through an opening in a wall, barrier, or enclosing case, there shall be a bushing or the equivalent that is substantial, reliably secured in place, and that has a smooth, rounded surface against which the cord bears. The bushing or the equivalent is to protect the cord from abrasion damage; it is not intended for strain-relief or flex-relief purposes. An insulating bushing shall be provided if:

a) Type SP-1, SPE-1, SPT-1, SP-2, SPE-2, SPT-2, or other cord lighter than Type HSJ is used;

b) The wall or barrier is of metal; and

c) Construction is such that the cord might be subjected to strain or motion.

The heat- and moisture-resistant properties of the bushing material shall be that required for the particular application.

13.5.2 In addition to the requirements in 13.5.1, Insulating bushings shall comply with the Standard for Insulating Bushings, UL 635.

Exception: Bushings specified in 13.5.5 need not comply with UL 635.

13.5.3 If the cord hole is in wood, porcelain, phenolic composition, or other nonconducting material, a smooth rounded surface is deemed equivalent to a bushing.

13.5.4 Ceramic materials and some molded compositions are acceptable for insulating bushings. A separate bushing of wood or rubber material (other than in a motor) is not. Vulcanized fiber may be used if the bushing is no less than 1/16 inch (1.6 mm) thick [with a minus tolerance of 1/64 inch (0.4 mm) for manufacturing variations] and if it is formed and secured in place so that it will not be affected adversely by conditions of ordinary moisture.

13.5.5 A separate soft rubber, neoprene, or polyvinyl chloride bushing may be used in the frame of a motor or in the enclosure of a capacitor physically attached to a motor (but not elsewhere in an appliance) when:

a) The bushing is not less than 1/16 inch (1.6 mm) thick, with a minus tolerance of 1/64 inch (0.4 mm); and

b) The bushing is located so that it will not be exposed to oil, grease, oily vapor, or other substance having a harmful effect on the bushing material.

Exception: A bushing of any of the materials specified may be used at any point in an appliance if used in conjunction with a type of cord for which an insulating bushing is not required and if the edges of the hole in which the bushing is mounted are smooth and free from any burr, fin, or similar abrading surface.

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

13.6 Direct plug-in appliances

13.6.1 With regard to Figure 13.4, the maximum moment, center of gravity, dimensions, and weight of a direct plug-in appliance shall comply with the requirements specified in (a) – (d). See 13.6.2 and 13.6.3 for symbol definitions and methods of application:

a) The quotient of WY/Z shall not exceed 48 ounces (1.36 kg).

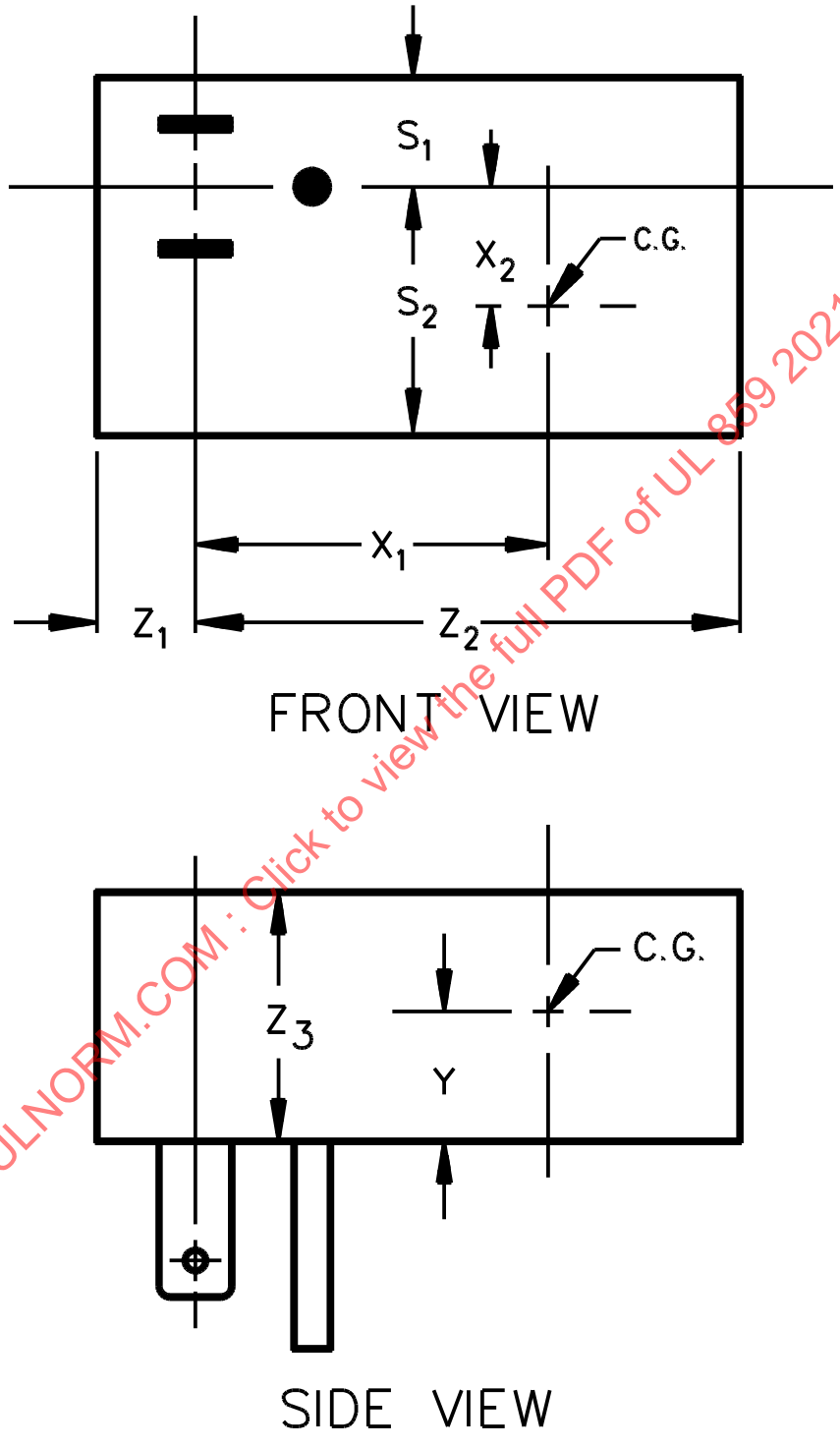
b) The quotient of WY/S shall not exceed 48 ounces.

c) The product of WX shall not exceed 80 ounce-inches (0.56 N•m).

d) The weight of an appliance shall not exceed 28 ounces (0.79 kg).

Figure 13.4

Dimensions of a direct plug-in appliance



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13.6.2 Definitions for the symbols used in 13.6.1 are as follows:

a) W is the weight of the appliance.

b) Y is the distance illustrated in Figure 13.4.

c) Z is the shorter distance, Z_1 or Z_2, as illustrated in Figure 13.4.

d) S is the shorter distance, S_1 or S_2, as illustrated in Figure 13.4.

e) X is the longer distance, X_1 or X_2, as illustrated in Figure 13.4.

13.6.3 The moment and weight specified in 13.6.1 are to be determined as follows for:

a) An appliance with an attached cord, the cord is to be cut off at the enclosure or at the strain-relief means if the strain-relief means extends outside the enclosure.

b) An appliance with a directly mounted accessory, the values are to be measured with the accessory in place.

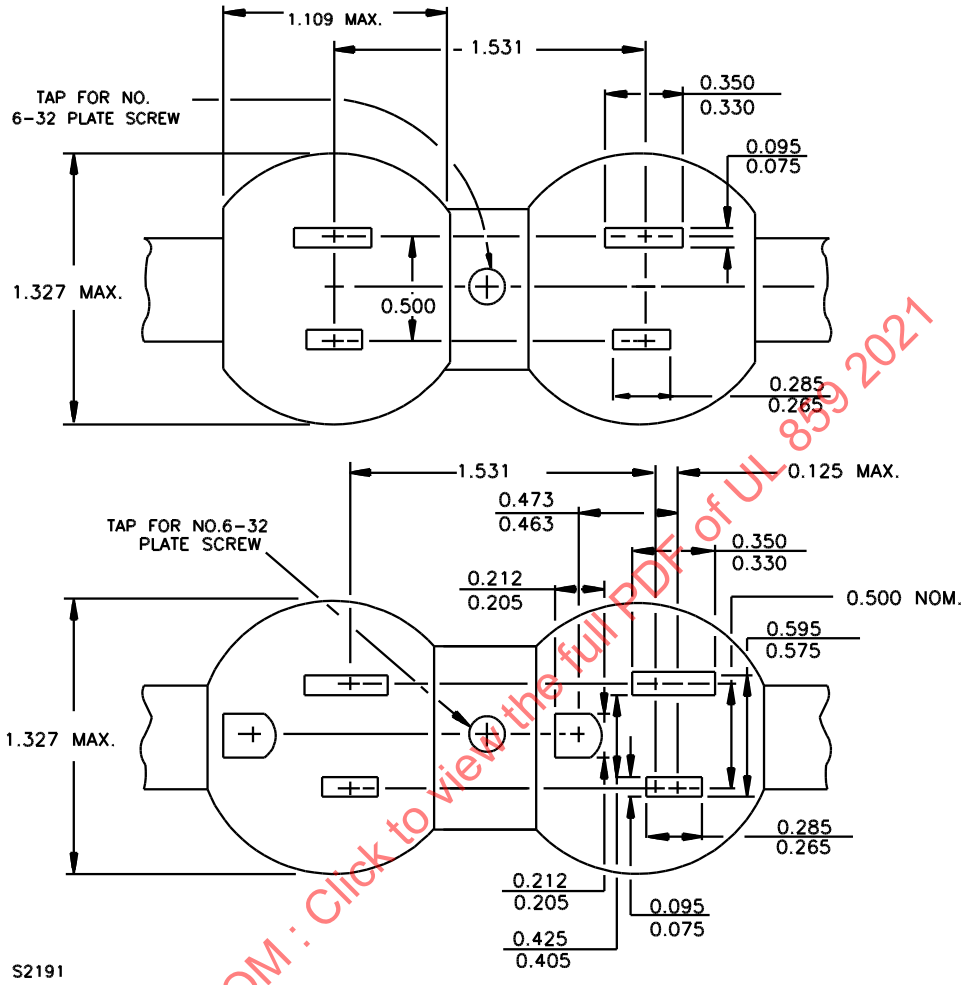
c) An appliance with a mounting tab, the tab is not to be included in the measurement of linear dimensions for the purpose of determining moments.

13.6.4 When inserted in a parallel-blade duplex receptacle, any part of an appliance, including a mounting tab, shall not interfere with full insertion of an attachment plug into the adjacent receptacle as illustrated in Figure 13.5.

Exception: An appliance that renders the adjacent receptacle completely unusable is acceptable.

Figure 13.5

Parallel receptacle duplex



13.6.5 An appliance shall not be provided with a mounting tab unless all the following conditions are met:

a) The appliance is of a type such that semipermanent mounting will not introduce a risk of fire or electric shock;

b) The appliance is intended for use on a 15-ampere, 125-volt receptacle;

c) A screw is provided and constructed so as to secure the mounting tab of the appliance to a parallel-blade duplex receptacle that has a center screw, as shown in Figure 13.5;

d) For an appliance without a grounding pin, the mounting tab is constructed so that the appliance may be mounted to both grounding and nongrounding receptacles; and

e) A marking as specified in 72.7.1 is provided.

13.6.6 The enclosure of a direct plug-in appliance shall be capable of being gripped for removal from the receptacle to which it is connected, and the perimeter of the face section from which the blades project shall be no less than 5/16 inch (7.9 mm) from any point on either blade.

Exception: For tab-mounted appliances intended for use with fixed systems, the perimeter of the face section shall not be less than 1/4 inch (6.4 mm) from any point on either blade.

14 Live Parts

14.1 A current-carrying part shall be of silver, copper, a copper alloy, or equivalent material.

14.2 Plated iron or steel may be used for a current-carrying part:

a) Whose temperature during intended operation is more than 100°C (212°F);

b) Within a motor or associated governor; or

c) If provided in a component in accordance with 2.1; but unplated iron or steel shall not be used.

Exception: Stainless steel and other corrosion-resistant alloys may be used for current-carrying parts regardless of temperature.

14.3 An uninsulated live part shall be secured to the base or mounting surface so that it will be prevented from turning or shifting in position if such motion results in a reduction of spacings below the minimum required values.

14.4 Friction between surfaces shall not be used as a means to prevent shifting or turning of an uninsulated live part, but a lock washer applied as intended is acceptable.

15 Reservoirs

15.1 If a reservoir is part of an appliance, a live part shall be located or protected so that it will not be subject to dripping if the reservoir does not perform as intended.

Exception: The requirement need not apply if the reservoir is resistant to corrosion from the liquid intended for use in it, and the reservoir does not develop cracks as a result of aging.

16 Internal Wiring

16.1 The wiring and connections between parts of an appliance shall be protected or enclosed.

Exception: A length of flexible cord may be used for external connections between parts of the appliance if flexibility is essential.

16.2 A wireway shall be smooth and entirely free from sharp edges, burrs, fins, moving part similar abrading surfaces that might damage the insulation on the conductors.

16.3 A hole in a sheet metal wall through which insulated wires pass shall be provided with a smooth rounded bushing or shall have a smooth, well-rounded surface upon which the wires bear.

16.4 A separate foot switch provided with an appliance shall be connected to the appliance by flexible cord no lighter than Type SJ.

16.5 Insulated internal wiring (including a grounding conductor) shall consist of a type or types of wire that are acceptable for the application with regard to:

a) The temperature and voltage to which the wiring is likely to be subjected;

b) Exposure to oil, grease, or other substances likely to have a harmful effect on the insulation;

c) Exposure to moisture; and

d) Other conditions of service to which it is likely to be subjected.

Exception: Insulated internal wiring evaluated as an uninsulated live part is not required to comply with the criteria specified in (a) – (d).

16.6 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;

c) The applicable UL standard(s) for other insulated conductor types specified in Chapter 3, Wiring Methods and Materials, of the National Electrical Code, ANSI/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.

16.7 A splice and connection shall be mechanically secure and shall provide effective electrical contact.

16.8 Aluminum conductors, insulated or uninsulated, used as internal wiring, such as for interconnection between current-carrying parts or as motor windings, shall be terminated at each end by a method acceptable for the combination of metals involved at the connection point.

16.9 If a wire-binding screw construction or a pressure wire connector is used as a terminating device for aluminum, it shall be required for use with aluminum under the conditions involved (for example, temperature, heat cycling, vibration).

16.10 A soldered connection shall be made mechanically secure before being soldered if breaking or loosening of the connection results in a risk of fire, electric shock, or injury to persons.

16.11 A wire-binding screw or nut shall be provided with a lock-washer if loosening by vibration permits shifting of parts thereby reducing spacings, or otherwise results in a risk of fire, electric shock, or injury to persons. The lock-washer shall be located under the head of a wire-binding screw or under a wire-binding nut.

16.12 An open-end spade lug shall not be used unless additional means (such as upturned ends on the tangs of the lug) are provided to hold the lug in place if the wire-binding screw or nut becomes slightly loosened.

16.13 The means of connecting stranded internal wiring to a wire-binding screw shall be such that loose strands of wire are prevented from contacting other live parts not always of the same polarity as the wire and from contacting dead-metal parts. This can be accomplished by using a pressure terminal connector, a soldering lug, a crimped eyelet, or by soldering all strands of the wire together or the equivalent.

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

16.15 Insulation consisting of two layers of friction tape, two layers of thermoplastic tape, or 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 dielectric properties, heat- and moisture-resistant characteristics, and similar criteria. Thermoplastic tape wrapped over a sharp edge shall not be used.

16.16 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.

16.17 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 inch), 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.

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

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

16.20 Single and multipole 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.

16.21 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.

16.22 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.

16.23 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:

a) Pin terminals, Section 13.3.2;

b) Live Parts, Section 14;

c) Electrical Insulation, Section 18; and

d) Spacings, Section 26

of this standard. This exception does not apply to protective conductor terminal blocks.

17 Heating Element

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

17.2 In determining whether a heating element is reliably supported, consideration is to be given to sagging, loosening, and other adverse conditions resulting from continuous heating.

17.3 An appliance in which the heating element is designed for operation only in an air stream shall be wired or controlled so that the element is capable of operation only when under the cooling effect of the air stream.

17.4 A sheathed element, open-wire heating element or the like shall be judged under the applicable requirements of this Standard.

17.5 Insulated heating wire shall comply with the Standard for Appliance Wiring Material, UL 758.

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

18 Electrical Insulation

18.1 General

18.1.1 An insulating washer, bushing, or similar part that is an integral part of an appliance, and a base or support for the mounting of a current-carrying part, shall be of a moisture-resistant material that will not be adversely affected by the temperatures to which it will be subjected under conditions of intended use. Molded parts shall be constructed so that they will have strength and rigidity to withstand the stresses of intended service.

18.1.2 Insulating material is to be evaluated 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 sole support of live parts. Other materials that shall not be used for general use, such as magnesium oxide, may be used if used in conjunction with other insulating materials, or if so located and protected that the risk of mechanical damage and the absorption of moisture are reduced. When it is necessary to investigate a material to determine its acceptability, consideration is to be given to its mechanical strength, 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 service. All these factors are to be considered with respect to thermal aging. When a polymeric enclosure also serves as an insulating material, or as the direct or indirect support for any live part, the polymeric material shall comply with the requirements specified in 8.2.1.

18.1.3 In the mounting or supporting of a small fragile insulating part, a screw or other fastening is not to be so tight as to result in cracking or breaking with expansion and contraction. Such a part shall be slightly loose.

18.1.4 A small molded part, such as a brush cap, shall be constructed so that it will have the strength and rigidity to withstand stresses during intended use.

18.1.5 Insulating material on which the opposite polarity fixed contacts of a hand-held hair dryer power "on-off" slide switch are mounted shall have a comparative tracking index (CTI) rating of 2 or better, and a flammability rating of V-1 or better.

18.1.6 Insulating tape shall comply with the Standard for Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape, UL 510.

18.1.7 Insulation sleeving shall comply with the Standard for Coated Electrical Sleeving, UL 1441.

18.1.8 Insulation tubing shall comply with the Standard for Extruded Insulating Tubing, UL 224.

18.1.9 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 and shall comply with the direct-support requirements for insulating materials in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluation, UL 746C.

Exception: A printed-wiring board containing Class 2 non-safety circuit only is required to comply with the Standard for Printed-Wiring Boards, UL 796 with flammability rating of HB or better.

18.1.10 Unless otherwise specified, the flammability class and temperature rating shall be that specified for insulating materials in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluation, UL 746C.

18.2 Film-coated wire (magnet wire)

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

18.2.2 Film coated wire in intimate combination with one or more insulators, or the magnet wire of induction heating coil, incorporated with 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.

19 Thermal Insulation

19.1 Combustible thermal and electrically conductive insulation shall not contact an uninsulated live part.

19.2 Mineral wool thermal insulation that contains conductive impurities in the form of slag shall not come into contact with any uninsulated live part.

19.3 Thermal insulation shall be rated for the temperature to which it is exposed when tested under the conditions described in 44.1.1.

20 Overcurrent Protection

20.1 If overcurrent conditions are likely to occur, the appliance shall be provided with a circuit breaker or fuse.

20.2 Overcurrent protection at not more than 20 amperes shall be provided by means of a circuit breaker or fuse in the appliance for each general use receptacle circuit and each lampholder circuit in the appliance, unless the appliance would be correctly connected to a branch circuit rated at 20 amperes or less.

20.3 The overcurrent protection specified in 20.2 shall be of a type rated for branch circuit protection.

20.4 A fuseholder or circuit breaker provided as a part of an appliance shall be of a type rated for the particular application and shall not be accessible from outside the appliance without opening a door or cover. A fuseholder for a plug fuse shall be constructed and installed so that an uninsulated live part other than the screw shell will not be exposed to contact by persons removing or replacing a fuse.

Exception: The operating handle of a circuit breaker may project outside the enclosure.

20.5 For other than a hand-supported appliance, if the handle of a circuit breaker is operated vertically rather than rotationally or horizontally, the up position of the handle shall be the on position.

21 Thermal Cutoffs (Fusible Links)

21.1 If an appliance is provided with a thermal cutoff, the cutoff shall open 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. This determination is to be made in accordance with the test requirements specified in the Test of Thermal Cutoffs (Fusible Links), Section 55.

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

22 Lampholders and Receptacles

22.1 Lampholders and indicating lamps integral with lampholder shall comply with the Standard for Lampholders, UL 496. A female screw shell used as a holder for a heating element shall be of copper or of copper alloy and shall be plated with nickel or an equivalent oxidation-resistant metal.

22.2 The circuit conductor of a 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 13.3 identifies the supply cord conductor intended to be grounded.

22.3 An Edison-base lampholder shall not be used in an appliance rated over 150 volts.

Exception: An Edison-base lampholder may be used if the construction is such that live parts of the lampholder and the lamp will not be exposed to contact by persons when the screw shell of the lamp is in contact with live parts of the lampholder or if used on a three-wire Edison system.

22.4 In determining compliance with the Exception to 22.3, the probe shown in Figure 8.1 shall be used as described in 8.5.3.

22.5 An Edison-base lampholder in an appliance rated 150 volts or less shall be constructed or installed so that an uninsulated live part other than the screw shell will not be exposed to contact by a person removing or replacing a lamp during intended service.

Exception: This requirement is not applicable to an appliance:

a) For which it is necessary to dismantle the appliance or remove a cover plate or other part by means of a tool to remove or replace a lamp or

b) That is permanently and legibly marked to indicate that such relamping is to be done with the appliance disconnected from the supply source.

22.6 A 15- or 20-ampere attachment plug receptacle intended for general use in an appliance shall be of the grounding type. The grounding contact of the receptacle shall be electrically connected to dead metal that will be grounded when the appliance is in use.

22.7 Attachment plug receptacle shall comply with the Standard for Attachment Plugs and Receptacles, UL 498.

22.8 The face of a receptacle that is less than 5/8 inch (15.9 mm) wide or 7/8 inch (22.2 mm) long shall project a minimum of 0.015 inch (0.38 mm) and a maximum of 3/16 inch (4.8 mm) from the part of the receptacle-mounting surface that is within a rectangle 5/8 inch wide and 7/8 inch long, the rectangle being symmetrically located about the receptacle contacts.

Exception: If the mounting surface for the receptacle is electrically conductive, the face of the receptacle shall project a minimum of 3/32 inch (2.4 mm).

22.9 An appliance provided with one or more general use receptacles shall not be equipped with a flexible cord not smaller than 16 AWG (1.3 mm^2).

22.10 When the branch circuit over current protection will be inadequate for any general use receptacle or receptacles provided as part of an appliance, over current protection for the receptacle or receptacles shall be provided as part of the appliance as follows:

a) Not more than 15 amperes for a single receptacle, and

b) Not more than 20 amperes for two or more receptacles (including a single duplex receptacle).

23 Switches

23.1 General

23.1.1 An appliance having any driven moving part, which by function could cause entrapment of hair, body parts, clothing or the like, shall be provided with a main on-off switch. Appliances in this group include, but are not limited to, hair dryers, hair untanglers, and the like.

23.1.2 A switch, as required in 23.1.1, shall be located so that it can be operated by the user to turn off the appliance.

23.1.3 A switch shall be acceptable for the particular application and shall have a current and voltage rating no less than that of the circuit (load) it controls. See 18.1.5 for electrical insulation of slide switch.

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

a) Standard for Switches for Appliances – Part 1: General Requirements, UL 61058-1;

b) *Deleted;*

c) Standard for General-Use Snap Switches, UL 20; or

d) Standard for Nonindustrial 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.

23.1.5 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.

23.1.6 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 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.

23.1.7 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 or circuit intended to be grounded. Table 13.3 specifies the identification of the power supply cord conductor intended to be grounded.

23.1.8 A switch that is subjected to a temperature of more than 65°C (149°F) shall be evaluated with respect to the temperature limitations of the materials used.

23.1.9 A switch shall be located or protected so that it will not be subjected to mechanical damage during use.

23.1.10 A switch, as required in 23.1.1, shall have a plainly marked "off" position. The use of a symbol alone, such as the symbol "O," shall not be used to denote the off position. The switch position marking need not be an integral part of the switch itself.

Exception: An appliance that is provided with a momentary contact on-off switch that automatically returns to the off position when the actuator is released is not required to have a marked "off" position.

23.1.11 A hand-supported hair-drying appliance is not intended to be immersible and shall not be so marked.

23.1.12 A maintained contact switch for a hand-supported hair dryer shall be subjected to a 6,000-cycle switch endurance test. A momentary contact switch that is likely to be operated several times during each use of a hand-supported hair dryer, such as the on-off switch, shall be subjected to a 30,000-cycle switch endurance test. A momentary-contact switch that is not likely to be operated several times during each use of a hand-supported hair dryer, such as a switch used to provide low-velocity, cool air for setting a curl (a "cool shot" switch), shall be subjected to 6,000 cycles of the switch endurance test. The tests, when required, are to be conducted in accordance with the Standard for Switches for Appliances – Part 1: General Requirements, UL 61058-1.

23.2 Dual-voltage selector

23.2.1 The construction of the supply circuit voltage selector shall be such that the supply circuit voltage setting cannot be changed without the use of a tool (a coin, screwdriver, or the like is considered to be a tool for the purpose of this requirement).

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

23.2.3 An appliance that can be set to different rated supply circuit voltages shall be provided with the statement required in 74.7(k)(13 – 14).

24 Automatic Controls and Control Circuits

24.1 General

24.1.1 The operation of an automatic control device in an appliance shall disconnect the element or elements it controls from all ungrounded conductors of the supply circuit.

Exception: Disconnection from all ungrounded conductors of the supply circuit is not required if there is no uninsulated live part exposed to unintentional contact when the switch is open, or if the fact that such part is live is definitely apparent.

24.1.2 Breakdown of a temperature control in a hand-supported hair dryer shall not result in a risk of fire, electric shock, or injury to persons as determined in accordance with 46.4.2.4 and 46.4.3.3. A limit control that operates to interrupt all heater and motor circuits and end the test shall comply with the requirements specified in Thermal Cutoffs (Fusible Links), Section 21.

24.1.3 The overload and endurance tests of a temperature controller consisting of a temperature sensor and the associated control circuit for an appliance having a preheat cycle shall be conducted in the appliance, or under conditions representative of those in the appliance, as described in the Test of Automatic Controls, Section 54. See 24.2.4.

24.1.4 A temperature controller that controls the duration of a preheat cycle by a timing circuit or by an equivalent means without using a temperature sensor is considered to be a temperature-regulating control and shall comply with the overload and endurance requirements specified in the Test of Automatic Controls, Section 54.

24.1.5 Auxiliary controls shall be evaluated in accordance with the applicable requirements of this standard and the parameters in Controls – End Product Test Parameters, Section 25 unless otherwise specified in this standard. See 24.1.12.

24.1.6 Operating (regulating) controls shall be evaluated in accordance with the applicable component standard requirements specified in 24.2, if applicable, and the parameters in Controls – End Product Test Parameters, Section 25, unless otherwise specified in this standard. See 24.1.12.

24.1.7 Electronic 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.

24.1.8 Protective (limiting) controls shall be evaluated in accordance with the applicable component standard requirements specified in 24.2 and if applicable, the parameters in Controls – End Product Test Parameters, Section 25, unless otherwise specified in this standard.

24.1.9 Electronic 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, Clause H 11.12.

See 25.4.

24.1.10 Electronic 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.

See 25.4.

24.1.11 If a single malfunction or breakdown of an electronic component, located in electronic operating control, results in increased risk of injury to persons, such as a loss of OFF control or unexpected operation, this control shall comply with the applicable requirements specified in 24.1.7 – 24.1.10. See 25.4.

24.1.12 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 (i.e. burn injury), is not required to comply with the requirements in 24.1.6 – 24.1.11, and is only required to be subjected to the applicable requirements of this standard.

24.2 Electromechanical and electronic controls

24.2.1 A temperature control shall comply with one of the following:

a) The Standard for Temperature-Indicating and -Regulating Equipment, UL 873 or

b) 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.

24.2.2 A temperature control as noted in 5.36 installed in a hand-supported hair dryer shall operate at not more than 8.3°C (15°F) above or below its rated operating temperature. Compliance is determined by subjecting the control, a sub-assembly including the control, or the complete appliance to the appropriate temperatures in an air oven.

24.2.3 In a wax depilatory appliance, an automatic-reset temperature control shall be a calibrated control endurance tested for at least 6,000 cycles of operation and shall comply with all other requirements applicable to limit controls in the Standard for Limit Controls, UL 353, or the requirements applicable to temperature-limiting controls in the Standard for Temperature-Indicating and -Regulating Equipment, UL 873. The calibration requirements shall be as specified for water-heater limit controls in UL 353 or water-heater temperature-limiting controls in UL 873. 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 the UL 873 requirements.

24.2.4 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.

25 Controls – End Product Test Parameters

25.1 General

25.1.1 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 26.

25.1.2 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.

25.2 Auxiliary controls

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

25.2.2 Auxiliary controls shall comply with the requirements of this standard.

Exception: An auxiliary control that complies with a component standard(s) specified in 24.2 is considered to fulfill this requirement.

25.3 Electronic Operating controls (regulating controls)

25.3.1 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 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. See Table 54.1;

c) Installation class 2 per 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 25.1;

e) For the applicable Material Group, see Table 25.2;

f) For the applicable Pollution Degree, see Table 25.3.

Table 25.1
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 25.2
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)	IIIa
100 ≤ CTI < 175 (PLC = 4)	IIIb
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 25.3
Pollution degrees

Appliance Control Microenvironment	Pollution degree
No pollution or only dry, nonconductive pollution. The pollution has no influence. Typically 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

25.3.2 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 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. See Table 54.1;

c) For the applicable Overvoltage Category, see Table 25.1;

d) For the applicable Material Group, see Table 25.2;

e) For the applicable Pollution Degree, see Table 25.3.

25.4 Electronic Protective controls (limiting controls)

25.4.1 An electronic control that performs a protective function shall comply with the applicable requirements in Automatic Controls and Control Circuits, Section 24 while tested using the parameters in this Section. Examples of protective controls are:

a) A control used to sense abnormal temperatures of components within the appliance;

b) An interlock function to de-energize a motor, etc.;

c) Temperature protection of the motor due to locked rotor, running overload, loss of phase; or

d) Other safety or limit function intended to reduce the risk of electric shock, fire, or injury to persons.

Exception: An electronic protective control, the failure of which would not increase the risk of fire, electric shock, or injury to persons, is not required to comply with the requirements in this Section.

25.4.2 The following test parameters shall be among the items considered when judging 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 Normal Temperature Test; Section 44;

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 and the maximum ambient temperature determined by conducting the Normal Temperature Test; see Section 44. The test shall be conducted for 14 days; and

h) Overload shall be conducted based on the maximum declared ambient temperature (T_{max}) or as determined by conducting the Normal Temperature Test, Section 44.

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

25.4.3 The test parameters and conditions used in the investigation of the circuit covered by 25.4.1 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 volts per meter 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 equipment covered by this standard;

g) For the Demonstrated Method Test, the multiplier for the test acceleration factor is to be 576.30 for intermittent use appliances, or 5763.00 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; and

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

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.

25.4.4 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.

26 Spacings

26.1 General

26.1.1 All uninsulated live parts connected to different circuits – line voltage, low voltage (Class 2), or limited energy primary – and separated electrically by insulation or impedance shall be spaced from one another as though they were parts of opposite polarity and shall be judged on the basis of the highest voltage involved.

26.1.2 The spacing between uninsulated live parts of opposite polarity and between such parts and dead metal that may be grounded in service is not specified for parts of circuits that are classified as low-voltage (Class 2) circuits.

26.1.3 The spacing between uninsulated live parts within a limited energy primary circuit is not specified if the:

a) Location and relative arrangement of the parts are such that permanent separation is provided and

b) Limited-energy circuit meets the abnormal test requirements specified in 46.6.1 – 46.6.4.

26.1.4 The spacing between uninsulated live parts of a limited-energy primary circuit and dead metal that may be contacted by persons, or that may become grounded in service, is as specified in 26.1.6.

26.1.5 With respect to 26.1.4, an entire component shall be evaluated as live part if any dead metal of the component is isolated from a live part by an insulation system or by a spacing that is inadequate for the line voltage involved.

26.1.6 There shall be a spacing of not less than 1/16 inch (1.6 mm) between uninsulated line voltage parts of opposite polarity, and between an uninsulated line-voltage part and a dead-metal part that might be exposed to contact by persons during operation of the appliance or that might be grounded. If an uninsulated live part is not rigidly supported, or if a movable dead-metal part is in close proximity to an uninsulated live part, the construction shall be such that this minimum spacing will be maintained under all operating conditions.

Exception: At closed-in points only, such as the screw and washer construction of an insulated terminal mounted in metal, a spacing of no less than 3/64 inch (1.2 mm) may be used. Within a thermostat, other than at contacts, the spacing between uninsulated live parts on opposite sides of the contacts shall not be less than 1/32 inch (0.8 mm) through air and 3/64 inch over surface of insulating material, and the construction shall be such that the spacings will be permanently maintained.

26.1.7 An insulating lining or barrier of fiber or similar material shall be so located or of such material that it will not be affected adversely by arcing. If the lining or barrier is used instead of an air spacing, the material shall not be less than 1/32 inch (0.8 mm) thick.

Exception No. 1: The insulating material may be 1/64 inch (0.4 mm) thick if a fiber liner or barrier is used in conjunction with an air spacing not less than 50 percent of that required for air alone.

Exception No. 2: Insulating material having a thickness less than that specified may be used if, upon investigation, it has been determined to be acceptable for the particular application.

26.2 Spacings on printed wiring boards

26.2.1 As an alternative to the spacing requirements in 26.1.6, 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 Section 45; or

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; or

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.

26.2.2 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 appliance is to be categorized as Overvoltage Category II. See Table 25.1;

b) The applicable Material Group per Table 25.2;

c) The pollution degree shall be Pollution Degree 2. See Table 25.3;

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.

26.2.3 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.

27 Grounding

27.1 All permanently connected appliances shall have provision for the grounding of all exposed metal parts that are likely to become energized.

Exception: An appliance provided with a double-insulation system, shall be constructed in accordance with the Standard for Double Insulation Systems for Use in Electrical Equipment, UL 1097, and is not required to be grounded.

27.2 An appliance marked as double insulated shall not be provided with a means for grounding.

27.3 If a grounding means is provided on the appliance, whether required or not, all exposed dead-metal parts and all dead-metal parts within the enclosure that are exposed to contact during any servicing operation and that are likely to become energized shall be reliably connected to the grounding means.

27.4 An equipment grounding conductor of a flexible cord shall comply with all of the following:

a) Finished to show a green color with or without one or more yellow stripes.

b) Conductively connected to:

1) All exposed dead-metal parts that are likely to become energized and

2) All dead-metal parts within the enclosure that are exposed to contact during any user servicing and that are likely to become energized.

The grounding conductor shall be connected by means of a screw or other means not likely to be removed during any servicing operation not involving the power supply cord. Solder alone shall not be used for securing this conductor.

c) Connected to the fixed grounding member of an attachment plug of the grounding type.

Exception: The grounding contact member of a grounding attachment plug used on the power supply cord of a portable hand-held, hand-guided, or hand-supported appliance may be of the movable, self-restoring type on circuits operating at 150 volts or less between any conductor and ground.

28 Motors

28.1 Construction

28.1.1 A motor provided as part of an appliance shall be capable of handling the load it is intended to drive without introducing a risk of fire, electric shock, or injury to persons.

28.1.2 A motor winding shall be constructed so as to resist the absorption of moisture.

28.1.3 With reference to the requirement specified in 28.1.2, film-coated wire is not required to be additionally treated to prevent absorption of moisture. Fiber slot liners, cloth coil wrap, and similar moisture-absorptive materials shall be provided with impregnation or otherwise treated to prevent moisture absorption.

28.1.4 A brush cap, accessible from outside an enclosure of a portable appliance that prevents contact with a live part at a potential of more than 30 volts rms (42.4 volts peak) to any other part or to ground, shall be fastened in place so that removal cannot be accomplished by an ordinary tool used in the intended manner. Wrenches, pliers, and flat-blade or cross-blade screwdrivers are deemed to be ordinary tools.

28.2 Brush wear-out

28.2.1 A brush-holder assembly shall be constructed so that when a brush is worn out (no longer capable of performing its function), the brush, spring, and other parts of the assembly will be retained to the degree necessary to reduce the likelihood of:

a) Accessible dead-metal parts becoming energized and

b) Live parts becoming accessible.

28.2.2 With reference to the requirement in 28.2.1, the parts of a brush holder assembly are considered to be acceptably retained if:

a) The motor is enclosed, independently of the appliance enclosure, to the degree that the brush, spring, or other parts of the assembly will be contained within the motor enclosure, and no conductive parts of the motor enclosure are accessible.

b) The appliance has spacings such that parts of the brush holder assembly which can become free to move will not become live and accessible, nor bridge live parts to accessible metal parts, and the motor enclosure is not accessible; or

c) Other constructions equivalent to (a) or (b).

28.2.3 A motor control device not having a horsepower rating equivalent to the motor it controls, shall be capable of performing effectively when subjected to an overload test as specified in the Motor Control Overload Test, Section 56.

28.3 Overload protection

28.3.1 Except as indicated in 28.3.8, the following appliances in which a 1 hp or smaller motor is used shall incorporate thermal or overload protection that prevents the motor from attaining excessive temperatures under any operating conditions:

a) A remotely or automatically controlled appliance and

b) A permanently connected, continuous-duty, manually started appliance.

An impedance-protected motor is not required to have additional thermal or overload protection.

28.3.2 An appliance intended to be automatically or remotely controlled, and employing a motor rated at more than 1 hp, shall incorporate thermal or overcurrent protection.

28.3.3 Fuses shall not be used as motor-overload-protective devices unless the motor is protected by the largest size of fuse that can be inserted in the fuseholder.

28.3.4 Thermal protection devices integral with the motor shall comply with one of the following:

a) *Deleted;*

b) The Standard for Thermally Protected Motors, UL 1004-3; 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 Thermal Motor Protectors, UL 60730-2-2; in conjunction with the Standard for Thermally Protected Motors, UL 1004-3 (to evaluate the motor-protector combination).

28.3.5 Impedance protection shall comply with the Standard for Impedance Protected Motors, UL 1004-2.

28.3.6 Electronic protection integral to the motor shall comply with the Standard for Electronically Protected Motors, UL 1004-7.

28.3.7 Electronically protected motor circuits shall comply with one of the following:

a) The Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991. When the protective electronic circuit is relying upon software as a protective component, it shall comply with the requirements in the Standard for Software in Programmable Components, UL 1998. If software is relied upon to perform a safety function, it shall be considered software Class 1;

b) The Standard for Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements, UL 60730-1. If software is relied upon to perform a safety function, it shall be considered software Class B; or

c) The Standard for Adjustable Speed Electrical Power Drive Systems – Part 5-1: Safety Requirements – Electrical, Thermal and Energy, UL 61800-5-1.

Exception: Compliance with the above standards is not required for an electronically protected motor circuit if there is no risk of fire, electric shock, or injury to persons during abnormal testing with the motor electronic circuit rendered ineffective; compliance with the applicable requirements of this standard is then required.

28.3.8 Motors indicated below are not required to comply with the overload protection requirement:

a) Motors that are supplied by Class 2 circuits.

b) Motors rated less than 1 horsepower and

1) Which are manually started;

2) Where the operator is in attendance during the entire operating cycle;

3) Where malfunction of the motor is evident.

28.3.9 Running overload protection is not required for the following constructions:

a) A motor that is used for air-handling only when the blower or fan impeller is coupled directly to the motor shaft or

b) A shaded-pole motor with a 2:1 or smaller ratio between locked-rotor and no-load currents and a 1 ampere or smaller difference between no-load and locked-rotor currents.

28.3.10 An overload-protective device that complies with the National Electrical Code, ANSI/NFPA 70, is determined to comply with 28.3.1. This overload-protective device shall be responsive to motor current and rated or set as specified in Column A of Table 430-72(b) of the NEC. When the rating of the motor-running overload protection determined in accordance with the foregoing does not correspond to a standard size or rating of a fuse, nonadjustable circuit breaker, thermal cutout, thermal relay, or heating element of a thermal-trip motor switch, the next higher size, rating, or setting is not prohibited from being used, and shall not be more than that specified in Column B of Table 430-72(b) of the NEC. For a multi-speed motor, each winding connection is to be evaluated separately.

28.3.11 The functioning of an overload protective device, whether or not such a device is required, shall not result in a risk of fire, electric shock, or injury to persons. Overload devices used for running overload protection, other than those that are inherent in a motor, shall be located in each ungrounded conductor of a supply system.

28.3.12 Motor-overload protection in which contacts control a relay coil in a motor starter shall comply with the requirements of 28.3.1.

28.3.13 Fuses used in motor-overload-protective devices shall be configured so that the motor is investigated with the largest size of fuse that is capable of being inserted in the fuseholder.

28.4 Insulation systems

28.4.1 Class A insulation systems shall consist of a combination of magnet wire and major component insulation materials evaluated and found to operate as intended in its end use. Thermoset materials and materials specified in Table 28.1 at the thicknesses specified are permitted to be used without further evaluation.

Table 28.1
Primary Class A insulating materials and minimum thicknesses

Material	Minimum thickness	
	Inch	(mm)
Vulcanized fiber	0.028	(0.71)
Polyethylene terephthalate film	0.007	(0.018)
Cambric	0.028	(0.71)
Treated cloth	0.028	(0.71)
Electrical grade paper	0.028	(0.71)
Mica	0.006	(0.15)
Aramid paper	0.010	(0.25)

28.4.2 For Class A insulation systems employing other materials or thinner materials than those indicated in Table 28.1 or a combination of materials, the materials, whether polymeric or not polymeric (treated cloth, for example), shall comply with the requirements in 28.4.3.

28.4.3 A polymeric material employed in a Class 105 (A) insulation system that isolates the windings from dead metal parts shall be unfilled or glass-reinforced nylon, polycarbonate, polybutylene terephthalate, polyethylene terephthalate, phenolic or acetal, and shall have a relative or generic thermal index for electrical properties of 105°C (221°F) minimum. Leads shall be rated 90°C (194°F) minimum. Motors employing thermoplastic materials shall be subjected to the tests in Thermoplastic Motor Insulation Systems, Section 66.

Exception No. 1: Other polymeric materials used in a Class 105 (A) insulation system shall comply with the requirements for Thermal Aging, 66.4.

Exception No. 2: Class (105) A DC motor located in limited energy primary circuit (See 5.30) or Class 2 circuit, shall comply with the applicable requirements in this standard.

28.4.4 Materials used in an insulation system that operates above Class 105 (A) temperatures shall comply with the Standard for Systems of Insulating Materials – General, UL 1446.

28.4.5 All insulation systems employing integral ground insulation shall comply with the requirements specified in the Standard for Systems of Insulating Materials – General, UL 1446

Exception: Class (105) A DC motor located in limited energy primary circuit (See 5.30) or Class 2 circuit, shall comply with the applicable requirements in this standard.

29 Transformers

29.1 General-purpose transformers shall comply with the Standard for Low Voltage Transformers – Part 1: General Requirements, UL 5085-1 and the Standard for Low Voltage Transformers – Part 2: General Purpose Transformers, UL 5085-2

Exception: A transformer that complies with the Standard for Transformers and Motor Transformers for Use in Audio-, Radio-, and Television-Type Appliances, UL 1411, and that is used in a circuit involving an audio or video component, meets the intent of this requirement.

29.2 Class 2 and Class 3 transformers shall comply with the Standard for Low Voltage Transformers – Part 1: General Requirements, UL 5085-1 and the Standard for Low Voltage Transformers – Part 3: Class 2 and Class 3 Transformers, UL 5085-3.

30 Batteries and Battery Chargers

30.1 A lithium ion (Li-On) single cell battery shall comply with the requirements for secondary lithium cells in the Standard for Lithium Batteries, UL 1642.

30.2 Rechargeable nickel cadmium (Ni-Cad) cells and battery packs shall comply with the applicable construction and performance requirements of this standard.

30.3 Rechargeable nickel metal-hydride (Ni-MH) battery cells and packs shall comply with the applicable construction and performance requirements of this standard, or the applicable requirements for secondary cells or battery packs in the Standard for Household and Commercial Batteries, UL 2054.

30.4 Primary batteries (non-rechargeable) that comply with the requirements of the relevant UL Standard and of 2.4 are considered to fulfill the requirements of this standard.

30.5 A Class 2 battery charger shall comply with one of the following:

a) The Standard for Class 2 Power Units, UL 1310 or

b) The Standard for Information Technology Equipment – Safety – Part 1: General Requirements, UL 60950-1 with an output marked "Class 2".

31 Capacitors

31.1 A capacitor provided as a part of a capacitor motor and a capacitor connected across the line, such as a capacitor for radio-interference elimination or power-factor correction, shall be housed within an enclosure or container that shall protect the plates against mechanical damage and prevent the emission of flame or molten material resulting from malfunction of the capacitor. The container shall be of metal providing strength and protection not less than that of uncoated steel having a thickness of 0.020 inch (0.51 mm). Sheet metal having a thickness less than 0.026 inch (0.66 mm) shall not be used. The motor starting or running capacitor shall comply with the Standard for Capacitors, UL 810. The across the line capacitor shall comply with the applicable requirements in the Standard for Fixed Capacitors for Use in Electronic Equipment – Part 14: Sectional Specification: Fixed Capacitors for Electromagnetic Interference Suppression and Connection to the Supply Mains, UL 60384-14.

Exception: The individual container of a capacitor may be of sheet metal less than 0.020 inch thick or may be of material other than metal if the capacitor is mounted in an enclosure that houses other parts of the appliance and provided that such housing is acceptable for the enclosure of live parts.

31.2 If a capacitor that is not a part of a capacitor motor or a capacitor-start motor is connected in an appliance that is intended to be automatically or remotely-controlled so that malfunction or breakdown of the capacitor would result in a risk of fire, electric shock, or injury to persons, thermal or overcurrent protection shall be provided in the appliance to reduce such a risk.

31.3 Capacitors, connected line-to-line or line-to-ground, shall comply with the requirements in the Standard for Fixed Capacitors for Use in Electronic Equipment – Part 14: Sectional Specification: Fixed

Capacitors for Electromagnetic Interference Suppression and Connection to the Supply Mains, UL 60384-14. A capacitor connected from one side of the line to the frame or enclosure of an appliance shall have a capacitance rating of not more than 0.10 µF.

31.4 The voltage rating of a capacitor other than a motor-starting or motor-running capacitor shall equal or exceed the maximum steady-state potential to which the capacitor is subjected during operation of the unit at the rated voltage.

31.5 Under both normal and abnormal conditions of use, a capacitor employing a liquid dielectric medium more combustible than askarel shall not cause a risk of electric shock or fire and shall be protected against expulsion of the dielectric medium.

32 Light Sources and Associated Components

32.1 Lighting ballasts shall comply with the Standard for Fluorescent-Lamp Ballasts, UL 935, or the Standard for High-Intensity Discharge Lamp Ballasts, UL 1029. Ballasts forming part of a luminaire that complies with an appropriate luminaire standard are considered to fulfill this requirement.

Exception: Ballasts for other light sources shall comply with the appropriate standard(s) and need not comply with UL 935 or UL 1029.

32.2 Light emitting diode (LED) light sources shall comply with the Standard for Light Emitting Diode (LED) Equipment For Use In Lighting Products, UL 8750. LED light sources forming part of a luminaire that complies with an appropriate luminaire standard are considered to fulfill this requirement.

Exception: Individual LED light sources intended for indicating purposes only, need not comply with UL 8750.

33 Ionization Circuits

33.1 Grooming appliances which employ ionization technology shall comply with 33.2 and 33.3.

33.2 The high voltage power supply used in the ionizer shall be evaluated to the applicable construction and component requirements for power supplies contained in the Standard for Electrostatic Air Cleaners, UL 867. The following performance tests of UL 867 shall be considered:

a) Output Test;

b) Temperature Test;

c) Dielectric Voltage Withstand Test – High Voltage Transformer Core;

d) Dielectric Voltage Withstand Test – Induced Energy, (for linear-type transformer only);

e) Abnormal Operations Test – Component Short- And Open-Circuit Test; and

f) High Voltage Insulating Materials Arcing Test.

33.3 The high voltage pins (electrodes) of ionizer shall not be accessible per 8.5.

33.4 A grooming appliance employing ionization circuitry shall not produce a concentration of ozone exceeding 0.05 parts per million by volume when tested as described in Ozone Test, Section 67.

33A Button or Coin Cell Batteries of Lithium Technologies

33A.1 To reduce the risk of injury due to battery ingestion by small children, the battery compartment of an appliance or any accessory, such as a wireless control, incorporating one or more coin cell batteries of lithium technologies shall comply with the Standard for Products Incorporating Button or Coin Cell Batteries of Lithium Technologies, UL 4200A, if the appliance or any accessory is intended for use with one or more single cell batteries having a diameter of 1.25 inches (32 mm) maximum with a diameter greater than its height.

Exception: Not applicable to appliances and accessories intended for fixed installation at a height no less than 4 feet (1.2 m) from floor.

PERFORMANCE

34 General

34.1 The tests described in Sections 38 – 46 shall be conducted in that order on the same samples.

Exception: Some tests on hand-supported hair dryers will require more than one sample.

34.2 A simulated head used for temperature testing is to consist of a foamed plastic wig form, approximately 21-1/2 inches (546 mm) in circumference, closely wrapped with two layers of cheesecloth. Pieces of black (exposed and developed) cellulose acetate photographic film to represent hair-holding devices are to be attached to the top and sides.

34.3 Wherever cheesecloth is specified in connection with either a temperature test or an abnormal test, the cloth is to be bleached cheesecloth 36 inches (914 mm) wide, running 14 – 15 yards per pound mass (approximately 28 – 30 m/kg mass), and having what is known in the trade as a "count of 32 x 28," which means that for any square inch there are 32 threads in one direction and 28 threads in the other direction (for any square centimeter there are 13 threads in one direction and 11 threads in the other direction).

34.4 For the purpose of these requirements, a primary temperature limiting control in an appliance that has two different temperature limiting controls is the control that is intended to operate before the second control operates. The second control, termed the backup temperature limiting control, is intended to operate in the event of malfunction of the primary control.

34.5 Wherever a hardwood surface is specified in connection with a test, the hardwood surface is to consist of a layer of tongue-and-groove oak flooring mounted on two layers of nominal 3/4 inch (19.1 mm) plywood. The oak flooring is to be nominally 3/4 inch thick [actual size 3/4 by 2-1/4 inch (19.1 by 57.2 mm)]. The assembly is to rest on a concrete floor or an equivalent nonresilient floor during the test.

35 Strength of Enclosure Test

35.1 A 5-pound (22.2-N) force shall be applied by means of the flat end of a circular steel rod that is 1/4 inch (6.4 mm) in diameter and 5 inches (127 mm) long for 1 minute to any part of the area described in 8.5.8. The rod is to be vertical, and the appliance may be oriented in any position relative to the rod before the force is applied. The results are acceptable if:

a) During the test, the rod does not contact an uninsulated live part; and

b) After the test, the construction is in compliance with 8.5.3, 8.5.4, and 26.1.6.

35.2 With reference to 35.1, the test is to be conducted on a guard such as a screen, which is located under an opening in an enclosure, through the opening in the enclosure only if the following conditions are met:

a) The guard is:

1) Metal or other electrically conductive material,

2) Accessible to user contact as determined in accordance with 8.5.4, and

3) Accessible to the rod; or

b) The guard is:

1) Electrically nonconductive material,

2) Accessible to user contact as determined in accordance with 8.5.4,

3) Accessible to the rod, and

4) Required for compliance with the accessibility requirements specified in 8.5.3.

36 Tip-Over Test

36.1 Three samples of an appliance as described in 9.2.1 shall be tested and each sample is to be tested three times. Each sample of the appliance 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 during intended use, and are to contain whatever combination of separable components and liquid that results in the most adverse condition for this test.

36.2 For an appliance with a capacity of 32 fluid ounces (947 mL) or less, the sample is to be tilted to determine its critical angle of balance (the angle at which the sample will tip over due only to the force of gravity). The results are acceptable if one of the following occurs:

a) The critical angle of balance is 45 degrees or greater or

b) The lid, if provided, remains in place and the amount of liquid emitted during the first 5 seconds from the appliance during tip over is no more than 5 fluid ounces (148 mL).

Exception: An appliance having a reservoir with a capacity of 5 fluid ounces or less need not be tested.

36.3 For an appliance with a capacity of greater than 32 fluid ounces (947 mL), the sample is to be tipped over. The results are acceptable if the lid remains in place.

37 Stability Test

37.1 In accordance with 11.1, an appliance shall be placed on a supporting surface that is inclined at a 10-degree angle from the horizontal. The appliance is to be turned to the position most likely to cause tipping. Any adjustable or movable part that will affect the location of the center of gravity of the appliance is to be placed in the position most likely to contribute to tipping. If the appliance is on castors, blocks are to be placed in front of them to prevent the appliance from moving down the incline. The results are acceptable if the appliance remains stable on the tilted surface.

37.2 An appliance of the type specified in 9.2.1 shall be placed on a plane inclined at an angle of 15 degrees to the horizontal. The appliance shall be positioned and loaded with whatever combination of separable components (strainers, cups, and similar parts) and liquid that results in the maximum tendency

to overturn under conditions of intended use. The appliance shall be prevented from sliding on the inclined surface. The result is acceptable if the appliance does not overturn as a result of this test.

38 Leakage Current Test

38.1 The leakage current of a cord-connected portable, stationary, or fixed appliance, when tested in accordance with 38.3 – 38.7, shall be no more than:

a) 0.5 milliampere for an ungrounded (two wire) portable, stationary, or fixed appliance;

b) 0.5 milliampere for a grounded (three wire) portable appliance; and

c) 0.75 milliampere for a grounded (three wire) stationary or fixed appliance.

38.2 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.

38.3 All exposed conductive surfaces are to be tested for leakage current. The leakage currents from these surfaces are to be measured to the grounded supply conductor individually as well as collectively where simultaneously accessible. Parts are considered to be exposed surfaces unless guarded by an enclosure that reduces the risk of electric shock as defined in 8.5.1 – 8.5.6. 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 considered not to present a risk of electric shock.

38.4 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 having an area of 10 by 20 centimeters in contact with the surface. Where the surface is less than 10 by 20 centimeters, 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.

38.5 The measurement circuit for leakage current is to be as shown in Figure 38.1. The measurement instrument is described in (a) – (d). The meter used for a measurement need only indicate the same numerical value for a particular measurement as would the defined instrument. The meter used need not have all the attributes of the defined instrument.

a) The meter is to have an input impedance of a 1,500-ohm resistor shunted by a capacitance of 0.15 microfarads.

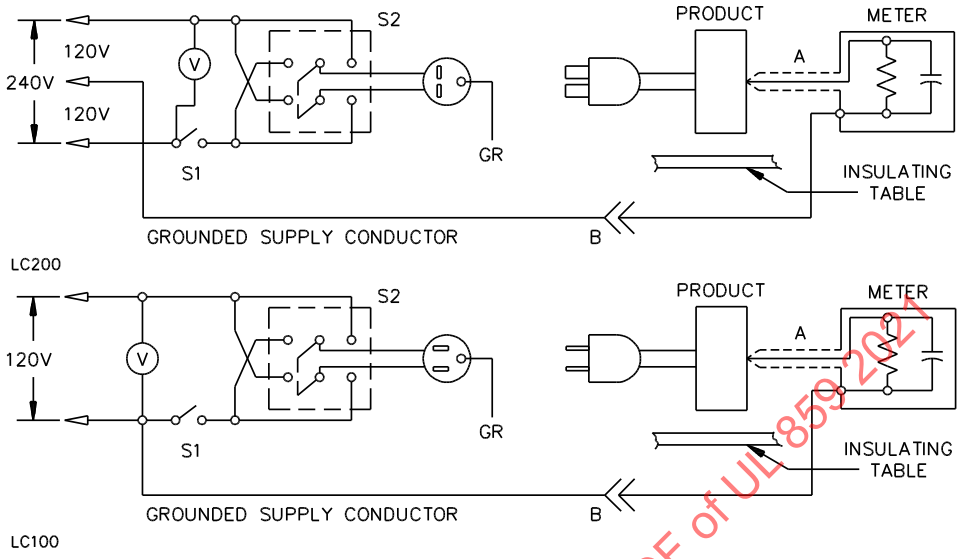
b) The meter is to indicate 1.11 times the average of the full wave rectified composite waveform of the voltage across the resistor or current through the resistor.

c) Over a frequency range of 0 – 100 kilohertz the measurement circuitry is to have a frequency response (ratio of indicated-to-actual value of current) equal to the ratio of the impedance of a 1,500-ohm resistor shunted by a 0.15-microfarad capacitor to 1,500 ohms. At an indication of 0.5 or 0.75 milliampere, the measurement is to have an error of no more than 5 percent.

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 an accessible part and the grounded supply conductor.

Figure 38.1

Leakage current measurement circuits



A – Probe with shielded lead.

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

38.6 A sample of the appliance is to be tested for leakage current starting with the as-received condition, but with its grounding conductor, if any, open at the attachment plug (open at receptacle as shown in Figure 38.1). The as-received condition is without prior energization, other than that which may have occurred as part of the production-line testing. The supply voltage is to be adjusted to 120 or 240 volts depending on the rating. Thermostats are to be closed. The test sequence, with reference to the measuring circuit (Figure 38.1) 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, and with the appliance switching devices in all their operating positions.

b) Switch S1 is then to be closed, energizing the appliance, and within 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 conditions. 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 temperature-regulating thermostat does not cycle at the maximum setting, the setting is to be lowered until the thermostat 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 uses a single pole switch or a thermostat with an off position, monitoring of leakage current is to continue until the leakage current stabilizes or decreases after the appliance is turned off. Both positions of switch S2 are to be used.

38.7 Normally a sample will be carried through the complete leakage current test program as described in 38.6, 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.

39 Leakage Current Test Following Humidity Conditioning

39.1 A cord-connected appliance shall comply with the requirements for leakage current specified in 38.1 following exposure for 48 hours to air having a relative humidity of 88 ±2 percent at a temperature of 32 ±2°C (89.6 ±3.6°F).

39.2 To determine compliance with the requirement specified in 39.1, a sample of the appliance that has been preheated to a temperature just above 34°C (93.2°F) is to be contained in a chamber under the time, humidity, and temperature conditions specified. Following the conditioning, while still in the chamber, the sample is to be tested unenergized as described in 38.6(a). The sample, either in or immediately after removal from the chamber, is to be energized and tested as described in 38.6 (b) and (c). The test is to be discontinued when the leakage current stabilizes or decreases.

40 Immersion Protection Trip Time Measurement Test

40.1 As-received hair dryers

40.1.1 Samples of hair dryers that are provided with an immersion protection shall be subjected to the tests described in 40.1.2 – 40.1.7. The results are acceptable if the immersion protection trips, causing the flow of current to ground to cease within the time interval, T, when the current to ground, I, is within the range of 6 – 264 milliamperes, in accordance with the relationship:

$$T = \left[\frac{20}{I}\right]^{1.43}$$

in which:

T is the interval in seconds and

I is the current to ground in milliamperes rms.

40.1.2 Three samples are to be tested individually while connected to their rated source of supply as described in 44.1.13, and then connected to a voltage equal to 85 percent of the rated voltage. The tests are to be conducted with the hair dryer samples in various configurations (including the orientation that results in the most unfavorable condition of use) with the:

a) Hair dryer switch in the off position,

b) Hair dryer switch in the on position,

c) Heat/speed switches in the most disadvantageous settings, and

d) Appliance plug inserted in one position into the supply circuit receptacle and then with the polarity reversed.

Exception: Testing at 85 percent of rated voltage is not required if the investigation of the immersion detection indicated it will function as intended at 85 percent of rated voltage.

40.1.3 Each sample is to be placed at the bottom of an empty, isolated, conductive metal tub of a convenient size. The tub is to be equipped such that it can be filled from beneath at a rate of no greater than 5 inches (127 mm) of water per hour. The tub is to be connected to earth ground through a noninductive 500-ohm resistor. As the tub is filled, the leakage current is to be continually measured and a trace of the current flow as a function of time is to be obtained. The water flow is to be stopped when the leakage current reaches 6 milliamperes or the immersion detection functions, whichever occurs first. One minute after the immersion detection has tripped and without changing any of the test conditions, a user-resettable IDCI is to be reset and the current value and tripping time measurements are to be repeated. The results are acceptable if in each immersion the immersion detection trips at a current:

a) Less than 6 milliamperes or

b) Greater than 6 milliamperes in a period of time to comply with the time and current relationship specified in 40.1.1. The period of time is to be measured from the moment the current flow exceeds 6 milliamperes to the moment the current ceases to flow. When the immersion detection trips, the flow of current to ground is to cease.

40.1.4 The isolated tub described in 40.1.3 is to be filled with 12 inches (305 mm) of water. Three samples are to be dropped into the water such that different surfaces of the samples strike the water first. The leakage current is to be continuously measured and a trace of the current flow as a function of time is to be obtained.

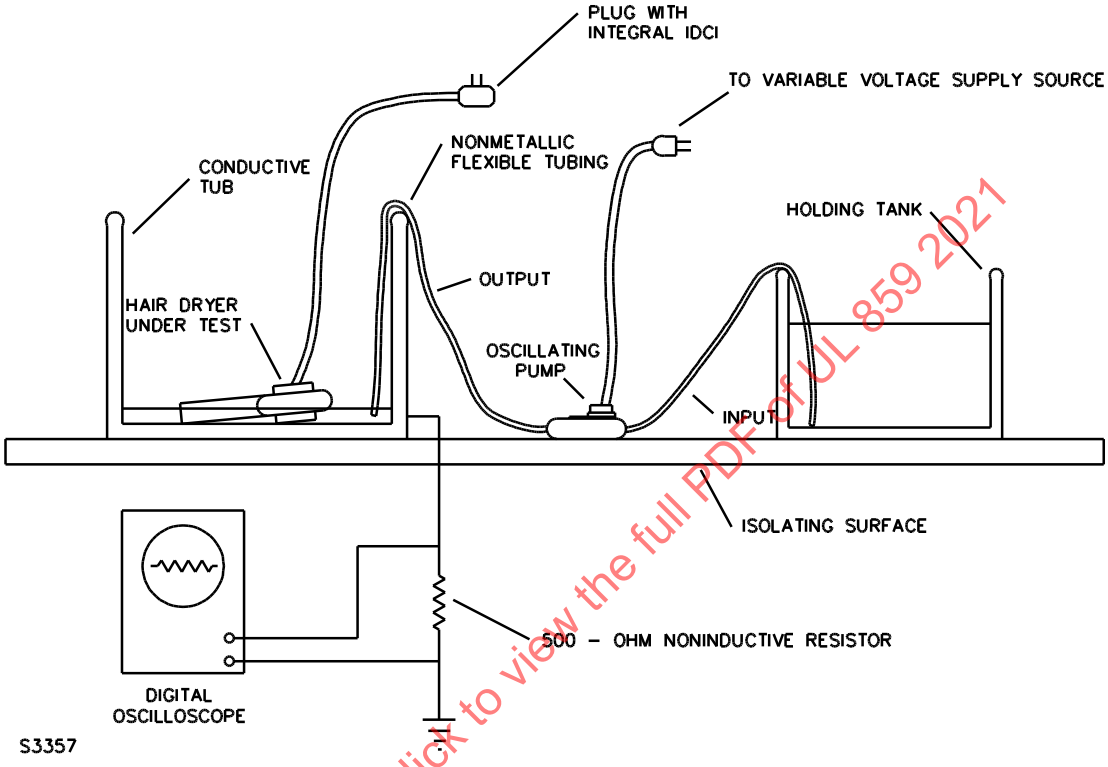
40.1.5 The tests described in 40.1.2 – 40.1.4 are to be conducted two separate times using water with a resistivity of 200 ohm-cm and 20,000 ohm-cm as described in 40.1.7.

40.1.6 A typical test arrangement for the test described in 40.1.3 is shown in Figure 40.1. In the arrangement, the pump is connected to a source of supply of variable voltage so that the water flow rate may be regulated. The tubing that connects the holding tank to the pump and the pump to the conductive

tank is nonmetallic flexible tubing (such as aquarium air hose) and is of such length that it extends to the bottom of the conductive tub so that the water fills the tub from below.

Figure 40.1

Immersion detection trip test arrangement



40.1.7 The water resistivities specified in 40.1.5 are to be obtained by the addition of sodium chloride (common table salt) to distilled water or tap water. The water temperature is to be 20 – 40°C (68 – 104°F).

40.2 Conditioned hair dryers

40.2.1 The requirements specified in 40.1.2 – 40.1.7 are to be applied to samples of a hair dryer provided with an immersion detection that have been subjected to one of the following tests (each test is to be conducted):

a) Drape test, 46.2.1 – 46.2.3;

b) Restricted air inlet test, 46.4.2.1 – 46.4.2.4;

c) Restricted air outlet test, 46.4.3.1 – 46.4.3.3;

d) Floor drop test, 46.4.4.1 and 46.4.4.2;

e) Motor slowdown test, 46.4.6.1 and 46.4.6.13; and

f) Short circuit and stall tests, 46.6.1 – 46.6.4.

40.2.2 The tests on the conditioned samples are to be conducted using the on-off switch position, the heat-speed selector switch(es) position(s), the supply circuit voltage and polarity, the water resistivity, and

the like as specified in 40.1.2 and 40.1.5, that resulted in the highest leakage current and longest immersion detection trip time determined in accordance with 40.1.3. The results are acceptable if the immersion detection trips at a current:

a) Less than 6 milliamperes or

b) Greater than 6 milliamperes in a period of time to comply with the time and current relationship specified in 40.1.1. The period of time is to be measured from the moment the current flow exceeds 6 milliamperes to the moment the current ceases to flow. When the immersion detection trips, the flow of current to ground is to cease.

41 Dew Point Humidity Test

41.1 Three samples of a hair dryer provided with an IDCI are to be conditioned in a chamber at a temperature of 5 ±2°C (41 ±3.6°F) for at least 4 hours and then transferred to a humidity chamber having a relative humidity of 86 ±2 percent at a temperature of 32 ±2°C (89.6 ±3.6°F). The transfer time is not to exceed 1 minute. The samples are to be energized by the insertion of their attachment plugs into receptacles of the voltage specified in 44.1.13. The on-off switch of the hair dryer is to be in the off position. The samples are to remain in the humidity chamber for 15 minutes. The results are acceptable if the IDCIs do not trip while in the chamber.

42 Conductive Coating Test

42.1 General

42.1.1 A hair dryer that is provided with a conductive coating for use as an IDCI sensor shall be conditioned as described in 42.2.1 – 42.5.1 and then subjected to the mechanical endurance test described in 42.1.2. Five separate samples are to be used for each conditioning. The resistance from at least three points on the interior of the enclosures (typically a point near the exhaust opening, a point near the intake opening, and a point that is the longest distance away from the point of connection of the sensor wire) to the sensor wire termination is to be determined before the conditioning begins, after conditioning, and then again after the mechanical endurance test.

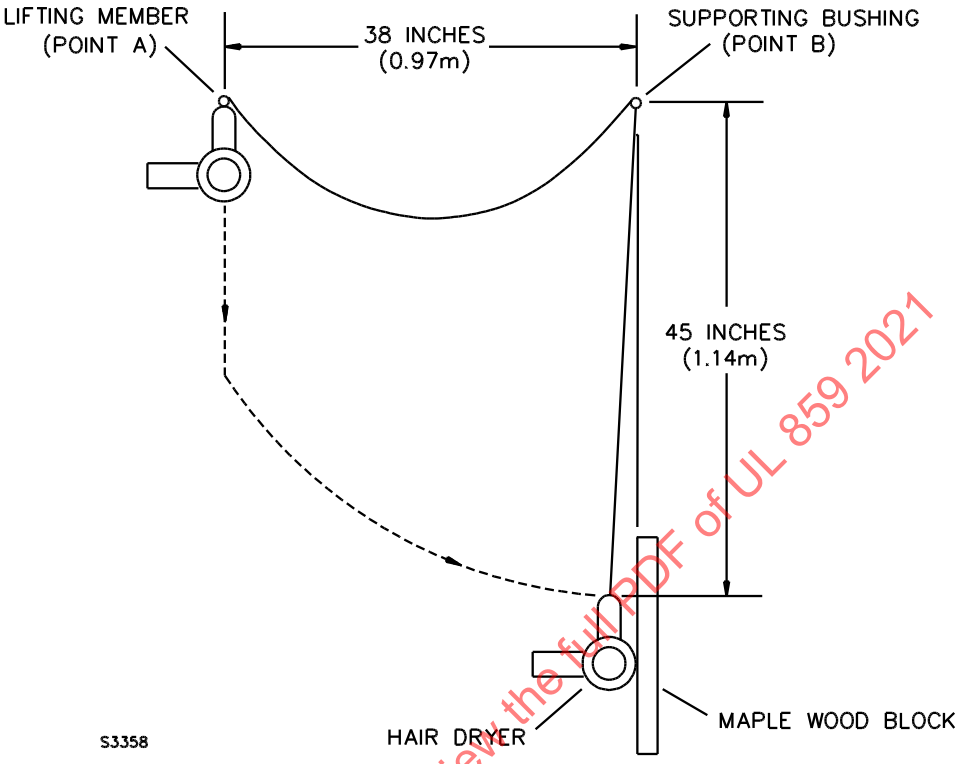
42.1.2 After conditioning, all samples are to be subjected to 150 cycles of mechanical endurance or the number of cycles less than 150 that results in the hair dryer becoming inoperable due to breakage of an electrical connection or component or a mechanical breakdown. Detachment of the exhaust grille or intake grille, or similar failure of mechanical parts that do not result in the hair dryer becoming inoperable shall not be considered to be the end of the test. It is usually necessary to examine and energize the samples after each impact to determine if the hair dryer has become inoperable. The samples are to be attached to a 45-inch (1.14-m) long cord positioned 38 inches (0.97 m) from the vertical plane of a Maplewood block as shown in Figure 42.1, with points A and B in the same horizontal plane. The samples are to be allowed initially to drop and then to swing in an arc onto the vertical surface of the maple block. The resistance of each sample is to be determined again between the same points previously used and compared to the first three values of resistance. The results are acceptable if:

a) The resistance of the samples does not increase to a value in excess of 50 percent of that determined to be the maximum value that will cause the IDCI to trip (The maximum resistance resulting in the threshold trip current flow for the IDCI is usually determined in a separate investigation of IDCIs) and

b) There is no visible cracking, flaking, peeling, wrinkling, blistering, or similar deterioration of the conductive coating.

Figure 42.1

Mechanical endurance test arrangement



42.2 Thermal cycling

42.2.1 Five samples are to be conditioned for:

a) One hour at 18.0 – 20.0°C (32.4 – 36.0°F) higher than the maximum measured normal-use temperature of the coating determined in accordance with 44.5, but no less than 85°C (185°F) in any case, followed by

b) One hour at 23.0 ±2.0°C (73.4 ±3.6°F) and a relative humidity of 50 ±5 percent, followed by

c) One hour at minus 29.0 ±2.0°C (minus 20.2 ±3.6°F), followed by

d) One hour at 23.0 ±2.0°C (73.4 ±3.6°F) and a relative humidity of 50 ±5 percent, followed by

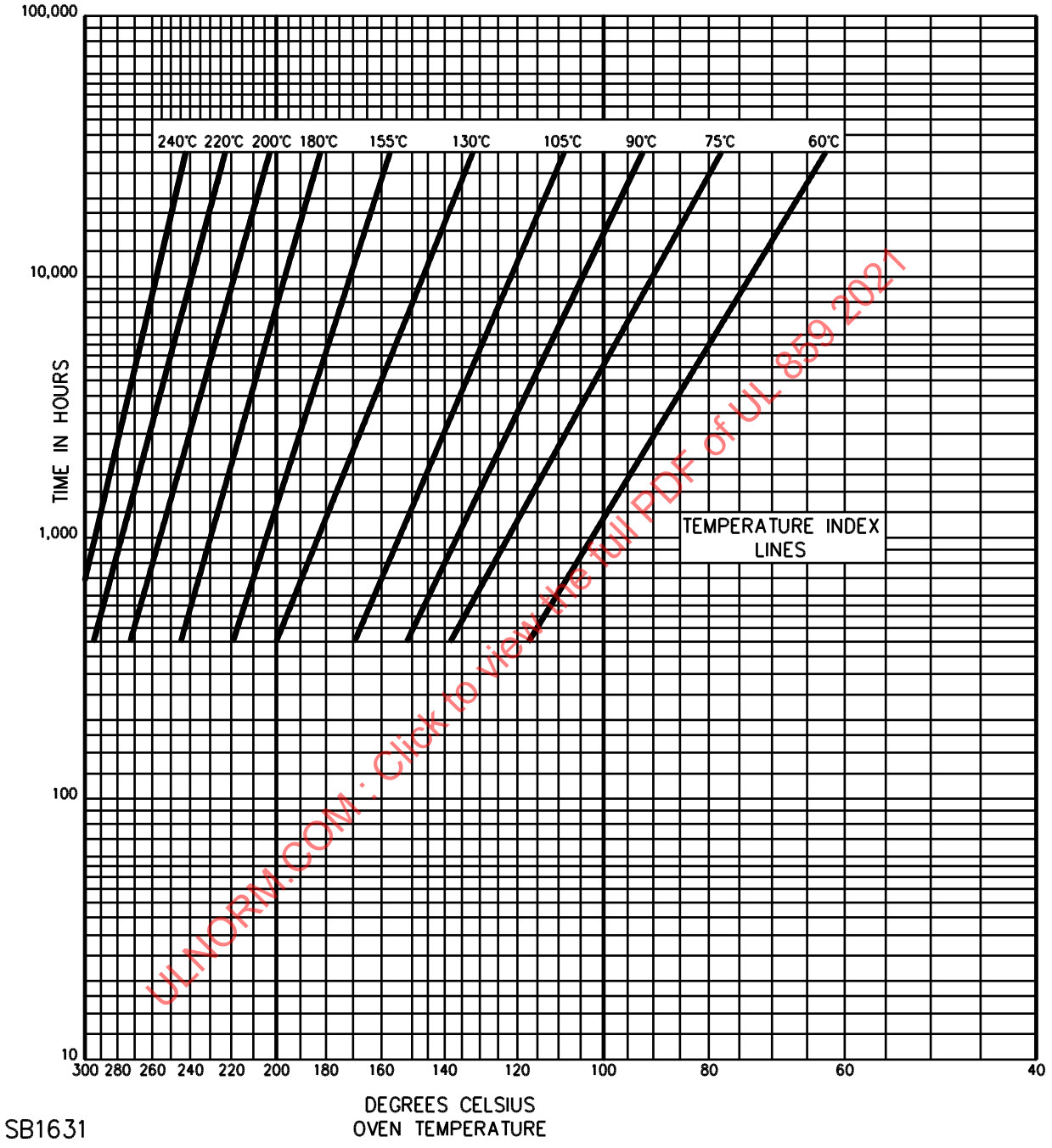
e) The steps outlined in (a) – (d) repeated two more times.

42.3 Limited thermal aging

42.3.1 Five samples are to be conditioned for 300 hours at the oven temperature determined from the respective temperature index line in Figure 42.2, in which the temperature index T is the measured normal operating temperature of the coating determined in accordance with 44.5, but no less than 60°C (140°F). If agreeable to all concerned, a longer time at a correspondingly lower temperature may be used as determined in accordance with Figure 42.2. After the conditioning, the samples are to be brought to and tested at a room ambient temperature of 23.0 ±2.0°C (73.4 ±3.6°F).

Figure 42.2

Conditioning time versus oven temperature for temperature index of conductive coatings



42.4 Short term aging

42.4.1 Five samples are to be conditioned for 56 days at 18.0 – 20.0°C (32.4 – 36.0°F) higher than the maximum measured normal use temperature of the coating determined in accordance with 44.5, but no less than 85°C (185°F) in any case.

42.5 Humidity conditioning

42.5.1 Five samples are to be conditioned for 56 days at 35.0 ±2.0°C (95.0 ±3.6°F) and a relative humidity of 90 ±5 percent.

43 Power Input Test

43.1 The power input to an appliance marked with a rating of 50 watts or less shall be within the inclusive range of 75 – 110 percent of that rating. If the marked rating is greater than 50 watts, the power input shall be within the inclusive range of 90 – 110 percent of that rating.

43.2 With respect to 43.1, the wattage of an appliance marked with its electrical rating only in amperes and volts will be assumed to be the product of those two values.

43.3 The power input to the appliance is to be measured with the appliance at operating temperature under full-load conditions, and while connected to a circuit of a voltage in accordance with 44.1.13. Control switches or the equivalent, if provided, are to be set to give the maximum power input. For an appliance having a preheat cycle of operation as defined in 5.33, the maximum input value measured during the preheat cycle, with the appliance at room temperature at the beginning of the measurement, is to be used to determine compliance with the requirement specified in 43.1.

Exception: The power input of an appliance that uses a positive temperature coefficient (PTC) heating element shall be measured 1 minute after it has become energized.

44 Normal Temperature Test

44.1 All appliances

44.1.1 An appliance tested under the conditions described in this test shall not attain temperature rises at any time during the test greater than those indicated in Table 44.1.

Exception: An initial peak temperature transient or the peak temperatures measured during preheat cycles not exceeding the temperature rise values specified in Table 44.1 by more than 20 percent are acceptable. If temperature excursions exceed the temperature rise values in Table 44.1 by more than 20 percent, the equivalent continuous normal use temperature is to be determined as described in 44.1.22. The equivalent continuous normal use temperature rises shall not exceed the values specified in Table 44.1.

Table 44.1
Maximum temperature rises

Materials and component parts	°C	(°F)
A. MOTORS		
1. Class 105 insulation systems on coil windings of DC and universal motors		
a. In open motors:		
Thermocouple method	65[a]	(117[a])
Resistance method	75[a]	(135[a])
b. In totally enclosed motors:		
Thermocouple method	70[a]	(126[a])
Resistance method	80[a]	(144[a])
2. Class 105 insulation systems on coil windings of AC motors having a frame diameter[b] of 7 inches (178 mm) of less (not including universal motors)		
a. In open motors (thermocouple or resistance method)	75[a]	(135[a])
b. In totally enclosed motors (thermocouple or resistance method)	80[a]	(144[a])
3. Class 130 insulation systems on coil windings for DC and universal motors:		
a. In open motors:		
Thermocouple method	85[a]	(153[a])
Resistance method	95[a]	(171[a])
b. In totally enclosed motors:		
Thermocouple method	90[a]	(162[a])
Resistance method	100[a]	(180[a])
4. Class 130 insulation systems on coil windings of AC motors having a frame diameter[b] of 7 inches (178 mm) of less (not including universal motors)		
a. In open motors (thermocouple or resistance method)	95	(171)
b. In totally enclosed motors (thermocouple or resistance method)	100	(180)
B. COMPONENTS		
1. Class 130 insulation systems except as indicated in subitems 3 and 4 of item A and subitem 2 of item B:		
a. Thermocouple method	85	(153)
b. Resistance method	95	(171)
2. Class 130 insulation systems on vibrator coils (thermocouple or resistance method)	95	(171)
3. Class 105 insulation systems on windings of relays, solenoids, or transformers	65[c]	(117[c])
4. Class 105 insulation systems on vibrator coils (thermocouple or resistance method)	75[a]	(135[a])
5. Sealing compounds	d	d
6. Capacitors		
a. Electrolytic	40[e]	(72[e])
b. Other types	65[f]	(117[f])
7. Phenolic composition (other than in a flatiron or appliance plug) used as electrical insulation or as a part whose breakdown would result in a condition risk	125[g]	(225[g])
8. Flatiron or appliance plugs	175	(315)
9. Black cellulose acetate photographic film (see 34.2)	85	(153)
C. CONDUCTORS		
1. Rubber- or thermoplastic-insulated wires and cords	35[g]	(63[g])

Table 44.1 Continued on Next Page

Table 44.1 Continued

Materials and component parts	°C	(°F)
2. Type HPN flexible cord	65	(117)
3. Copper or copper-base alloy conductors:		
a. Tinned or bare having:		
1. Diameter or thickness less than 0.015 inch (0.38)	125	(225)
2. A diameter of thickness 0.015 inch or more	175	(315)
b. Plated with nickel, silver, gold, or a combination of these metals	225	(405)
D. ELECTRICAL INSULATION – GENERAL		
1. Varnished cloth insulation	60	(108)
2. Fiber used as electrical insulation	65	(117)
3. Phenolic composition (other than in a flatiron or appliance plug used as electrical insulation or as a part)	125[g]	(225[g])
4. Glass fiber sleeving:		
a. Unimpregnated	225[h,i]	(405[h,i])
b. Coated	25°C less than its temperature rating[h,i]	
E. GENERAL		
1. Wood or other combustible material	65	(117)
2. Water in reservoir or electrode type appliances[j]	29[k]	(53[k])
3. Points on surface supporting a cord-connected appliance	125	(225)
4. Points on surface supporting a permanently-connected appliance	65	(117)
5. For a direct plug-in appliance, points on surface of receptacle and on surrounding wall surfaces	65	(117)

[a] See 44.1.3, 44.1.5, and 44.1.11.

[b] This is the diameter measured in the plane of the lamination of the circle circumscribing the stator frame, excluding lugs, boxes, and the like, used solely for motor mounting, assembly, or connection.

[c] The maximum rise is 85°C (153°F) by the resistance method.

[d] Except in the case of 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 in the Standard Test Methods for Softening Point of Resins Derived from Naval Stores by Ring-and-Ball Apparatus, ASTM E28.

[e] For an electrolytic capacitor that is physically integral with or attached to a motor, the temperature rise on insulating material integral with the capacitor enclosure shall not exceed 65°C (117°F).

[f] A capacitor that operates at a temperature rise of more than 65°C (117°F) may be evaluated on the basis of its marked temperature limit.

[g] The limitations on phenolic composition and on rubber and thermoplastic insulation do not apply to compounds that have been investigated and found to have special heat-resistant properties.

[h] A higher temperature rise is acceptable when the appliance complies with the Extended Operation Test, Section 60.

[i] This requirement does not apply to sleeving installed where it is not folded nor subjected to compression or sharp bends.

[j] This requirement does not apply to an appliance complying with 83.2. See Table 44.3 for flow chart of acceptance criteria for an appliance in which the water temperature rise exceeds 29°C (53°F).

[k] See 44.1.20.

44.1.2 A temperature control that under intended operating conditions is relied upon to maintain temperatures within the limits specified in Table 44.1 and Table 44.2, shall comply with the requirements in 54.2.1 for a combination temperature-limiting and temperature-regulating control.

Table 44.2
Maximum temperature rise of surfaces of a hand-supported hair dryer that may be contacted by the user

Surface function and material[a]	°C	(°F)
1. A part of the appliance that is intended to be grasped for lifting, carrying, or holding the appliance		
a) Metal	30	(54)
b) Porcelain or vitreous material	40	(72)
c) Molded material, rubber, or wood	50	(90)
2. A handle or knob that is contacted but does not involve lifting, carrying, or holding the appliance, and any other surface normally subjected to contact during operation or user maintenance		
a) Metal	35	(63)
b) Porcelain or vitreous material	45	(81)
c) Molded material, rubber, or wood	60	(108)
3. A surface other than a heating surface whose function is known to be hot due to its proximity to the heating function surface, and the enclosure surface of a hair dryer spaced more than 1/2 inch (12.7 mm) from the outermost perimeter of the heated air outlet		
a) Metal	45	(81)
b) Other than metal	70	(126)

[a] A handle, knob, or the like made of a material other than metal, that is placed or clad with metal having a thickness of 0.005 inch (0.127 mm) or less, is to be evaluated as a nonmetallic part.

Table 44.3
Acceptability criteria for water reservoirs or boiling chambers of electrode-type appliances

<table>
<tr><td colspan="5">Does appliance have water temperature of < or > 29°C (53°F) Rise?</td></tr>
<tr><td colspan="4">If > 29°C</td><td>If < 29°C (53°F)</td></tr>
<tr><td colspan="4">Is capacity ≥ or < 8 ounces (23.7 mL)?</td><td>Acceptable</td></tr>
<tr><td colspan="2">If ≥ 8 ounces (23.7 mL)</td><td colspan="2">If < 8 ounces (23.7 mL)</td><td></td></tr>
<tr><td>Is marking in accordance with Exception to 83.2 ?</td><td colspan="2">Is ≤ or > 2 ounces (5.9 mL) spilled during Spillage Test (see Exception to 83.2)?</td><td colspan="2">Is ≤ or > 2 ounces (5.9 mL) spilled during Spillage Test (see Exception to 83.2)?</td><td></td></tr>
<tr><td>Acceptable</td><td>Is ≤ 2 ounces (5.9 mL) spilled?</td><td>Is > 2 ounces (5.9 mL) spilled?</td><td>Is ≤ 2 ounces (5.9 mL) spilled?</td><td>Is > 2 ounces (5.9 mL) spilled?</td><td></td></tr>
<tr><td></td><td>Acceptable</td><td>Unacceptable</td><td>Acceptable</td><td>Unacceptable</td><td></td></tr>
</table>

44.1.3 At coils, the preferred method of measuring temperatures is the thermocouple method; temperature measurements by either the thermocouple or change-of-resistance method may be used. When temperatures of a coil or winding are measured by means of thermocouples, they are to be mounted on the outside of the coil wrap. If the coil is inaccessible for mounting thermocouples (for example, a coil immersed in sealing compound) or if the coil wrap includes thermal insulation such as more than 1/32 inch (0.8 mm) of cotton, paper, rayon, or similar insulation, the change of resistance method is to be used. For the thermocouple-measured temperature of a coil of an alternating-current motor (other than a universal motor) having a frame diameter of 7 inches (178 mm) or less (Table 44.1, item A, subitems 2 and 4), the thermocouple is to be mounted on the integrally applied insulation of the conductor.

44.1.4 In using the resistance method, the windings are to be at room temperature at the start of the test. The temperature rise of a winding is to be calculated from the formula:

$$t = \frac{R}{r}(k + t_1) - (k + t_2)$$

in which:

t is the temperature rise, in °C;

R is the resistance of the coil at the end of the test, in ohms;

r is the resistance of the coil at the beginning of the test, in ohms;

k is 234.5 for copper, 225.0 for electrical conductor grade (EC) aluminum, and k for other grades shall be determined;

t_1 is the room temperature at the beginning of the test, in °C; and

t_2 is the room temperature at the end of the test, in °C.

44.1.5 At a point on the surface of a coil where the temperature is affected by an external source of heat, the temperature rise measured by means of a thermocouple may be higher than the maximum indicated in Table 44.1 by the following amount:

Reference in Table 44.1	Temperature rise, °C	(°F)
Subitem 2(a) of item A; subitem 4 of item B	5	(9)
Subitem 4(a) of item A; subitem 2 of item B	10	(18)
Subitem 3 of item B	15	(27)

44.1.6 With respect to 44.1.5, if the coil wrap is not caused to exceed its temperature limitation by radiation from an external source, the temperature of the coil may be measured by means of a thermocouple on the integral insulation of the coil conductors.

44.1.7 All values for temperature rises in Table 44.1 and Table 44.2 are based on an assumed ambient temperature of 25°C (77°F); however, tests may be conducted at an ambient temperature within the range of 20 – 30°C (68 – 86°F).

44.1.8 If the retention of the insulation of a heater cord depends upon a fabric braid, the braid shall not be removed nor subjected to a temperature rise of more than 65°C (117°F) unless other means are provided to hold the insulation in place. The jacket of Type HSJ or HSJO cord shall not be subjected to a temperature rise of more than 35°C (63°F) if the protection afforded by the jacket is required.

44.1.9 Certain special treatments, such as the use of an impregnant, have been determined to be acceptable for retaining the insulation around the conductors of a heater cord at elevated temperatures.

44.1.10 Thermocouples used to measure temperatures obtained by the thermocouple method are to consist of wires not larger than 24 AWG (0.221 mm^2). The temperature is considered to be stabilized when three successive readings, taken at intervals of 10 percent of the previously elapsed duration of the test but not less than 5 minutes indicate no change.

44.1.11 When thermocouples are used in the determination of temperatures in connection with heating of electrical equipment, it is common practice to use thermocouples consisting of 30 AWG (0.05 mm^2) iron and constantan wires and a temperature-indicating instrument. Thermocouples consisting of 30 AWG iron

and constantan wires and a potentiometer-type temperature-indicating instrument are to be used whenever referee temperature measurements by thermocouples are required.

44.1.12 To determine whether an appliance complies with the requirement in 44.1.1, it is to be operated as follows. If the voltage rating of the appliance is within the range of 110 – 120 volts (inclusive), the test voltage is to be 120 volts. If the voltage rating of the appliance is within the range of 220 – 240 volts (inclusive), the test voltage is to be 240 volts. For an appliance having a voltage rating other than those previously specified, the test voltage is to be the marked voltage rating. Unless a particular voltage or other test condition is specified, the test voltage is to be increased, if necessary, to cause the wattage input to the appliance to be equal to its marked wattage rating.

44.1.13 If an appliance uses a motor in addition to a heating element, the voltage applied to an integrally connected motor is to be 120 volts for an appliance rated at 110 – 120 volts, 240 volts for an appliance rated at 220 – 240 volts, or the rated voltage of the appliance for other cases. A motor supplied from a separate circuit is to be operated at a voltage (depending upon the motor rating) as specified for an integrally connected motor.

44.1.14 During the test, each general use receptacle, or a general use receptacle intended for a limited current load, shall be loaded with a 15-ampere resistive load or with a lesser load if marked in accordance with 72.1.6.

Exception: Each outlet of a duplex receptacle shall be loaded with a 10-ampere load.

44.1.15 The appliance is to be mounted or supported as in service and tested under conditions approximating those of intended operation. If a timer switch or the equivalent is provided as part of the appliance, an appropriate cycle of operation shall be used.

Exception: For requirements regarding hand-supported hair dryers, see 44.5.1.

44.1.16 A manually resettable thermal device or a thermal cutoff shall not operate during the normal temperature test.

44.1.17 In a hand-supported hair dryer, the motor circuit shall not become de-energized during the normal temperature test.

44.1.18 A means for adjusting the operating temperature is to be set to give maximum heating.

44.1.19 An electrical heating element intended for application to the hair is to be loaded with a moistened cloth and then operated until the moisture has been evaporated and the heating surface of the unit has attained a temperature of 204°C (400°F). Following a 2 minute period with the unit disconnected, during which it is to be reloaded with another moistened cloth, the heating and evaporating operation is to be conducted a second time. The complete cycle is then to be repeated again. Temperatures are to be measured throughout the test.

44.1.20 An appliance having a reservoir for heating water shall have the water temperature measured by means of a thermocouple floated approximately 3/16 inch (4.8 mm) beneath the surface of the solution and located midway between the outer surface of the electrode enclosure and the inner surface of the water reservoir. The unit is to be tested in a room ambient of 25°C (77°F).

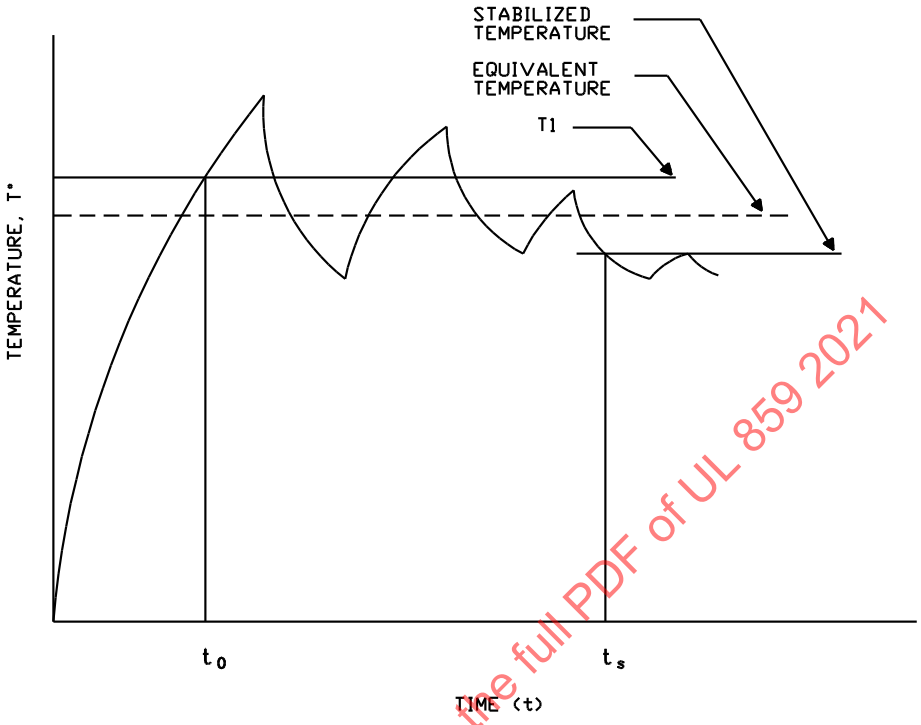
Exception: This requirement does not apply to electrode-type appliances with a water reservoir or boiling chamber having a capacity of 8 ounces (23.7 mL) or less and marked in accordance with 83.2.

44.1.21 For an appliance in which clips to be applied to the hair are heated by an external heater, the test is to consist of operation of the appliance until temperatures are constant, with the clips in place on the heater.

44.1.22 With regard to the Exception to 44.1.1, the equivalent continuous normal use temperature is to be determined as follows. The graph of the temperature plotted against time from the start of the test until a stabilized condition has been established is to be obtained, and the area under the curve over the period of time, ts minus t_0, is to be determined. Figure 44.1 shows t_0 as the time when the graph first crosses the line, TI, and t_s as the time when a stabilized temperature is obtained. (TI represents the temperature index or the temperature acceptable for the material or component in question.) The area under the curve, divided by the period of time (t_s minus t_0), will yield the equivalent continuous normal use temperature. The area under the curve may be determined mathematically (Simpson's Rule), graphically, or by using a planimeter.

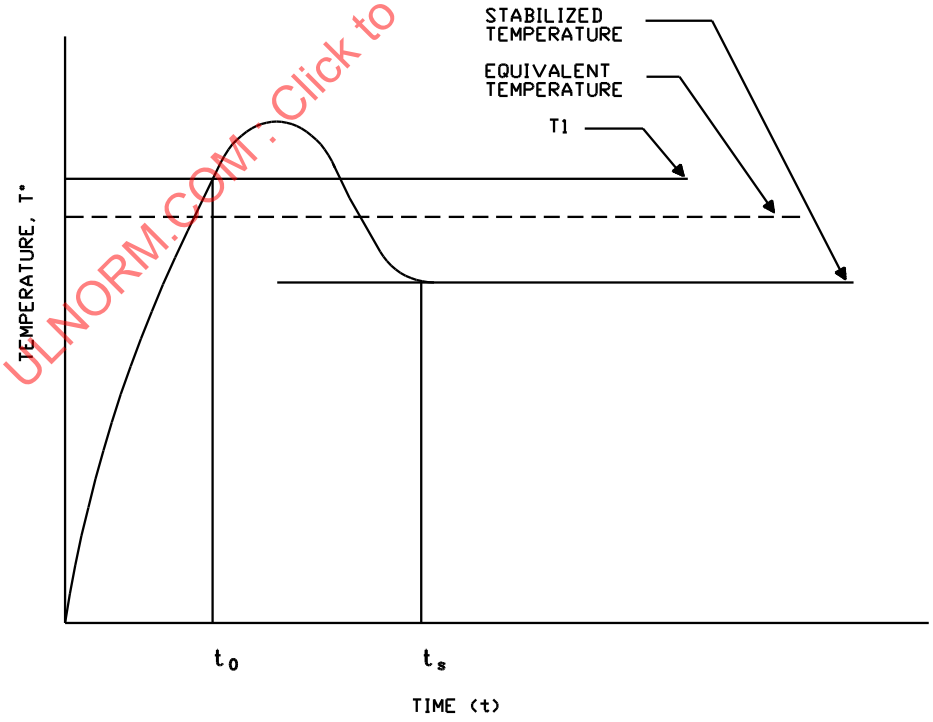
Figure 44.1

Determination of the equivalent continuous normal use temperature



Example using a thermostatically–controlled appliance

SM1168



Example using a preheat–type appliance

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44.2 Wax depilatory appliances

44.2.1 The appliance is to be loaded with the maximum recommended amount of wax and operated continuously until constant temperatures have been reached. An adjustable temperature control is to be set for maximum heating. If the appliance has several heat settings for different functions (as noted in 9.3.3), it is to be operated at the highest heat setting, as well as at the maximum setting intended to maintain the molten wax at the temperature for application to the skin.

44.2.2 The wax temperature is to be measured by means of a thermocouple immersed beneath the surface of the wax to a depth of approximately one-half of the total depth, at the approximate center of the reservoir. The wax is to be slowly and continuously stirred while temperatures are being recorded. For depilatory appliances having self-contained wax applicators (no open reservoirs), thermocouples are to be inserted into the wax applicators to a depth of approximately one-half of the total depth of the wax.

44.2.3 In addition to complying with the requirements specified in 9.3.1, 9.3.2, and 44.1.1, the visible overheat condition indicator, when required as specified in 9.3.3(b), shall function when the wax temperature exceeds 75°C (167°F).

44.3 Heated air curling irons and brushes

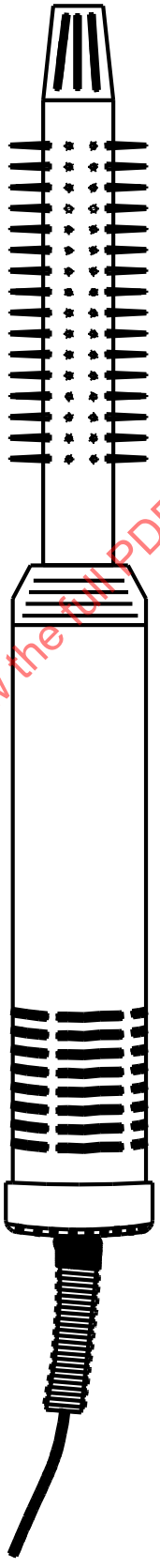
44.3.1 A heated air curling iron or brush is to be operated continuously with all air intake and outlet openings unrestricted until temperatures stabilize. The appliance is then to be operated through 30 cycles, with one cycle consisting of one minute of operation with the air intake and outlet openings blocked as described in 44.3.2, followed by 10 seconds of operation with all air openings open.

Exception: With the concurrence of all concerned, the cycling portion of the test may be replaced with 30 minutes of continuous operation with the openings blocked as described in 44.3.2.

44.3.2 With regard to 44.3.1, air intake openings provided in the gripping area of the handle that may be blocked by the user's hand, such as those shown in Figure 44.2, are to be blocked such that all openings in three or fewer quadrants of the handle circumference will be blocked. (If there are openings in all quadrants, those in one quadrant are to be left open. Openings provided in the base of a cylindrical handle, such as those shown in Figure 44.3, are not considered likely to be blocked by the user's hand and are not to be blocked.) Three-fourths of the air outlet openings in the barrel are also to be blocked. For example, in a unit provided with eight parallel rows of openings in the length of the barrel, two adjacent rows are to be left unblocked.

Figure 44.2

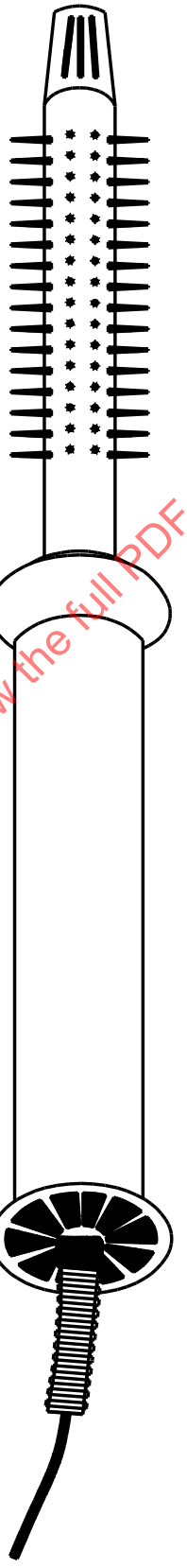
Example of a curling brush with air intake openings provided in the gripping area of the handle



SM1178

Figure 44.3

Example of a curling brush with air intake openings provided in the base of the handle



44.4 Hair-drying appliances

44.4.1 For a floor- or table-supported hair dryer having a bonnet or rigid hood and provided with an adjustable temperature control, temperatures are to be recorded after 15 minutes of operation with the control set for maximum heating and with the dummy head in the position normally occupied by the human head under the dryer. The control is then to be set for the coolest condition that results in an average temperature of no less than 43°C (109.4°F) on the top and sides of the dummy head, and operation is to be continued until all temperatures become constant. The dummy head is then removed, the control is to be reset for maximum, and operation is to be continued until temperatures become constant. A hair dryer that has a flexible air tube that can be separated from the bonnet or rigid hood is also to be tested under the conditions described in 44.5.1.

44.4.2 For a hair dryer that is provided with a rigid hood, the dummy head is to be located so that its surface will be a minimum of 1 inch (25.4 mm) from the interior surface of the hood and so positioned in the hood that maximum temperatures will result.

44.4.3 A floor-supported hair dryer not provided with an adjustable temperature control is to be operated continuously (with the dummy head in place) until all temperatures become constant.

44.5 Hand-supported hair dryers

44.5.1 A hand-supported hair dryer shall be tested with the adjustable temperature control, if any, set for the most severe condition of use and supported in the position representing the most severe conditions of use. The dryer shall be operated continuously until stabilized conditions are achieved, first without any attachment on the heated air outlet nozzle, and then, if the dryer is provided with one or more attachments for the heated air outlet, in turn with each attachment in place, as intended.

44.5.2 A dryer with screen-covered air inlet openings shall have two layers of fabric loosely secured over the openings to simulate the accumulation of hair, lint, or other particulate matter. The fabric shall be white, 100 percent untreated cotton terrycloth having a pile weave and a nominal weight of 8 ounces per square yard (271 g/m^2).

44.5.3 If an automatically-resetting thermostat operates during the test procedure described in 44.5.2, the test is to continue for no less than 5 cycles, or 3 hours (whichever is less) to determine maximum temperatures under those conditions. The test is then to be repeated with only one layer of fabric over the air inlet openings. If the thermostat operates under this condition, the test is to continue for no less than 3 cycles, or 1 hour (whichever is less) to determine maximum temperatures under those conditions. The test is then to be repeated with no fabric. Operation of the thermostat under this condition is not permitted.

44.5.4 During each of these tests, the plane of the thermocouple grid specified in 44.5.5 is to be positioned 1 inch (25.4 mm) from the plane of the heated air outlet of:

a) The dryer nozzle or

b) The attachment nozzle.

The center of the air stream is to be directed at the center of the grid. Temperatures are to be measured throughout the test. There shall not be a temperature rise greater than the limits specified in Table 44.1 and Table 44.2, nor greater than 100°C (180°F) for the average of the five highest thermocouple readings on the grid described in 44.5.5.

44.5.5 The thermocouple grid assembly is to consist of two pieces of 1/16-inch (1.6-mm) thick glass epoxy board of the configuration and dimensions shown in Figure 44.4. The two boards are to be separated 1/8-inch (3.2-mm) by one 5-1/4- by 1/4- by 1/8-inch (133- by 6.4- by 3.2-mm) wood spacer at

the top and bottom edges. Each spacer is to be secured by four 4 – 40 by 3/8-inch countersunk flat head machine screws. Each end screw is to be threaded from the face of the assembly into a nut against the rear epoxy board. Each of the middle screws is to be located approximately 1-1/2 inches (38.1 mm) from the nearest longer edge of the board and threaded from the face into a standoff leg of a sheet aluminum back plate. The 5-1/2 by 3-1/4 inch (140 by 83 mm) stand-off back plate is to consist of sheet aluminum that is 0.05 inch (1.3 mm) thick, having a minimum 7/16-inch (11.1-mm) wide integral standoff leg formed at each corner by means of an extension of the metal being bent in two successive 90-degree angles to cause the back plate to stand away from the rear epoxy board a distance of 1/4 inch. The back plate is to be secured to the center 5-1/2 by 3-1/4 inch section of the board. The board assembly is to be provided with 53 thermocouples rated 30 AWG (0.05 mm^2). The thermocouples are to be located on the grid spaced as shown in Figure 44.4. The thermocouples are to be passed through the two thicknesses of glass epoxy board, and the thermocouple junction is to be cemented to the face of the board using epoxy cement, as shown in Figure 44.5.

Figure 44.4

Spacings on thermocouple grid

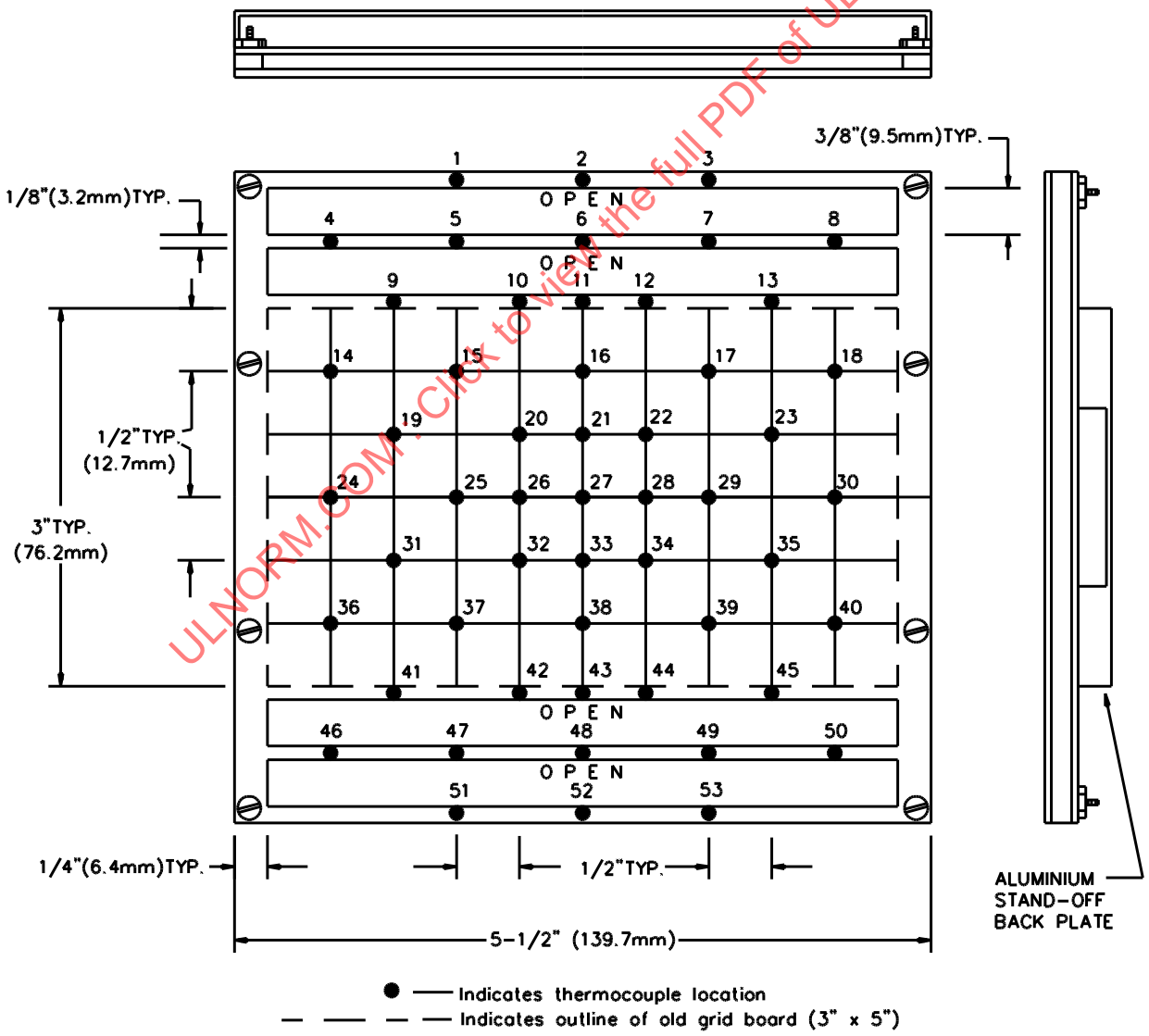
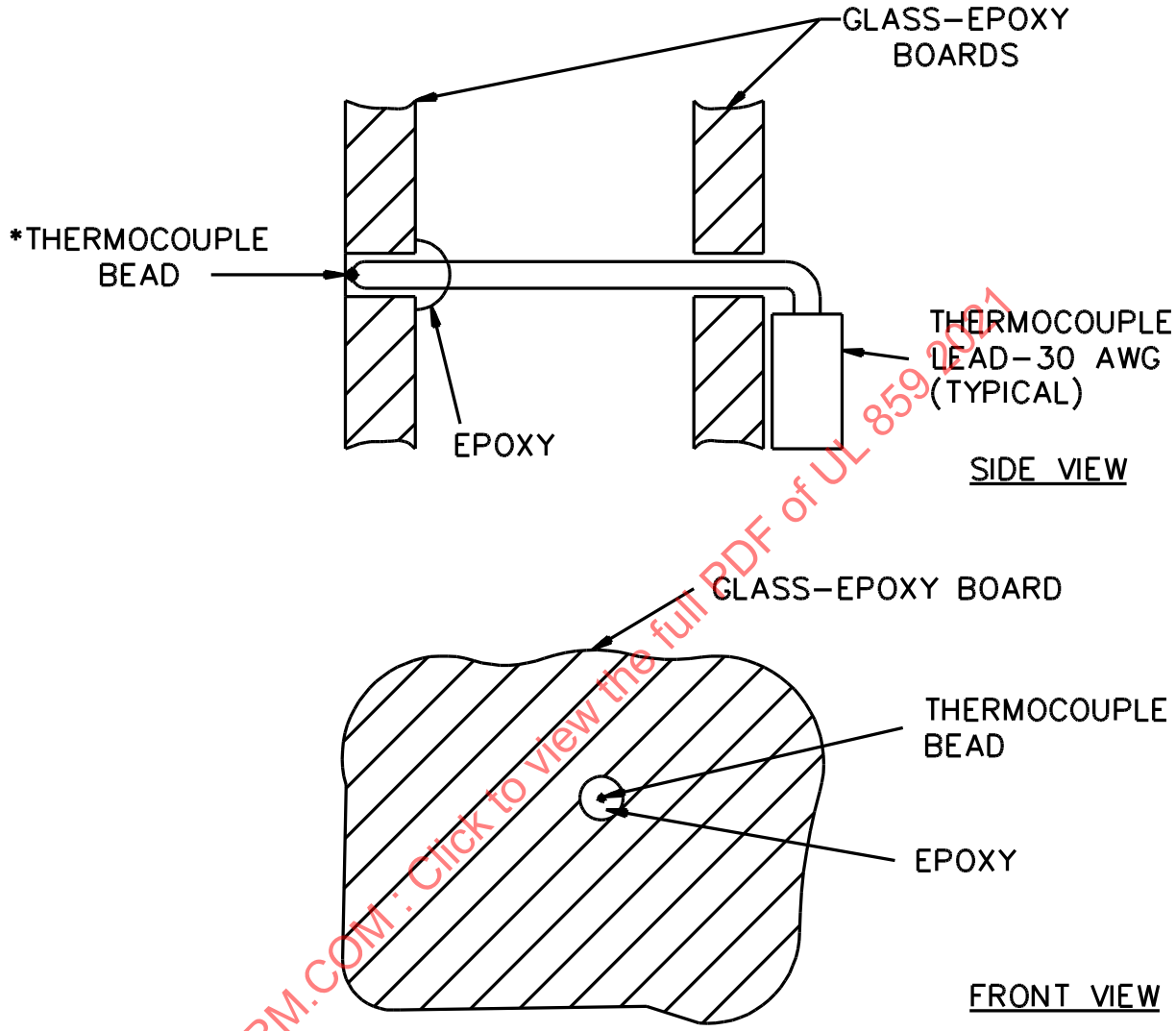


Figure 44.5

Glass bead construction



* TIP OF BEAD EXPOSED AT OUTER SURFACE OF BOARD BY SANDING AWAY EPOXY AFTER ASSEMBLY. BEAD NOT NECESSARILY CENTERED IN HOLE.

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45 Dielectric Voltage-Withstand Test

45.1 An appliance, while heated to its operating temperature, shall be subjected for 1 minute to a 60 hertz essentially sinusoidal potential as specified in Table 45.1 applied between live parts and exposed dead-metal parts. There shall not be dielectric breakdown.

Table 45.1
Dielectric test potential

Appliance	Test potential, volts (rms)
An appliance not intended to be applied directly to a person, such as a wig dryer, hair curler heater (hair setter), hand-supported hair dryer, or similar appliance.	1,000
An appliance intended to be applied directly to a person without moisture present, such as a dry curling iron	1,000 + 2V[a]
An appliance (or attachment provided with it) intended to be applied in a wet or moist condition directly to a person, such as a steam curling iron, a mist-type hair curler, or similar appliance.	2,500[b]
An appliance such as a hair dryer-styler or hair untangler having comb or brush accessories, or both, that may be used for setting or styling of wet or damp hair	2,500[b]
[a] V is the maximum marked voltage but no less than 120 volts for a nominal 120-volt appliance or 240 volts for a nominal 240-volt appliance. [b] A 2,500-volt potential is also to be applied to the handle, which is wrapped in metal foil, of a hand-supported appliance and to selected switch areas of any other appliance.	

45.2 With respect to 45.1, an appliance that has no exposed dead-metal parts is to be closely wrapped in metallic foil and the test potential is to be applied between the foil and all live parts.

45.3 To determine compliance with the requirements in 45.1 and 45.2, the test is to be made using a 500 volt-ampere or larger capacity testing transformer, the output voltage of which is essentially sinusoidal and can be regulated. The applied potential is to be increased from zero until the required value is reached and is to be held at that value for 1 minute. The increase in the applied potential is to be at a substantially uniform rate and sufficiently rapid to be consistent with its value being correctly indicated by a voltmeter.

45.4 An appliance provided with a normally-open immersion protective device is to be tested as follows. The appliance is to be connected to a supply circuit of rated voltage, the protective device is to be reset (closed), an on-off switch of the appliance is to be in the "off" position, and the test potential is to be applied between each supply circuit conductor and exposed dead-metal parts as described in 45.1 – 45.3.

46 Abnormal Operation Tests

46.1 General

46.1.1 A hair dryer shall not cause ignition of any material or emission of flame, sparks, molten metal, or similar result when operated under the conditions described in:

a) 46.1.2, 46.1.3, and 46.2.1 – 46.4.6.13 for a hand-supported type, or

b) 46.1.2, 46.1.3, and 46.2.1 – 46.3.4 for other than a hand-supported type.

The dryer shall not collapse or experience displacement of any part that results in a risk of fire or electric shock, such as short-circuiting or grounding.

46.1.2 In a test to determine compliance with the requirement in 46.1.1, the dryer is to be connected to a supply circuit of a voltage in accordance with 44.1.13. Temperature-control adjustments or the equivalent,

if any, are to be set in the position that will result in the most severe test, and thermostats or other temperature controls are to be shunted out of the circuit unless it has been determined that they are rugged, reliable, and not likely to be defeated by the user. The fuseholder of the branch circuit to which the dryer is connected is to be of the size that normally would be used with the dryer, and the branch-circuit fuse (or fuses) is to be of the maximum current rating that such a fuseholder will accommodate. Exposed metal parts are to be connected to ground through a 3-ampere fuse. A cord-connected dryer is to be placed on white tissue paper on a softwood surface. Operation is to be continued until the ultimate effects of the heating have been observed.

46.1.3 The test procedures described in 46.2.1 – 46.4.5.1 are for a conventional-type appliance. If the appliance involves unusual features, the test procedures may be modified or supplemented as necessary in order to take such unusual features into account.

46.1.4 A curling iron is to be operated without any separable stand on a softwood surface covered with two layers of white tissue paper. The curling iron is to be covered loosely with a double layer of cheesecloth as described in 46.2.1.

46.1.5 A steam-type curling iron is to be energized at rated wattage and the water reservoir filled with a solution of hard water (1/2 gram of calcium sulfate, $CaSO_4$ $2H_20$, per liter of distilled water) in an amount equal to the capacity of the reservoir. With the steam outlet opening blocked, a steam actuator control is to be operated at the fastest possible rate that produces steam, until the water supply is exhausted or for 15 minutes, whichever occurs first. The sample is to be positioned in the most unfavorable position with respect to internal components, and the leakage current is to be continuously monitored. The result is acceptable if the leakage current does not exceed that specified in the Leakage Current Test, Section 38. Immediately following the test, the sample shall be subjected to a 2,500-volt dielectric voltage-withstand test as described in the Dielectric Voltage-Withstand Test, Section 45. There shall not be dielectric breakdown.

46.1.6 A steam-type curling iron or mist-type hair styler having an integral liquid reservoir shall be subjected to an overfill test consisting of pouring a solution of hard water as described in 46.1.5 into the reservoir. The amount of solution shall be 200 percent of the intended capacity of the reservoir. During the test the appliance is to be held in its fill position and the leakage current is to be continuously monitored. There shall not be the leakage current exceeding that specified in the Leakage Current Test, Section 38. Immediately following the test, the sample shall be subjected to a 2,500-volt dielectric voltage-withstand test as described in the Dielectric Voltage-Withstand Test, Section 45. There shall not be dielectric breakdown.

46.1.7 In order to determine if a steam-type hair curler having an integral liquid reservoir will need to have the wording specified in 74.7(g)(16), the appliance shall be subjected to a water droplet test consisting of pouring a solution of hard water, as described in 46.1.5, into the reservoir. The amount of solution shall be the specified capacity of the reservoir. During the test the appliance is to be energized at rated wattage. The appliance steam control system is to be actuated continuously, commencing with the appliance cold, and ending beyond the point when the appliance becomes fully heated. If no water droplets are emitted from the steam vents at any time during the test, the appliance Important Safety Instructions need not include the information described in 74.7(g)(16).

46.2 Hair dryers – drape test

46.2.1 A bonnet-style hair dryer shall be operated without the use of a dummy head until all temperatures stabilize, and then draped with a double layer of cheesecloth.

46.2.2 A handheld hair dryer shall be placed on a flat, horizontal softwood surface, operated until all temperatures stabilize, and then draped with a double layer of cheesecloth.

46.2.3 The cheesecloth shall be draped in a manner so as to retard the air flow and cover the hottest area of the hair dryer but not be deliberately manipulated to cause an overly restrictive air flow.

46.2.4 The hair dryer shall be operated for 8 hours or until stabilized conditions are apparent, whichever is longer. The cheesecloth shall not discolor, glow, or flame as a result of this test.

46.3 Hair dryer locked rotor test

46.3.1 The sample from the drape test shall be used for this test.

46.3.2 The motor blower shall be locked and a single layer of cheesecloth loosely draped over the appliance as described in 46.2.3. The dryer is then to be operated for 7.5 hours or until stabilized conditions are apparent, whichever is longer.

46.3.3 A second handheld hair dryer sample shall be subjected to the conditions in 46.3.2 while mounted with the air outlet nozzle pointed downward 45 degrees from vertical.

46.3.4 The tests in 46.3.2 and 46.3.3 shall be conducted at each heat setting. A new sample shall be used if a limit control operates to render a sample inoperative prior to completing all tests.

46.4 Hand-supported hair dryers

46.4.1 Softwood surface temperature test

46.4.1.1 A hand-supported hair dryer is to be placed on a flat, horizontal, softwood surface covered with two layers of white tissue paper, and operated until constant temperatures are attained. During this test, both the heating element and the blower are to be operating. The position of the dryer is to be such (considering the possibilities of actual service) that the maximum temperature will be produced on the paper-covered supporting surface. The temperature rise on the paper shall not exceed 125°C (225°F).

46.4.2 Restricted air inlet test

46.4.2.1 Three samples shall each be subjected to a restricted air inlet condition in which the unit is oriented in the most adverse operating condition and operating at the maximum permitted wattage (110 percent of rated wattage in accordance with 43.1 and 43.2) and at the highest heat and motor speed setting. The air inlet opening shall be gradually obstructed until the operation of all circuits is interrupted by the functioning of a limit or a temperature control, or until ultimate results are otherwise obtained (see 46.4.2.2). If the highest heat and motor speed settings do not result in the most adverse condition, the restricted air inlet procedure is to be repeated under the conditions that produce the most adverse results. In addition to the conditions specified in 46.1.1, there shall not be circuit interruption by component burnout other than operation of a limit control.

46.4.2.2 The air intake openings are to be gradually obstructed by using layers of terrycloth, as defined in 46.4.2.3, sized at least 2 inches (50.8 mm) greater than the dimension of the intake opening. The terrycloth is to be placed over the opening one layer at a time at 3 minute intervals up to a maximum of 10 layers, and remain over the opening for 7-1/2 hours of operation, at which point ultimate results may be considered obtained. If draping does not restrict the air opening, then additional restraint, such as taping, may be necessary to hold the terrycloth in place. Tape is not to be used as the means of blocking the air openings. If the unit is provided with two separate sets of intake openings (such as the gun-type dryer), both sets of intake openings are to be gradually obstructed simultaneously.

46.4.2.3 Fabric used in the test described in 46.4.2.2 shall be white, 100 percent untreated cotton terrycloth having a pile weave and a nominal weight of 8 ounces per square yard (271 g/m^2).

46.4.2.4 The same test conditions specified in 46.4.2.1 and 46.4.2.2 shall be applied, but with all temperature controls simultaneously bypassed and with no additional layers of terrycloth added after the limit control operates. When the limit control operates, the test shall be stopped.

46.4.3 Restricted air outlet test

46.4.3.1 The tests and the investigation of the results specified in 46.4.2.1 shall be repeated but the air outlet is to be blocked, as described in 46.4.3.2.

46.4.3.2 The air outlet is to be gradually obstructed using masking tape such that approximately 50, 75, 90, and 100 percent of the outlet opening area is progressively blocked for 3 minutes at each of the four positions. For each of three samples, the location at which the blocking begins (the top, a side, or bottom) is to progress in the same direction in which it was started and is to be such that the limit control will remain in the air flow for the longest possible time as blocking progresses. If temperatures cause degradation of the tape, or if the use of tape would cause deformation of an outlet nozzle, a metal plate or other material resistant to combustion may be used to block the outlet opening. If the final 100 percent blockage test does not result in interruption of all heater and motor circuits by a limit control, the test is to be continued, at 100 percent blockage, for 7-1/2 hours, at which time ultimate results are considered to be achieved.

46.4.3.3 The same test conditions specified in 46.4.3.2 shall be applied, but with all temperature controls simultaneously bypassed and with no additional masking tape added. When the limit control operates, the test is to be stopped.

46.4.4 Floor drop test

46.4.4.1 Each of three samples (without thermocouples) shall be energized at rated wattage and set to operate at maximum intended speed. While operating, they are to be dropped three times from a height of 36 inches (914 mm) onto a hardwood surface so that the point of impact is different for each of the three drops. After each drop, compliance with 46.4.4.3(a), (c) and (d) is to be determined. After the third and final drop in each case, compliance with 46.4.4.3(b) and (e) is to be determined.

Exception: It is acceptable for a heating element to break if tests show that after this occurs the appliance consistently:

a) Complies with the requirements in 46.1.1 and 46.1.2 and

b) Has no spacing reduced below the minimum required level.

46.4.4.2 If a hand-supported hair dryer appears operable following the three drops, it is to be set up as indicated for the full motor speed test as specified in 44.5.1, and temperatures on the thermocouple grid are to be recorded. In addition, current input to the unit and motor speed are to be recorded. If the temperatures on the thermocouple grid do not exceed the limits specified in 44.5.1, and if the current input to the unit and the motor speed do not differ from the values obtained in the initial full motor speed test by more than ±10 percent, the test results are considered acceptable and the test is to be discontinued.

46.4.4.3 The result is not acceptable if, after being subjected to the test specified in 46.4.4.1, a sample:

a) Permits the entry of the accessibility probe, as shown in Figure 8.1, into the enclosure to contact an uninsulated live part;

b) Is unable to comply with the Dielectric Voltage-Withstand Test, Section 45;

c) Experiences circuit interruption by component burnout other than operation of a limit control;

d) Has caused the 3-ampere fuse to ground to open; or

e) If still in an operating condition, exceeds the temperature limits specified in Table 44.1 and Table 44.2 when tested as described in 44.5.1 and 44.5.2.

46.4.5 Broken heating element test

46.4.5.1 The heating element in a hand-supported hair dryer shall be constructed so that if the wire is cut at any point, electrical spacings shall not be reduced below the limits specified in this standard. After being cut, no portion of the heating element wire shall be accessible to contact by the accessibility probe, as illustrated in Figure 8.1, through any opening in the enclosure while the hair dryer is rotated and moved as intended during use without intentional jerking or shaking. The test shall be conducted on an as-received sample or on a sample that has been conditioned by 1 hour of continuous, intended operation with heat selectors set for maximum heat. In the event that unacceptable results are obtained on an as-received sample, a referee test shall be conducted on a conditioned sample.

46.4.6 Motor slowdown test

46.4.6.1 Three samples of a hand-supported hair dryer, heated air curling iron, or heated air brush shall be subjected to the test described in 46.4.6.2 – 46.4.6.13 to determine compliance with 46.1.1 under conditions of maximum heat and minimum airflow as described in this section.

46.4.6.2 The input voltage to and wattage drawn by the motor, along with the motor speed, shall be measured and recorded with the appliance operating at rated input voltage.

46.4.6.3 The motor leads shall be brought outside the appliance and connected to a separate variable supply source so that the motor speed can be varied with negligible effect on the heater circuit.

46.4.6.4 Hair dryers with a motor load connected in the heating element circuitry (such as a low-voltage direct-current motor) shall have a motor identical to the motor in the appliance (a dummy motor load) electrically connected to replace the motor in the appliance so the internal motor speed can be separately controlled and adjusted without affecting the heater circuit.

46.4.6.5 A temperature-regulating control shall be shorted out during the test.

46.4.6.6 The input voltage to the appliance shall be adjusted so that the appliance draws 110 percent rated wattage.

46.4.6.7 For an appliance tested without a dummy motor load, the target wattage in 46.4.6.6 shall be 110 percent of the rated appliance wattage minus the normal wattage drawn by the motor as recorded under 46.4.6.2. The (separately controlled) input voltage to the internal appliance motor shall be adjusted to obtain the motor speed measured under 46.4.6.2.

46.4.6.8 The samples shall be mounted in the orientation, provided with the attachment(s), and operated at the heater settings that cause the highest temperatures on polymeric materials near the heater elements.

46.4.6.9 The samples shall be operated for 30 minutes to obtain stabilized temperatures. A sample whose temperature control operates during that time frame shall have its input voltage incrementally reduced, to lower the wattage drawn by 10 percent, until the sample is able to operate without disruption.

46.4.6.10 The voltage to the internal motor shall then be reduced as follows, recording the motor speed at each step:

a) At a rate of 1 volt per minute for a motor operating at 30 volts or less or

b) At a rate of 5 volts per minute for all other motors.

46.4.6.11 The motor voltage and speed at the point when a temperature control operates to open all heater and motor circuits shall be recorded. If all heater and motor circuits are not interrupted by operation of a temperature control, then the motor speed is to be reduced until the limit control operates or to a stopped condition.

46.4.6.12 A sample for which a (non-resettable) limit control operates before a temperature control shall be replaced by an alternate sample. The alternate sample shall be subject to 46.4.6.13 based on the data recorded on the nonfunctional original sample.

46.4.6.13 The appliance shall then be operated under the conditions of 46.4.6.8 with the internal motor operated under either conditions (a) or (b) below:

a) The motor input voltage set at the voltage recorded under 46.4.6.11 plus 10 percent of the difference between that voltage and the original voltage measured under 46.4.6.2 or

b) The motor speed adjusted to the speed recorded under 46.4.6.11 plus 10 percent of the difference between that speed and the original speed measured under 46.4.6.2.

46.5 Dual-voltage appliances

46.5.1 In addition to the applicable tests described in 46.2.1 – 46.4.5.1, a dual-voltage appliance shall be subjected to the tests described in 46.5.2 – 46.5.4. These tests are subject to the test conditions described in 46.1.2 and the acceptance criteria described in 46.1.1. There shall be no electrical or mechanical breakdown of the voltage selector switch.

46.5.2 The appliance shall have its voltage selector set in any marked supply-circuit voltage position with the equipment 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.

46.5.3 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 is to consist of moving the voltage selector to its alternate position and back at a rate of 6 cycles per minute, with the voltage selector in each position for 5 seconds. The operating and temperature controls are to be set so as 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 will be as described in 46.5.4.

46.5.4 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 the minimum rated 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.

46.6 All appliances – short-circuit, stall tests

46.6.1 A motor in a limited-energy circuit is to be short-circuited and, as a separate test, is to be stalled. A motor in a low-voltage circuit is to be stalled. Any solid-state device, such as a rectifier, a transistor, a resistor, or a capacitor, is to be subjected to the tests described in 46.6.2 and 46.6.3.

Exception: The tests referenced in 46.6.1 are not required on a motor in a limited-energy circuit or low-voltage circuit when the motor's insulation system and spacings are provided as applicable for the line voltage involved.

46.6.2 If an appliance uses one or more solid-state devices such as a rectifier, a transistor, a resistor, or a similar component, no condition that involves a risk of fire, electric shock, or injury to persons shall develop when the circuit between any two terminals of any such component is opened or shorted. If the appliance uses a capacitor in combination with one of the above-specified components, no condition that involves a risk of fire, electric shock, or injury to persons shall develop when the capacitor is short-circuited. Only one of the simulated fault conditions described is to be imposed at one time. Exposed dead-metal parts of the appliance are to be connected to ground through a 3-ampere fuse, and the results are acceptable if the fuse does not rupture during the test. During the test operations, the appliance is to be draped with a double layer of cheesecloth.

Exception: A wire-wound resistor is not required to be shorted.

46.6.3 Short-circuit tests to determine compliance with the requirements in 46.6.2 are to take into account the intended usage of the appliance. For example, if the appliance is provided with a momentary contact switch having no provision for being locked in the on position, and if there is indication of malfunction (abnormal operation of the appliance, emission of smoke, failure of the appliance to operate in the intended manner, or other indication), the test is to be discontinued when the malfunction becomes evident. Otherwise, the test is to be continued until ultimate results occur.

46.6.4 If an appliance is provided with means for controlling speed, the test is to be conducted at both the maximum and minimum speed settings of the control, and may be conducted at interim speed settings.

46.7 Hair curler heater – short-circuit test

46.7.1 If a hair curler heater uses one or more automatic resetting thermostats, the thermostats are to be short-circuited and the appliance is to be operated under the conditions described in 46.7.2. Six samples of the appliance shall be tested.

46.7.2 Three samples of the hair curler heater are to be tested with the curlers in place, and three samples are to be tested without the curlers. The samples are to be placed on a white, tissue-paper-covered soft pine wood surface in a draft-free location and connected to a circuit of a voltage in accordance with 44.1.13. Exposed dead-metal parts are to be connected to ground through a 3-ampere quick-acting plug fuse. The samples are to be arranged for operation under the most adverse conditions, including with the cover closed if the appliance can be so operated, and are to be draped with a double layer of cheesecloth. Operation is to be continued in this manner until ultimate results are noted or until a manually resettable protector or a replaceable cutoff opens the circuit.

46.7.3 The results of the test described in 46.7.2 are acceptable if:

a) There is no glowing of the supporting surface, flaming of the cheesecloth, or similar manifestation of a risk of fire;

b) There is no degradation of the enclosure material exposing uninsulated current-carrying parts to contact; and

c) The fuse in the grounding connection does not rupture.

46.7.4 A manually-resettable protector or a replaceable thermal cutoff (fusible link) used to provide compliance with the requirement in 46.7.1 shall not function during the normal temperature test.

46.8 Bonnet-type hair dryers – hair entanglement test

46.8.1 A bonnet- or helmet-type hair dryer with heater and blower integral with the head piece shall be subjected to the test described in 46.8.2.

46.8.2 A sample of the hair dryer is to be mounted on a stand and connected to a 120-volt, 60-hertz source of power supply. The hair dryer bonnet is to be installed in the intended operating position over a dummy head equipped with orifices, pitot tubes, and interconnecting tubing such that air pressure can be measured at various points on the head. While the dryer is operating, air pressures are to be measured by means of an air pressure gage having a scale of minus 0.10 inch of water (0.025 kPa) to plus 0.14 inch of water (0.035 kPa). Results are acceptable if no negative pressures are recorded on the gage.

Exception: Negative air pressure may be acceptable if an investigation shows that hair entanglement is not likely to occur.

46.9 Wax depilatory appliances

46.9.1 If a wax depilatory appliance uses one or more automatic reset temperature controls, all such controls are to be short-circuited and the appliance is to be operated under the conditions described in 46.9.2 and 46.9.3.

Exception: Acceptable limit controls tested for 100,000 cycles of operation are not to be short-circuited.

46.9.2 The appliance is to be operated empty and also with the maximum recommended amount of wax. A movable part or cover is to be in the intended position resulting in the most adverse conditions. A self-closing cover (as described in 9.3.4) is to remain in its closed position.

46.9.3 One sample is to be tested under each condition in 46.9.2. Each sample is to be placed on a white, tissue-paper-covered soft pine wood surface in a draft-free location. The sample is to be draped with a double layer of cheesecloth and connected to a circuit of the voltage as specified in 44.1.13. Adjustable temperature controls are to be set for maximum heating. Exposed dead-metal parts of the appliance are to be connected to ground through a 3-ampere, nontime-delay plug fuse. Operation is to be continued in this manner for 7-1/2 hours, or until a manual reset limit control or thermal cutoff opens the circuit. If a limit control can be manually reset without disassembling the appliance, the control is to be held in the on position until 7-1/2 hours of operation elapse or the ultimate results are obtained. If a manually-reset limit control cannot automatically reset when the reset means is held in the "on" position, the control is to be reset as quickly as possible after each tripping for a total of four times or for the number of cycles for which it can be reset during the 7-1/2-hour period, whichever is less. The maximum temperature of the wax, as specified in 44.2.3, shall be recorded during wax heating. The maximum temperatures of the interior surface(s) of the wax reservoir(s) shall be recorded during wax heating and empty operation.

46.9.4 The results are acceptable if:

a) There is no glowing of the supporting surface, flaming of the cheesecloth, or similar manifestation of a risk of fire;

b) There is no degradation of the enclosure material exposing uninsulated current-carrying parts to contact;

c) The fuse in the grounding connection does not rupture; and

d) The maximum wax and empty reservoir temperatures do not exceed the flash point temperature of the wax, as determined by the Standard Test Methods for Flash-Point by Pensky-Martens Closed Cup Tester, ASTM D93.

46.9.5 An abnormal test is also to be conducted by operating the appliance under the conditions of intended use, as described in 44.2.1 and 44.2.2, but defeating the temperature control that operates to keep the wax temperature at or below 75°C (167°F). The visible overheat condition indicator specified in 9.3.5 shall function when the wax temperature exceeds 75°C.

46.10 Hair dryer immersion protective devices with convenience receptacles

46.10.1 To determine compliance with 7.9(h), the hair dryer immersion protective device shall not present a risk of fire or electric shock when tested as described in 46.10.2 – 46.10.5. Additionally, if the immersion protective device is functional at the end of the test, it shall comply with the applicable requirement in the high-resistance ground faults test specified in the Standard for Ground-Fault Circuit-Interrupters, UL 943.

46.10.2 With regard to the requirement specified in 46.10.1, a risk of fire or electric shock is considered to exist if any of the following occur:

a) Glowing, charring, or flaming of the cheesecloth as specified in 46.10.3;

b) Opening of the 3-ampere fuse as specified in 46.10.3;

c) Emission of flame, sparks, or molten metal from the enclosure;

d) Development of an opening in the body of the immersion protective device that exposes live parts involving a risk of electric shock to contact by persons (see 8.5.1 – 8.5.4); or

e) Loss of structural integrity to such a degree that the immersion protective device collapses or experiences such displacement of parts that may lead to short-circuiting or grounding of live parts, or cannot be removed from a receptacle immediately after the test without deformation that may present a risk of electric shock.

46.10.3 The immersion protective device is to be plugged into a duplex receptacle. The outlet's face of the duplex receptacle is to be in a vertical plane. The test voltage and frequency are to be in accordance with 44.1.13. The supply circuit is to be protected by a 20-ampere nontime-delay fuse. During the test, the device is to be draped with a double layer of cheesecloth conforming to the outline of the device. Exposed dead-metal parts of the device are to be connected to earth ground through a 3-ampere nontime-delay fuse. A user-serviceable fuse is to be effectively defeated. The hair dryer is to be operated with its temperature and speed control adjustments set in the positions that will result in the most severe test. The convenience receptacle is to be connected to a resistive load adjusted to 15 amperes. Operation is to be continued for 7 hours or until one or more of the following results are observed:

a) A risk of fire or electric shock develops (see 46.10.2);

b) The branch-circuit fuse opens;

c) The appliance protective device opens;

d) Any other circuit component opens. If this occurs, the test is to be repeated two more times using new components for each test; or

e) A minimum of 1 hour has elapsed, the circuit conditions have stabilized, and there is no further evidence of overheating of parts. The overheating of parts may be detected by indicators such as odor, smoke, discoloration, cracking of materials, charring, flaming, glowing, arcing, changes in circuit current, or similar phenomena.

If the results in (b), (c), or (d) occur, additional tests as indicated in 46.10.4 shall be conducted.

46.10.4 If the 20-ampere line fuse, appliance protective device, or any other circuit component opens as indicated in 46.10.3(b), (c), or (d), the load on the convenience receptacle is to be adjusted to the highest value that will permit the test to be conducted for 7 hours or a minimum of 1 hour with stabilized conditions.

Exception: If agreeable to those concerned, the size of the overcurrent protective device for the supply circuit may be increased or the appliance protective device or other circuit components which opened may be short-circuited or replaced with higher rated devices in order to conduct the test without adjusting the load.

46.10.5 If operation of the supervisory circuit indicates that the immersion protective device is functional, the device shall comply with the applicable requirement in the high-resistance ground faults test specified in the Standard for Ground-Fault Circuit-Interrupters, UL 943.

46.11 Appliances having an automatically-controlled preheat cycle

46.11.1 Six samples of a hair curler heater (hair setter) and three samples of other appliances are to be tested. Three samples of a hair curler heater are to be tested with the curlers in place and three samples are to be tested without the curlers. The samples are to be placed on a white-tissue-paper-covered soft pine wood surface in a draft-free location. Exposed dead-metal parts are to be connected to ground through a 3 ampere non-time delay fuse. The samples are to be arranged for operation under the most adverse conditions, including with the cover closed, if the appliance can be so operated, and draped with a double layer of cheesecloth. The samples initially at room temperature are to be energized on a supply circuit with a voltage in accordance with 44.1.13 and then de-energized at a rate of one cycle per minute for 10 cycles or until a limit control opens, whichever is less. A cycle is to consist of one energization and one de-energization. The "on" time shall be sufficient for the preheat cycle to be completed. The cycle rate and "on" and "off" or times per cycle may be adjusted as necessary to obtain the intended abnormal heating conditions.

46.11.2 The results are acceptable if:

a) There is no ignition of any material;

b) There is no emission of flame, sparks, molten metal, or similar result;

c) The appliance does not collapse or experience such displacement of any part that may result in a risk of fire or electric shock, such as short-circuiting or grounding;

d) The enclosure does not permit the entry of the accessibility probe, as shown in Figure 8.1, to contact an uninsulated live part; and

e) The 3-ampere fuse to ground does not open.

47 Exposure to Moisture Test

47.1 An appliance that may alternately be used wet and dry (such as a hair dryer-styler having comb and brush accessories that may be used for setting or styling of wet or damp hair and then used as a dryer, or a hair untangler) shall be tested as described in 47.2 – 47.6.

47.2 One sample is to be subjected to this test in an unenergized condition. Any attachment is to be oriented to result in the most unfavorable condition of use.

47.3 Each sample is to be oriented above a standard test solution (consisting of 1/2 gram of calcium sulfate per liter of water) so that the comb teeth or the center row (or rows) of brush bristles are pointing vertically downward. While held in this position, and without axial rotation, jerking or shaking, the sample is to be lowered so that the teeth or bristles enter the test solution. The depth of insertion is to be such that the exposed bases of the teeth or bristles are at the surface of the water. The sample is to be held in this position for 2 seconds, then removed from the water without changing the angle of the appliance and then tilted to a vertical position with the accessory end up. This position is to be held for 5 seconds, after which the original position is to be resumed and the sample again dipped into the water as before. This operation is to be repeated without interruption a total of ten times at the nominal rate of six per minute.

47.4 Following the dipping cycles, and while being held in its final vertical position, the sample is to be completely and closely wrapped in metal foil. The foil is to contact all exposed accessible dead-metal parts, if any. The sample is then to be oriented in the most unfavorable position with regard to components (such as switches, and the like) and subjected to the dielectric voltage-withstand test described in 47.5.

47.5 The results are acceptable if the appliance, in an unenergized condition, withstands for 1 minute without breakdown a 60-hertz essentially sinusoidal potential of 2,500 volts applied between live parts and the foil wrapping.

47.6 If the appliance is supplied with one or more accessory attachments, the complete moisture test is to be conducted using each accessory. Samples of the appliance are to be in operating condition for this test.

48 Strain Relief Test

48.1 The strain relief means provided on an attached flexible cord, when tested in accordance with 48.2, shall withstand for 1 minute a pull of 35 pounds force (156 N) applied to the cord.

Exception: In the case of a hand-held appliance having a mass of 1/2 pound (227 g) or less, exclusive of the cord, the pull applied to the cord shall be 20 pounds force (89 N).

48.2 The connections of the cord inside the appliance are to be disconnected. The specified force is to be applied to the cord and so supported by the appliance that the strain relief means will be stressed from any angle that the construction of the appliance permits. At the point of disconnection of the conductors, there shall not be movement of the cord to indicate that stress on the connections would have resulted.

49 Cord Flexing Test

49.1 Each of six "as received" samples of a hand-supported hair-drying appliance (such as a hair dryer, blower-styler, heated air comb or brush, hair dryer-curling iron combination, wall-hung hair dryer, or the hand unit of a wall-mounted hair dryer), comb, curling iron, untangler, hair crimping iron, hair straightening iron, or similar hand-supported appliance shall be subjected to a cord flexing test as described in 49.2. Three additional samples of a hand-supported hair-drying appliance shall be subjected to the conditioning and flexing test described in 49.6.

49.2 Each sample is to be mounted in a guide with a 1/4 pound (113 g) weight attached to the cord 8 inches (203 mm) from the cord entry hole so that the unit can be rotated 540 degrees about the axial center of the cord. A typical arrangement is shown in Figure 49.1. The rate of flexing is to be 10 cycles per minute, where 1 cycle is equivalent to three complete rotations as defined in Note (a) of Table 49.1, resulting in a rotational speed of 30 rotations per minute. During the test, the supply cord conductors of the sample are to carry current equal to the current rating of the appliance at rated voltage. The "as received"

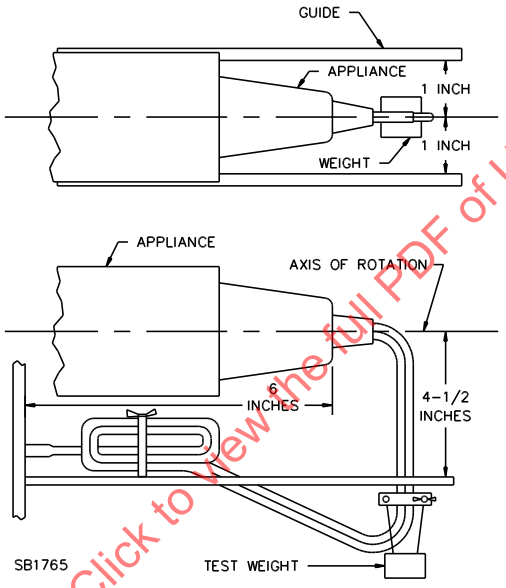
samples are to be subjected to the number of cycles of flexing specified in Table 49.1. The conditioned samples of a hand-supported hair-drying appliance are to be subjected to 1,000 cycles of flexing.

Exception No. 1: With the concurrence of all concerned, the attached weight may be other than 1/4 pound, adjusted such that the cord is held taut and the intended flexing action is produced.

Exception No. 2: With the concurrence of all concerned, the rate of rotation or cycle rate may be greater than specified.

Figure 49.1

Cord flexing test apparatus



Inches	(mm)
1	(25.4)
4-1/2	(114)
6	(152)

Table 49.1
Number of cycles of test for "as received" samples

Type of appliance	Number of cycles required
Hand-supported hair-drying appliances, other than curling irons and brushes, with or without swivel assemblies	6,000
Curling irons and brushes with or without swivels	5,000
Other hand-supported appliances such as hair crimpers and hair straighteners, with or without swivels	1,000
NOTE – A cycle consists of 540 degrees of rotation in one direction plus 540 degrees in the reverse direction back to the starting point.	

49.3 For an appliance using a cord swivel construction, the test described in 49.2 is to be conducted with the swivel locked in place.

Exception: An appliance using a cord swivel construction can be tested with the swivel operating provided it complies with 49.5.

49.4 For both "as received" and conditioned samples, test results are acceptable if:

a) There is no breakage of the cord or exposure of an uninsulated conductor strand;

b) Each sample is subjected to and complies with a 1,000–volt dielectric voltage-withstand test between the individual conductors of the flexible cord with the internal connections to the unit severed and insulated; and

c) For an appliance using a 3-conductor grounding-type cord, the conditions of the grounding continuity test specified in 57.1 are met.

49.5 An appliance using a cord swivel construction and tested with the swivel operating is to be tested with and without the weight, using separate sets of six samples for each condition, with the cord hanging freely during the test. The swivel shall remain functional during and after completion of the test and shall comply with the requirements in 49.4. A functional swivel shall serve to keep the cord from rotating past the horizontal plane through the axis of rotation.

49.6 Three samples of a hair-drying appliance are to be conditioned in an air oven maintained at a temperature of 100°C (212°F) for 96 hours or at 87°C (189°F) for 168 hours, as specified by the manufacturer. Following oven conditioning and cooling to a room temperature of 23 ±2°C (73 ±3.6°F), the samples are to be tested as described in 49.2.

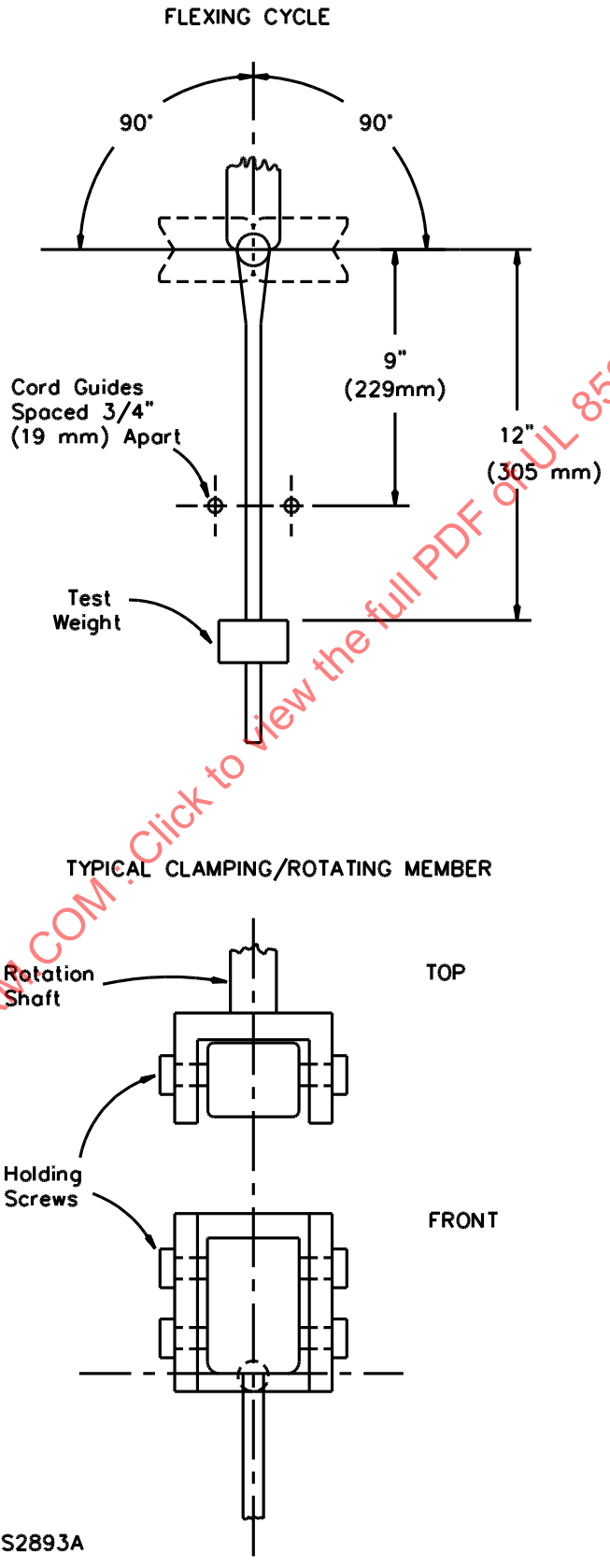
50 Cord Flexing Test for Appliance Leakage-Current-Interrupter (ALCI)

50.1 An appliance leakage-current-interrupter (ALCI) configured as an attachment plug cap shall be subjected to the cord flexing test described in 50.2 – 50.4. There shall be no damage to the power supply cord insulation or appliance leakage-current-interrupter enclosure and no loss of continuity in any power supply conductor.

50.2 To conduct this test, the specified units of the ALCI are to be assembled to the test fixture shown in Figure 50.1 so there is no interference with the test procedure. Each unit is to be mounted with the point of cord entry into the ALCI at the center of rotation. For the start of the test, the cord is to hang vertically downward. The cord is to be passed through the two cord guides spaced 3/4 inch (19.1 mm) apart and located 9 inches (229 mm) below the cord entry into the ALCI. The cord guides are to have smoothly rounded edges where they may be contacted by the cord. A 1/4-pound (113-gram) unsupported weight is to be attached to the free end of the cord, 12 inches (305 mm) from the cord entry into the ALCI. The conductors of each unit are to be connected in series with each other, and with a low-voltage, low-current relay circuit that will shut down the flexing machine if a conductor opens.

Figure 50.1

Flexing test apparatus



50.3 Six units are to be subjected to 6,000 cycles of flexing at a rate of 10 cycles per minute in the plane of the face of the ALCI. The test is to be repeated using six additional units with the flexing in the direction perpendicular to the plane of the face of the ALCI.

50.4 With reference to 50.3, each cycle consists of a 90-degree rotation of the unit in one direction; a 180-degree rotation in the opposite direction; and then a return to the starting point.

51 Test for Security of Swivel Assembly

51.1 The supply swivel assembly on one as-received sample and three conditioned samples (as described in 51.2) are each to be subjected to a direct pull force of 35 pounds (156 N) for 1 minute with the force applied at any angle the construction of the appliance will permit. The appliance is to be energized at rated wattage during this test. The result is acceptable if:

a) There is no displacement of the cord and no evidence of intermittent contact in the electrical circuit and

b) The appliance complies with 8.5.3 during and after the test.

Exception: The direct pull force for an appliance weighing 1/2 pound (227 g) or less (exclusive of the cord) is to be 20 pounds (89 N).

51.2 With regard to 51.1, the conditioned samples are to be maintained for 7 hours at a temperature of 10°C (18°F) higher than the temperature measured on the swivel assembly during the normal temperature test, but not less than 70°C (158°F).

52 Swivel Endurance Test

52.1 An appliance provided with a cord swivel shall be subjected to the cord swivel endurance test described in 52.2 – 52.6.

52.2 If a hand-supported comb, curling iron, hair untangler, or similar hand-supported appliance is provided with a cord swivel, each of the same six samples subjected to the Cord Flexing Testing, Section 49, under the condition of the swivel operating are to be subjected to the tests described in 52.3 and 52.5. For a hand-supported hair dryer provided with a cord swivel, six new samples are to be tested as described in the exception of 52.3 and in 52.5.

52.3 The cord flexing test described in 49.2 is to be continued and the swivel is to be cycled for the additional number of cycles required to total 100,000 cycles. (A cycle consists of 540 degrees in one direction plus 540 degrees in the reverse direction back to the starting point).

Exception: The cycle for the cord swivel of a hand-supported hair dryer is to consist of 100 degrees in one direction, back to the starting point, then 100 degrees in the reverse direction and back to the starting point. Other test conditions are specified in 49.2.

52.4 A hand-supported hair dryer that can be converted into a curling iron (for example, by use of a hair-curling attachment) is to be cycled in accordance with 52.3, with the appliance in the curling iron configuration and, in accordance with the Exception to 52.3, with the appliance in the hair dryer configuration. A separate set of six samples is to be used for testing in each configuration.

52.5 At the conclusion of the cycling in 52.3, a dielectric voltage-withstand test, at a voltage in accordance with the requirements in Table 45.1, is to be performed, as described in 45.1 – 45.3, between live parts and exposed surfaces of the swivel assembly.

52.6 Test results are acceptable if:

a) There is no breakage of the cord or cord swivel, or exposure of an uninsulated conductor strand;

b) Each sample operates as intended;

c) Each sample complies with the requirements of the dielectric voltage-withstand test as required in 52.5; and

d) For an appliance using a 3-conductor grounding-type cord, the conditions of the grounding continuity test specified in 57.1 are met.

53 Hinge Endurance Test

53.1 A hair crimping iron, a hair straightening iron, or an appliance such as a hair dryer having a foldable handle shall be subjected to the hinge endurance test described in 53.2 – 53.4.

53.2 Three samples are to be energized at the voltage specified in 44.1.13. Each sample of a hair crimping or hair straightening iron is then to be subjected to 30,000 cycles of opening and closing the appliance. Each sample of an appliance with a foldable handle is to be subjected to 6,000 cycles of folding and unfolding the handle. The rate of cycling is to be 10 cycles per minute, with one cycle consisting of closing the moveable part from the fully open position to the fully closed position and then back to the fully open position.

Exception: With the concurrence of all concerned, the cycle rate may be greater than specified.

53.3 At the conclusion of the cycling described in 53.2, a dielectric voltage-withstand test as described in the Dielectric Voltage-Withstand Test, Section 45, is to be conducted. The test potential is to be applied between live parts and exposed surfaces of the hinge assembly.

53.4 The results of the cycling described in 53.2 are acceptable if, upon completion of the required number of cycles, the samples are operable (that is, no electrical or mechanical change occurs that renders the appliance inoperable) and:

a) There is no exposure of an uninsulated live part or a normally enclosed insulated wire, and

b) Each sample complies with the requirements in the Dielectric Voltage-Withstand Test, Section 45.

54 Test of Automatic Controls

54.1 Overload

54.1.1 An automatic control provided on an appliance for temperature regulating or limiting shall be capable of operating successfully for 50 cycles of operation when the appliance is connected to a circuit having a voltage of 120 percent of the voltage in accordance with 44.1.13. There shall not be dielectric or mechanical breakdown of the control, or undue burning, pitting, or welding of the contacts.

54.1.2 To determine whether an automatic control complies with the requirement specified in 54.1.1:

a) The appliance is to be connected to a grounded supply circuit;

b) The enclosure, if of metal, is to be connected to ground through a 3-ampere fuse; and

c) The control, if single-pole, is to be connected in an ungrounded conductor. The test is to be made with direct-current. The fuse shall not open.

Exception: An appliance intended for use on alternating-current only is to be tested with alternating-current.

54.2 Endurance

54.2.1 Unless it has been shown by previous tests to be acceptable, an automatic temperature control provided on an appliance shall be subjected to an endurance test that shall consist of the number of cycles of operation indicated in Table 54.1 when connected as described in 54.1.2. If it is indicated in the table that the test is to be conducted under load, the thermostat shall make and break, at a voltage in accordance with 44.1.13, the maximum rated current that it carries under any condition of intended operation of the appliance. There shall not be dielectric or mechanical breakdown of the thermostat and no undue burning, pitting, or welding of the contacts.

Table 54.1
Number of cycles of operation for endurance test

Type of control	Automatically reset control	Manually reset control
Temperature-regulating	A number of cycles equivalent to 1,000 hours of intended operation, but no less than 6,000 cycles. However, the test may be omitted if, with the control short-circuited, no temperature rises of more than the limiting values described in Table 44.1 are attained in a normal temperature test of the appliance.	To be made the subject of an appropriate investigation.[a]
Temperature-limiting	A number of cycles equivalent to 100 hours of operation of the appliance under any condition which causes the control to function, or 100,000 cycles, whichever is greater. However, the test may be omitted if, with the control short-circuited, there is no evidence of a risk of fire as described in 46.1.1 during continuous abnormal operation of the appliance.	1,000 cycles under load and 5,000 cycles without load. However, the test may be omitted if, with the control short-circuited, there is no evidence of a risk of fire as described in 46.1.1 during continuous abnormal operation of appliance.
Combination temperature-limiting and -regulating	100,000 cycles if, with the control short-circuited, there is evidence of a risk of fire as described in 46.1.1. If there is no such evidence, the control is to be tested as described for a temperature-regulating control.	To be made the subject of an appropriate investigation.[a]
Temperature control for hand-supported hair dryers	6,000 cycles. See also 5.35.	

[a] If the operation of the control involves physical movement of a part of the appliance, the test is to be so arranged that each cycle will involve the complete intended operation of the appliance.

54.2.2 With reference to Table 54.1, controls are classified as follows:

a) A temperature-regulating control functions only to regulate the temperature of the appliance under conditions of intended use. The breakdown of the control would not result in a risk of fire, electric shock, or injury to persons.

b) A temperature-limiting control functions only under conditions that produce temperatures higher than intended. The breakdown of the control might or might not result in a risk of fire, electric shock, or injury to persons.

c) A combination temperature-regulating and -limiting control functions to regulate the temperature of the appliance under conditions of intended use, and also serves to reduce the risk of fire, electric shock, or injury to persons that might result from temperatures higher than intended.

55 Test of Thermal Cutoffs (Fusible Links)

55.1 A thermal cutoff shall open 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. This determination is to be made with the appliance connected to a circuit of a voltage in accordance with 44.1.13 and operated in a position to cause excessive heating.

55.2 In the case of a hand-supported hair dryer using a thermal cutoff, each of five samples shall be tested with the dryer oriented in the position most likely to:

a) Cause molten metal from the cutoff to short-circuit a heating element or other electrical part or

b) Expel molten metal through an enclosure opening.

A separate sample shall be used for each different test position.

55.3 To determine whether a thermal cutoff complies with the requirement in 55.1, the appliance is to be operated five times as indicated, and it is required that the cutoff perform acceptably each time.

Exception: Tests are not required on a thermal cutoff complying with the Standard for Thermal-Links – Requirements and Application Guide, UL 60691.

55.4 The opening temperature of a thermal cutoff shall not differ by more than 8.3°C (15.0°F) from the rated opening temperature. A thermal cutoff shall be investigated with respect to its aging characteristics and its ability to open without a risk of fire, electric shock, or injury to persons under overload and short-circuit conditions.

Exception: A thermal cutoff may have an opening temperature of more than 8.3°C from its rated opening temperature if tests indicate that a greater temperature tolerance is acceptable for a particular appliance. The test will normally consist of those specified in 55.2 and 55.3, using selected thermal cutoffs that will not open at more than 8.3°C below the temperature obtained by adding the tolerance to be conducted to determine that the cutoff does not operate during the normal temperature test in accordance with 44.1.17.

56 Motor Control Overload Test

56.1 A motor control device supplied as a part of an appliance and not having a horsepower rating equivalent to the motor it controls, shall be capable of performing effectively when subjected to an overload test consisting of 50 cycles of operation, making and breaking the stalled rotor current of the motor. Dielectric or mechanical breakdown of the device or undue pitting or burning of the contacts shall not occur.

56.2 To determine whether a motor control device complies with the requirement in 56.1, the device is to be tested with the appliance connected to a supply circuit of rated frequency and a voltage in accordance with 44.1.13, and with the rotor of the motor locked in position. During the test, the frame or enclosure of the appliance is to be connected to ground through a 3-ampere plug fuse, and the electrical connections are to be such that any single pole, current-rupturing device will be located in an ungrounded conductor of the supply circuit. If the appliance is intended for use on direct-current, the exposed dead-metal parts of the appliance are to be connected so as to be positive with respect to a single pole, current-rupturing device. The fuse in the grounding connection shall not open.

57 Grounding Continuity Test

57.1 The resistance of the grounding path between a dead-metal part of an appliance as specified in 27.3 and the equipment grounding terminal or lead or the point of attachment of the wiring system or the grounding blade of an attachment plug shall be no more than 0.1 ohm.

57.2 With reference to 57.1, the resistance may be determined by any convenient method. If the results do not comply with the requirement specified in 57.1, either a direct- or alternating-current at a potential of no more than 12 volts, and equal to the current rating of the maximum-current-rated branch circuit overcurrent protective device that may be used with the appliance, is to be passed from a dead-metal part to either the:

a) Equipment grounding terminal,

b) Point of attachment of the wiring system, or

c) Grounding blade of the attachment plug.

The resulting drop in potential is to be measured between these 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.

58 Test for Permanence of Cord Tag for Hand-Supported Hair-Drying Appliances

58.1 General

58.1.1 To determine compliance with 72.4.2 and 72.4.4, representative samples that have been subjected to the tests described in 58.2.2 – 58.3.1 shall meet the following requirements:

a) The tag shall resist tearing for longer than 1/16 inch (1.6 mm) at any point;

b) The tag shall not separate from the power supply cord;

c) The tag shall not slip or move along the length of the power supply cord more than 1/2 inch (12.7 mm);

d) There shall be no permanent shrinkage, deformation, cracking, or any other condition that will render the marking on the tag illegible; and

e) Overlamination shall remain in place and shall not be torn or otherwise damaged. The printing shall remain legible.

Exception: A cord tag that complies with the applicable requirements in the Standard for Marking and Labeling Systems – Flag Labels, Flag Tags, Wrap-Around Labels and Related Products, UL 969A, under the intended cord surfaces, temperature, specific environmental conditions and limited slippage rating, is not required to comply with this requirement.

58.2 Test conditions

58.2.1 For each type of conditioning specified in 58.2.2 – 58.2.4, three samples of the tag applied to the power supply cord in the intended manner are to be used. If tags are applied by an adhesive, tests are to be conducted no sooner than 24 hours after application of the tag.

58.2.2 Three samples are to be tested as received.

58.2.3 Three samples are to be tested at the end of 30 minutes of conditioning at a room temperature of 23 ±2°C (73.4 ±3.6°F) and 50 ±5 percent relative humidity, following conditioning in an air-circulating oven at 60 ±1°C (140 ±1.8°F) for 240 hours.

58.2.4 Three samples are to be tested within 1 minute after exposure for 72 hours to a humidity of 85 ±5 percent at 32 ±2°C (89.6 ±3.6°F).

58.3 Test method

58.3.1 Each sample is to consist of a length of power supply cord to which the tag has been applied. The power supply cord, with the attachment plug pointing up, is to be held tautly in a vertical plane. A force of 5 pounds (22.2 N) is to be applied for 1 minute to the uppermost corner of the tag farthest from the power supply cord, within 1/4 inch (6.4 mm) of the vertical edge of the tag. The force is to be applied vertically downward in a direction parallel to the major axis of the cord. In determining compliance with 58.1.1(d), manipulation is permissible, such as straightening of the tag by hand. To determine compliance with 58.1.1(e), each sample is to be scraped 10 times across printed areas and edges, with a force of approximately 2 pounds (8.9 N), using the edge of a 5/64 inch (2.0 mm) thick steel blade held at a right angle to the test surface.

59 Mounting Means Strength Test

59.1 To determine compliance with 12.1 after the appliance is installed, the appliance is to be mounted in accordance with the manufacturer's installation instructions using fasteners and constructions as described. If no wall constructions are specified, 3/8-inch (9.5-mm) thick plasterboard – drywall on 2 by 4 studs at 16-inch (406.4-mm) centers – is to be used as the support surface. Fasteners are to be applied as specified in the instructions and if not noted are to be positioned in the plasterboard between studs. An adjustable appliance is to be adjusted to the position that will give the maximum projection from the wall. A gradually increasing force is to be applied to act vertically through the center of gravity of the appliance in the extended position. The force is to be increased over a period of 5 to 10 seconds until a load of four times the weight of the appliance, but no less than 10 pounds (44.5 N), is applied to the mounting system. The load is to be sustained for 1 minute. Results should show no evidence of damage to the mounting surface, to the hanging means, or to the appliance.

60 Extended Operation Test

60.1 To determine if a higher temperature rise than that specified in Table 44.1 is acceptable for a fiberglass sleeving (see Note (h) of Table 44.1), three samples of the appliance are to be tested as described in 60.2 – 60.5.

60.2 Each sample is to be operated continuously for 1,000 hours. The test voltage (as specified in 44.1.13) is to be increased, if necessary, to cause the wattage input to the appliance to be equal to its marked wattage rating. Each sample is to be placed on a thermal insulating surface, supported by its stand, if provided. Adjustable temperature controls are to be adjusted for maximum heating. Each sample of an appliance having an automatically controlled preheat cycle is to be subjected to 6,000 cycles of operation. Each cycle is to consist of energizing the appliance from room temperature to the maximum stabilized temperature condition, then de-energizing and cooling to room temperature. Forced cooling, such as by directing air jets at the appliance, may be used to reduce the cooling time. The "on" time of each cycle is to be such that the total "on" time will be no less than 1,000 hours. Following the successful completion of the 6,000 cycles of operation or the 1,000-hour continuous operation, and after being allowed to cool to room temperature, each sample is to be tested for compliance with the Leakage Current Test, Section 38.

Exception: The appliance is not required to be subjected to the 6,000 cycles of operation if aged for 1,000 hours at a temperature equal to the maximum temperature during the preheat cycle.

60.3 Each sample, while at room temperature, is then to be subjected to impacts as described in 60.4 – 60.6. After each drop for a hand-supported appliance and the one impact for other types of appliances, the leakage current test is to be repeated. After the leakage current test, each sample is to be subjected to the Dielectric Voltage-Withstand Test, Section 45. For a hand-supported appliance, the dielectric voltage-withstand test is to be conducted after the final leakage current test.

60.4 Each of three samples of a hand-supported portable appliance is to be dropped 3 feet (0.91 m) to strike a hardwood surface in the position most likely to produce adverse results. The hardwood surface is to be as described in 34.5. Each sample is to be dropped three times so that, in each drop, the sample strikes the surface in a position different from those in the other two drops.

60.5 Stationary, fixed, counter-supported, or floor-supported appliances are to be subjected to the ball impact test described in 60.6.

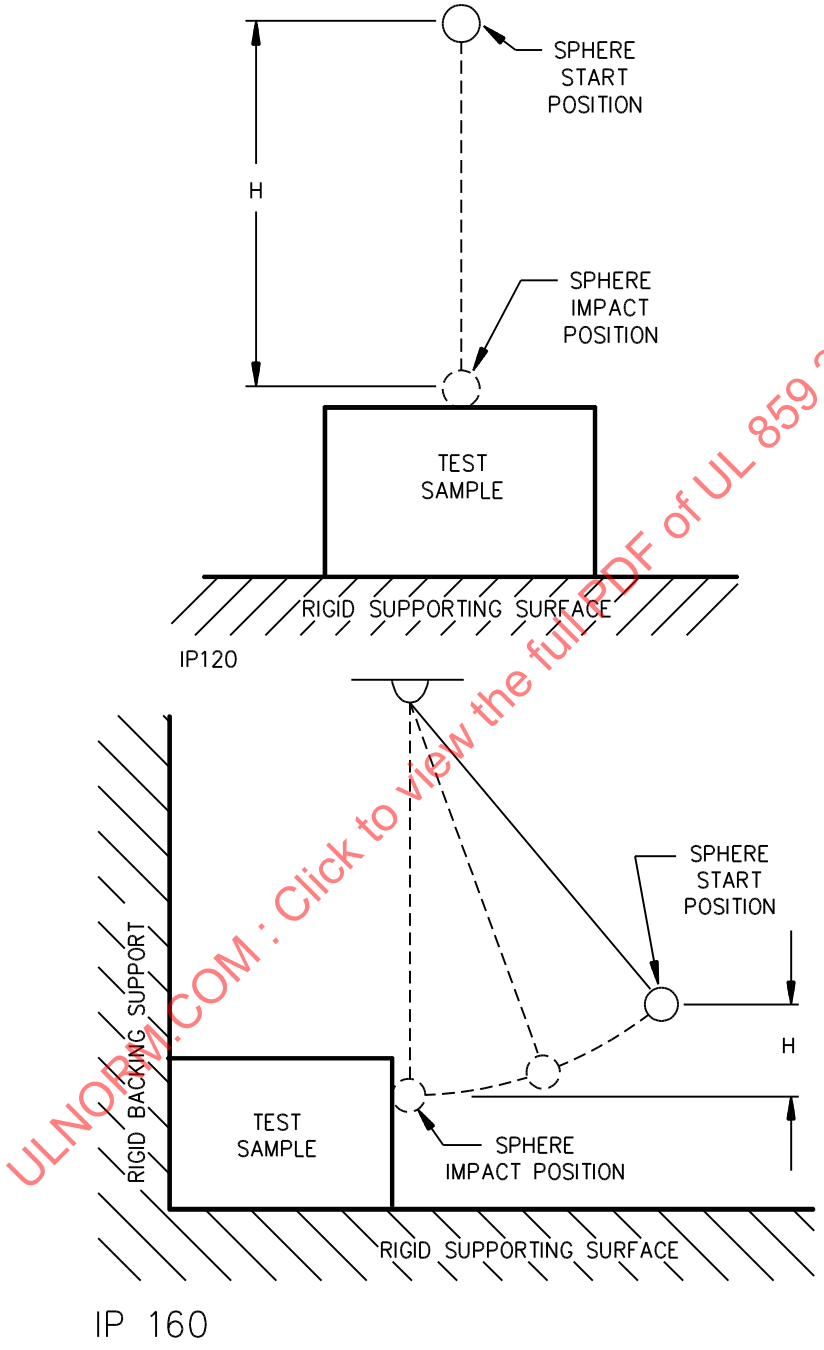
60.6 Each of three samples of the appliance is to be subjected to a single impact of the value specified in Table 60.1 for the applicable appliance type, on any surface that can be exposed to a blow during normal use. This impact is to be produced by dropping a steel sphere, 2 inches (50.8 mm) in diameter and weighing 1.18 pounds (0.535 kilogram mass) from a height necessary to produce the specified impact as shown in Figure 60.1. For surfaces other than the top of an enclosure, the steel sphere is to be suspended by a cord and swung as a pendulum, dropping through the vertical distance necessary to cause it to strike the surface with the specified impact as shown in Figure 60.1.

Table 60.1
Ball impact requirements for equipment

Portable					
Counter-supported,		Floor-supported,		Stationary or fixed,	
foot-pounds	(joules)	foot-pounds	(joules)	foot-pounds	(joules)
0.75	(1.02)	5.0	(6.8)	5.0	(6.8)

Figure 60.1

Ball impact tests



NOTES

1 H indicates the vertical distance the sphere must travel to produce the desired impact.

2 For the ball-pendulum impact test, the sphere is to contact the test sample when the string is in the vertical position.

3 The rigid supporting surface is to be as described in 34.5.

60.7 The results are acceptable if all samples:

a) Are operable at the end of the 1,000 hours or 6,000 cycles of operation as specified in 60.2 and

b) Comply with the Leakage Current Test, Section 38, and the Dielectric Voltage-Withstand Test, Section 45.

It is acceptable for the samples to become inoperable after a drop or an impact.

61 Heating Element Endurance Test

61.1 Each of six samples of an appliance having an automatically controlled preheat cycle are to be subjected to 6,000 cycles of operation. Each cycle is to consist of energizing the appliance at the test voltage specified in 44.1.13 from room temperature to the maximum stabilized temperature condition, then de-energizing and cooling to room temperature. Forced cooling, such as directing air jets at the appliance, may be used to reduce the cycling time. Following the successful completion of the 6,000 cycles of operation and after being cooled to room temperature, each sample is to be subjected to Leakage Current Test, Section 38, and subjected to a the Dielectric Voltage-Withstand Test, Section 45.

Exception No. 1: Failure of the heating element assembly before the 6,000 cycles are completed is permissible if breakage of the heating element, and movement of the broken pieces of the element within the appliance, will not result in a risk of fire or electric shock.

Exception No. 2: The heating element endurance test is not required to be conducted if the Extended Operation Test, Section 60, is conducted.

62 Test of Physical Properties of a Liquid Container, Seal, or Diaphragm

62.1 If physical deterioration of a liquid container, seal, diaphragm, or similar part would result in a risk of fire or electric shock, the component shall be tested to determine its resistance to deterioration from the liquid intended to contact it.

Exception: Physical properties of the component are not required to be investigated if it is removed during an abnormal operation test. During and after the abnormal operation test, the Leakage Current Test, Section 38, and the Dielectric Voltage-Withstand Test, Section 45, are to be conducted. Acceptable test results for the leakage current and dielectric voltage-withstand tests are specified in 38.1 and 45.3.

62.2 The test procedure for determining whether a component complies with the requirements specified in 62.1 depends upon the material of which it is composed, its size and shape, the mode of application in the appliance, and similar criteria. The test procedure includes visual inspection for cracks, deformation, and similar deterioration after accelerated aging and a comparison of hardness, tensile strength, and elongation before and after accelerated aging.

62.3 With respect to 62.1 and 62.2, a component of rubber, neoprene, or thermoplastic material shall be tested to compare its tensile strength and elongation before and after artificial aging. The results are acceptable if the properties are found to be no less than the minimum values indicated in Table 62.1 corresponding to the temperature of the component during the temperature test.

Exception No. 1: A part that is too small to be a practical subject of the physical properties measurements in Table 62.1 shall show no cracking or significant deformation or change in hardness after accelerated aging as determined by visual inspection.

Exception No. 2: Test phase II of Table 62.1 is not required to be conducted on materials that have a temperature index as a result of long-term aging or a generic temperature index of at least the measured

temperature. See the relative thermal indices in the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B.

Table 62.1
Accelerated aging conditions

Test phase	Test conditions					Minimum percent of original tensile strength and elongation
I	Immersion for 7 days in the liquid used with the material at a temperature no less than 10°C (18°F) higher than the maximum operating temperature of the material measured under intended operating conditions, but no less than 70°C (158°F) in any case.					50
Test phase	Maximum temperature of material during temperature tests, °C	(°F)	No. of days in circulating air oven	Oven temperature, °C	(°F)	Minimum percent of original tensile strength and elongation
II	60	(140)	7	87	(189)	60
	75	(167)	7	100	(212)	60
	80	(176)	7	113	(234)	60
	90	(194)	7	121	(250)	60
	105	(221)	7	136	(277)	60
	145	(293)	10	150	(302)	60
	150	(302)	10	160	(320)	60
	160	(320)	30	170	(338)	60
	170	(338)	30	180	(356)	60
	180	(356)	30	190	(374)	60
	190	(374)	30	200	(392)	60
	200	(392)	30	210	(410)	60

62.4 As an alternative to the air oven aging specified in Table 62.1, the acceptability of a liquid container, seal, or diaphragm may be determined by means of an aging test on the complete appliance under service conditions.

63 Label Adhesion Test *(Deleted)*

Section 63 deleted

64 Flammability Test – Wax for Depilatory Appliances

64.1 The wax for a depilatory appliance shall comply with the flammability test described in 64.2.

Exception: This requirement does not apply to constructions in which the molten wax is stored in a closed applicator and is not exposed to external sources of ignition before being dispensed.

64.2 The depilatory appliance is to be loaded with the maximum recommended amount of wax and operated at the voltage specified in 44.1.13 and the highest heat setting until the molten wax is at its maximum temperature. A wooden match is then to be lighted and touched against the surface of the wax. The wax in the reservoir shall not ignite.

65 Additional Testing for Hand-Supported Grooming Appliances with a Detachable Power Supply Cord and for Hand-Supported Grooming Appliances with Detachable Parts Intended to be Disconnected From Power Under Load Conditions

65.1 Hand-supported appliances provided with a detachable power supply cord and hand-supported appliances with detachable parts intended to be disconnected from power under load conditions shall additionally comply with 65.1 – 65.11.

65.2 Appliances with detachable power supply cords shall withstand the impact described in 65.3 with the power supply cord attached and detached from the appliance. A hand-supported appliance, when detached from its base or stand, shall withstand the drop impact test described in 65.3. Compliance shall be determined after impact(s) as follows:

a) Uninsulated live parts shall not be accessible to contact as determined by the probes in Figure 8.1 and Figure 13.3;

b) An operating condition shall not arise that affects the mechanical performance of the appliance including compliance with (a) and (b) of the Exception to 13.3.1.2; or

c) The electrical insulation shall comply with the dielectric voltage-withstand requirements of Section 45.

With reference to (b), cracking or denting of the enclosure shall not affect the function of any locking features and the mating ability of the detachable cord set with the appliance. Cracking or denting of the enclosure shall not result in exposure of uninsulated live parts of the connector or damage to the locking feature.

65.3 A hand-supported appliance or hand-supported part of an appliance shall be subjected to the drop impact test described in (a) and (b). The test is conducted with the power supply cord attached and then is repeated on previously untested samples with the power supply cord detached.

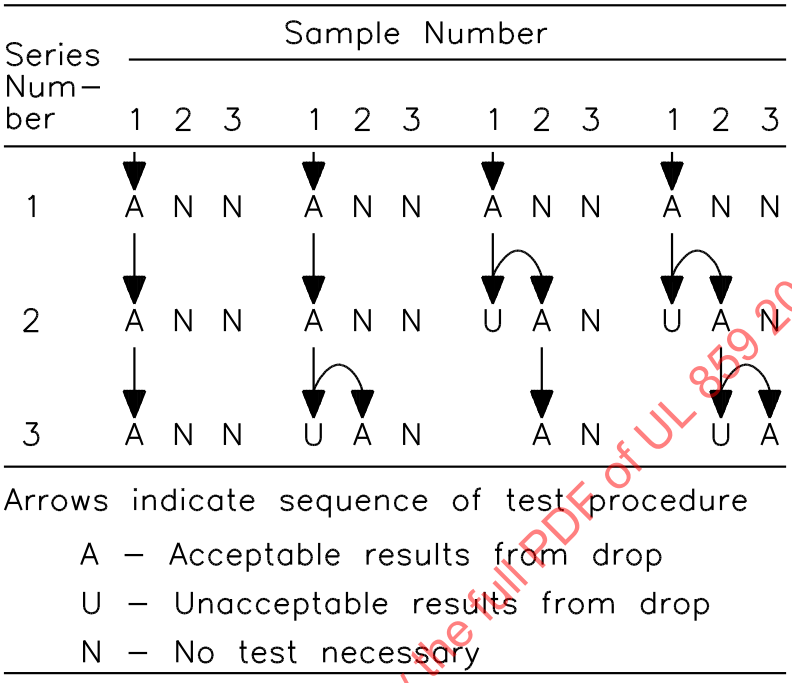
a) Each of three samples of the appliance is to be dropped through 0.91 m (3 ft) to strike a hardwood surface in the position most likely to produce adverse results. The hardwood surface is to consist of a layer of nominal 25 mm (1 inch) tongue-and-groove oak flooring (actual size 19 by 57 mm or 3/4 by 2-1/4 inches) mounted on two layers of nominal 19 mm (3/4 inch) plywood. The assembly is to rest on a concrete floor or an equivalent non-resilient floor during the test.

b) Each sample is to be dropped three times so that, in each drop, the sample strikes the surface in a position different from those in the other two drops. Three samples shall be employed for the test; however, if the manufacturer elects, fewer samples may be used in accordance with Figure 65.1. The overall performance is acceptable upon completion of any one of the procedures represented in that Figure. If any sample does not comply on its first series of three drops, the results of the test are unacceptable.

Figure 65.1

Procedures for impact tests

(Each series consists of three drops or one ball impact on each sample as applicable.)



65.4 A sample of the appliance constructed as detailed in 13.3.1.14 shall be subjected to the testing detailed in 65.5 without occurrence of any of the following:

a) Making uninsulated live parts accessible to contact;

b) Producing a condition that affects the mechanical performance of the appliance;

c) Producing a condition that increases the likelihood of an electric shock as determined by the dielectric voltage-withstand test in Section 45;

d) Visible pitting of the contacts in either the connector or appliance plug;

e) Carbon tracking that reduces spacings below the acceptable value; or

f) Cessation of normal function of the appliance.

65.5 A sample of the appliance shall be connected to a supply adjusted to rated voltage and operated under conditions of maximum loading. The appliance coupler shall be inserted and withdrawn for 50 cycles of operation at a rate of not more than 10 operations per minute with the blades or pins of the mating part connected for not more than one second. At the conclusion of the test, the appliance shall be examined for compliance with 65.4.

65.6 A sample of the appliance constructed as detailed in 13.3.1.15 shall be subjected to the testing detailed in 65.7 without occurrence of any of the following:

a) Making uninsulated live parts accessible to contact;

b) Producing a condition that affects the mechanical performance of the appliance;

c) Producing a condition that increases the likelihood of an electric shock as determined by the dielectric voltage-withstand test in Section 45;

d) Visible pitting of the contacts in either the connector or appliance plug;

e) Carbon tracking that reduces spacings below the acceptable value; or

f) Cessation of normal function of the appliance.

65.7 A sample of the appliance shall be connected to a supply adjusted to rated voltage and operated under conditions of maximum loading. The hand supported portion of the appliance shall be inserted and withdrawn from the mating connector for 10,000 cycles of operation at a rate not more than 10 operations per minute with the blades or pins of the mating part connected for not more than one second. At the conclusion of the test, the appliance shall be examined for compliance with 65.6.

65.8 To determine compliance with 13.3.1.16, an appliance shall be placed on a supporting surface inclined at 10 degrees from the horizontal and is to be oriented to the position most likely to cause tipping. Any adjustable or movable part that will affect the location of the center of gravity of the appliance shall be placed in the position most likely to contribute to tipping. Blocks shall be used to prevent the appliance from sliding down the incline.

65.9 After completion of the test of 65.8 and with the base of the appliance still at a 10 degree angle, the hand-supported part of the appliance shall be removed and inserted ten complete times.

65.10 A sample of the appliance provided with the locking mechanism required by 13.3.1.17 shall be subjected to the unenergized mechanical testing detailed in 65.11 without occurrence of any of the following:

a) Producing a condition that affects the mechanical performance of the appliance;

b) Producing a condition that prevents the appliance plug from being securely held and locked in place during normal operation; or

c) Producing a condition that defeats the locking means of (b) of the Exception to 13.3.1.2.

65.11 The locking mechanism shall be subjected to 10,000 cycles of assembly/disassembly at a rate not to exceed 10 cycles per minute. At the conclusion of the test, the locking mechanism shall be examined for compliance with 65.10.

66 Thermoplastic Motor Insulation Systems

66.1 General

66.1.1 Motors that employ thermoplastic materials to electrically isolate the windings and similar live parts from other live parts or noncurrent-carrying metal parts are to be subjected to the tests specified in 66.2 and 66.3.

Exception No. 1: A motor that functions to move air only with a direct mounted fan need not be subjected to the test in 66.3.

Exception No. 2: A double-insulated appliance is to be tested in accordance with the Abnormal Operation and Overload Test on Motors in the Standard for Double Insulation Systems for Use in Electrical Equipment, UL 1097.

Exception No. 3: A motor that uses Class A insulation materials and has been subjected to the Locked Rotor Cycling Test specified in the Standard for Rotating Electrical Machines – General Requirements, UL 1004-1, need not be subjected to these tests.

Exception No. 4: A motor that complies with the Standard for Thermally Protected Motors, UL 1004-3 need not be subjected to these tests.

66.2 Abnormal conditioning

66.2.1 The motor is to be subjected to the abnormal conditioning described in 66.2.2 and shall comply with all of the following conditions:

a) The 3 ampere fuse shall remain intact and

b) The material under test shall withstand without breakdown, the dielectric voltage-withstand potential specified in Dielectric Voltage Withstand Test, Section 45 immediately following the conditioning specified in 66.2.2 and with the 3 ampere fuse removed from the circuit.

66.2.2 The motor is to be operated with the armature locked until ultimate results have been determined or for 7 hours, whichever occurs first. Noncurrent-carrying metal parts of the motor that are insulated by the material under test are to be connected to ground through a 3-ampere, quick-acting, plug type fuse.

66.2.3 With reference to 66.2.2, when the length of the test is limited by an external factor – such as the functioning of a reliable, nonuser-serviceable device (such as a fuse or circuit breaker), or the functioning of the maximum-size branch-circuit protective device to which the equipment is likely to be connected (but not less than 30 amperes) – the test is to be terminated when an overtemperature or overcurrent device functions to open the circuit.

66.3 Overload-burnout conditioning

66.3.1 Thermoplastic insulating material employed in motors with a stalled-rotor current greater than twice the normal operating current shall comply with the following after the overload-burnout conditioning described in 66.3.2:

a) The 3 ampere fuse shall remain intact and

b) The thermoplastic material under test shall comply with the requirements in Dielectric Voltage-Withstand Test, Section 45 immediately following the overload-burnout conditioning.

66.3.2 Each of three samples of the motor is to be subjected to operation at normal load for 1 hour. Immediately following operating at normal load, the load is to be increased in steps of 10 percent of the rated current for each of four successive 1-hour periods, followed by two 1/2-hour periods, followed by eight 1/4-hour periods, followed by such additional periods of 5 minutes until the motor burns out. During the test, noncurrent-carrying metal parts of the motor that are insulated by the material under test are to be connected to ground through a 3-ampere, quick-acting fuse.

66.3.3 With reference to 66.3.2, the opening of the circuit by an overtemperature or overcurrent protective device, is considered an acceptable end of test.

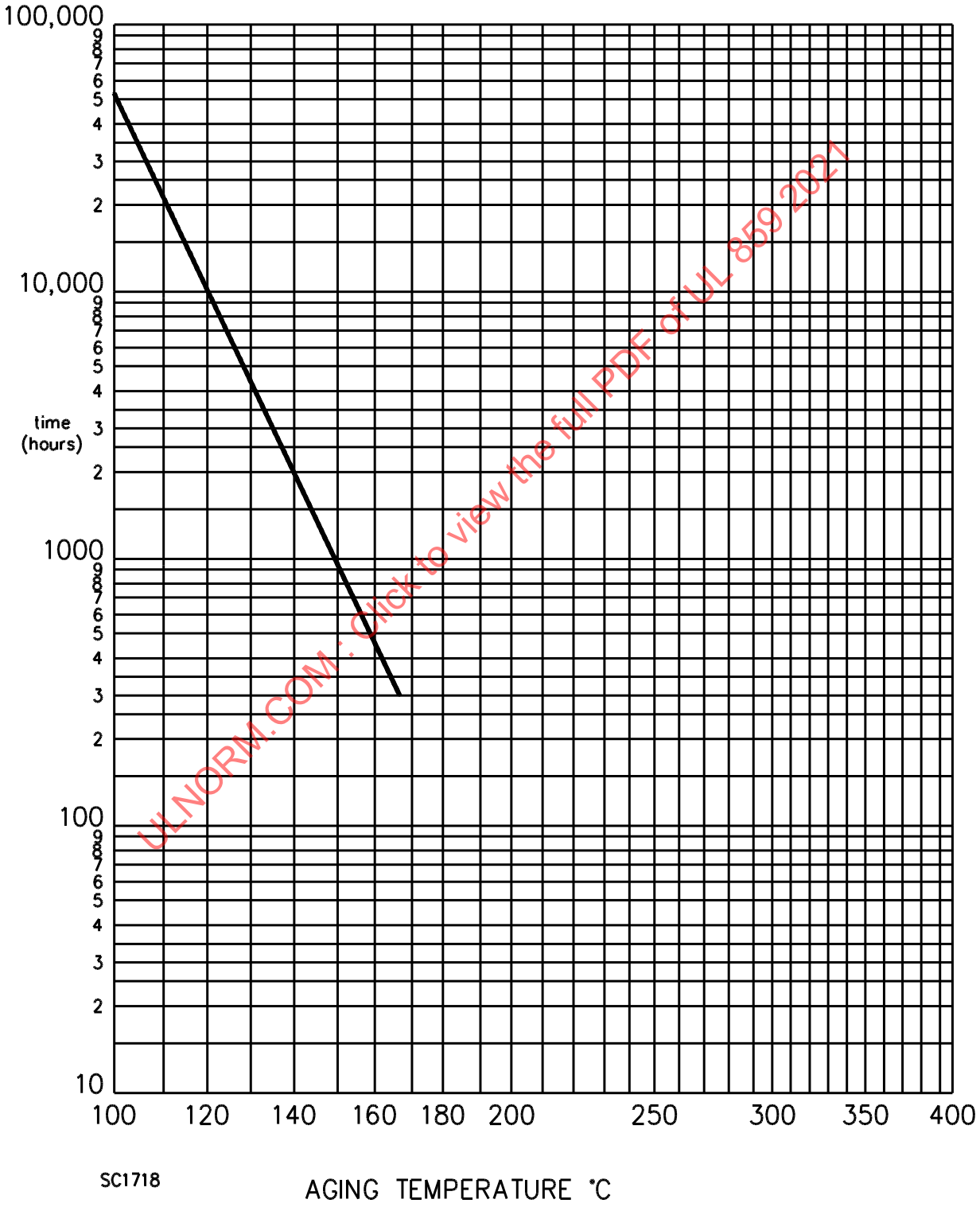
66.4 Thermal aging

66.4.1 A polymeric material employed in a Class 105 (A) insulation system in accordance with the Exception to 28.4.3 is to be aged for the amount of time corresponding to an aging temperature that appears on the Class 105 (A) system response shown in Figure 66.1. The motor insulation system is to cool to room temperature and the applicable dielectric voltage-withstand requirements specified in Section

45 are to be applied between live parts and noncurrent-carrying metal parts that are isolated from each other by the material under consideration.

Figure 66.1

Class 105(A) system response



67 Ozone Test

67.1 Grooming appliances employing ionization circuitry shall not produce a concentration of ozone exceeding 0.05 parts per million by volume when tested as described in 67.2 – 67.7.

67.2 The test is to be conducted in a room having a volume of 950 – 1100 cubic feet (26.9 – 31.1 m^3) with a minimum side dimension of 8 feet (2.4 m) and a maximum height dimension of 10 feet (3.0 m) without openings. The test room walls and ceiling are to be covered with a sheet of polyethylene or aluminum. The floor is to be of a nonporous material such as vinyl tile or aluminum.

67.3 During the test, the test room is to be maintained at a temperature of 25 ±2°C (77 ±4°F) and a relative humidity of 50 ±5 percent. Prior to the start of this test, the ozone background level is to be measured with the product off. The background level shall be subtracted from the maximum measurement during the test.

67.4 The product is to be located in the center of the test room floor for floor supported product and about 30 – 36 inches (762 – 910 mm) above the floor for table-mounted or hand-held product.

67.5 The ozone monitor sampling tube is to be located 2 inches (50 mm) from the air outlet of the product and is to point directly into the air stream.

67.6 The product shall be operated at maximum ozone output and the emission of ozone shall be monitored for 7 hours to determine the concentration.

Note: For hairdryers, the maximum ozone output condition is typically low heat and low speed.

Exception: For attended grooming appliances, such as hand-supported hair dryers, etc., the appliance is to be operated in the same manner and for the length of time specified as for the temperature test described in Section 44.

67.7 If the ionizing can be energized with the fan not functioning or with particle filters removed, the test described in 67.2 – 67.6 is to be repeated with the fan not operating or with particle filters removed.

MANUFACTURING AND PRODUCTION-LINE TESTS

68 Dielectric Voltage-Withstand Test

68.1 As a routine production-line test, each appliance shall be subjected to the application of a potential at a frequency within the range of 40 – 70 hertz:

a) Between the primary wiring, including connected components, and accessible dead-metal parts that are likely to become energized and

b) Between primary wiring and accessible low voltage (42.4 volts peak or less) metal parts, including terminals.

68.2 Each power supply cord terminating in a swivel assembly shall be subjected to a test potential between:

a) Line conductors and

b) Each line conductor and grounding conductor, if provided.

The 40 – 70 hertz test potential is to be 1,250 volts maintained for 60 seconds or 1,500 volts maintained for 1 second. The test is to be conducted prior to assembly of the appliance.

Exception: The end product manufacturer is not required to conduct the test if:

a) The power supply cord-swivel assembly combination has been investigated with respect to the requirements covering wiring harnesses and

b) The test is conducted as a routine production-line test by the manufacturer of the power supply cord-swivel assembly combination.

68.3 The production-line test described in 68.1 shall be in accordance with either condition A or B of Table 68.1. The results are acceptable if there is no dielectric breakdown.

Table 68.1
Production-line test conditions

Appliance type or component	Condition A		Condition B	
	Applied potential, volts	Time, seconds	Applied potential, volts	Time, seconds
An appliance not intended to be applied directly to a person during operation, such as a wig dryer, lotion heater with removable reservoir, curler heater, hand- or counter-supported hair dryer, and the like	1,000	60	1,200	1
An appliance intended to be applied directly to a person but without moisture present, such as a dry curling iron	1,000 + 2V[a]	60	1,200 + 2.4V[a]	1
An appliance (or attachment provided with it) intended to be applied in a wet or moist condition directly to a person, such as a steam curling iron, a mist-type hair curler, or the like	2,500	60	3,000	1
An appliance such as a hair dryer/styler or hair untangler having comb or brush accessories, or both, that may be used for setting or styling of wet or damp hair	2,500	60	3,000	1

[a] V is the maximum marked voltage but not less than:

1) 120 volts for a nominal 120-volt appliance or

2) 240 volts for a nominal 240-volt appliance.

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

68.5 The test described in 68.1 shall be conducted when the appliance is 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 friction fit knob that would interfere with conducting the test is required to be in place.

Exception No. 2: The test may be performed before final assembly if the test represents that for the completed appliance.

68.6 When the appliance uses a solid-state component that is not relied upon to reduce the risk of electric shock and that can be damaged by the dielectric potential, the test described in 68.1 may be conducted before the component is electrically connected, only when a random sampling of daily production is tested at the potential specified in Table 68.1. The circuitry may be rearranged for the purpose of the test to reduce the likelihood of solid-state component damage while retaining representative dielectric stress of the circuit.

68.7 The test equipment shall include:

a) A transformer having an essentially sinusoidal output,

b) A means of indicating the test potential,

c) An audible or visible indicator of dielectric breakdown, and

d) Either a manual reset device to restore the equipment after dielectric breakdown or an automatic reject feature activated by any unit indicating dielectric breakdown.

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

68.9 If the output of the test equipment transformer is 500 volt-amperes or larger, the test potential shall be indicated by:

a) A voltmeter in the primary circuit or in a tertiary winding circuit,

b) A selector switch marked to indicate the test potential, or

c) In the case of equipment having a single test potential output, a marking in a visible location to indicate the test potential. When a marking is used without an indicating voltmeter, the equipment shall include a positive means, such as an indicator lamp, to indicate that the manual reset switch has been reset following a dielectric breakdown.

68.10 Test equipment other than that described in 68.7 – 68.9 may be used if the intended factory test is accomplished.

68.11 During the test described in 68.1, the primary switch is to be in the on position, both sides of the primary circuit of the appliance are to be connected together and to one terminal of the test equipment, and the second test equipment terminal is to be connected to the accessible dead metal.

Exception No. 1: An appliance (resistive, high-impedance winding, and the like) having circuitry not subject to excessive secondary voltage buildup in case of dielectric breakdown during the test may be tested with:

a) A single-pole primary switch, if used in the off position, or

b) Only one side of the primary circuit connected to the test equipment when the primary switch is in the on position or when a primary switch is not used.

Exception No. 2: An appliance provided with a normally-open immersion protective device is to be tested as follows. The appliance is to be connected to a supply circuit of rated voltage, the protective device is to be reset (closed), the on-off switch of the appliance is to be in the "off" position, and the test potential is to be applied between each supply circuit conductor and exposed dead-metal parts.

69 Grounding Continuity Test

69.1 Continuity of grounding connection

69.1.1 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 grounding blade of the attachment plug and the accessible dead-metal parts of the appliance that are likely to become energized.

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

69.2 Electrical indicating device

69.2.1 Any effective indicating device (an ohmmeter, a battery and buzzer combination, or the like) may be used to determine compliance with the requirements specified in 69.1.1 and 69.1.2.

70 Hair Dryer Power Input Test

70.1 The power input to each hand-supported hair dryer shall be tested as described in 70.2, as a routine production-line test.

70.2 The power input is to be measured with the dryer at operating temperature under full-load conditions while connected to a circuit maintained at:

a) 120 ±6 volts for a dryer rated 110 – 120 volts,

b) 240 ±12 volts for a dryer rated 220 – 240 volts, or

c) The marked voltage on the dryer for all other voltage ratings.

Control switches or the equivalent, if provided, are to be set to result in the maximum power input.

70.3 The results are acceptable if the power input to a dryer is within the inclusive range of 90 – 110 percent of the rating.

70.4 With regard to 70.3, the wattage of a dryer that has its electrical rating marked only in amperes and volts will be assumed to be the product of those two values.

RATINGS

71 Details

71.1 An appliance shall be rated in volts and amperes or watts. It may be rated for alternating current only or direct current only. The rating shall include the number of phases if the appliance is for use on a polyphase circuit and the frequency, if needed to comply with requirements in this standard, for a motor relay coil or other component. To determine compliance, the requirements in 43.3 shall be used. For a preheat type appliance, the ampere or wattage rating shall be based on the maximum value measured during the preheat cycle.

71.2 The current rating of an appliance shall include 15 amperes for a single receptacle provided as part of the appliance and intended as a general use outlet, 20 amperes for two or more receptacles (including a single duplex receptacle), or, if the outlet is marked as noted in 72.1.6, that marked rating shall be included in the current rating of the appliance.

71.3 The voltage rating of a cord-connected appliance intended for connection to a nominal 120-volt supply circuit shall not exceed 125 volts. The voltage rating of a dual-voltage appliance intended for connection to a nominal 120/240 volt supply circuit shall not exceed 125/250 volts.

MARKINGS

72 Details

72.1 General

72.1.1 An appliance shall be legibly and permanently marked, where it will be plainly visible (after installation in the case of a permanently connected appliance), with:

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

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

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

d) The electrical rating.

Exception No. 1: The date of manufacture may be located where visible behind a cover that is movable without the use of a tool. If the cover is removable, the marking shall be on other than the cover.

Exception No. 2: The date of manufacture may be located on the body or blade of the attachment plug.

72.1.2 The repetition time cycle of a date code shall not be less than 10. The date code shall not require reference to the manufacturer's records to determine when the appliance was manufactured.

72.1.3 If a manufacturer produces or assembles appliances at more than one factory, each appliance shall have a distinctive marking, which may be in code, to identify it as the product of a particular factory.

72.1.4 A marking shall be:

a) Paint-stenciled, die-stamped, molded, or indelibly stamped;

b) In the form of pressure-sensitive labels; or

c) In a form that has been determined to be the equivalent.

A pressure-sensitive label, that is required to be permanent, shall comply with the applicable requirements in the Standard for Marking and Labeling Systems, UL 969, under the intended application surface, temperature and environmental conditions.

72.1.5 Block lettering shall be used for the marked words "CAUTION," "WARNING," or "DANGER," and for the marking wording that follows any of these words.

72.1.6 An appliance provided with general-use receptacles intended for limited current loads shall have each such receptacle permanently marked "___ amperes, maximum, ___ watts, maximum" or the equivalent, adjacent to the receptacle. The ampere rating shall be the receptacle ampere load used during the normal temperature test. The absence of this marking shall be construed as permitting the loading of the receptacle during the normal temperature test to the full current rating of the receptacle.

72.1.7 With regard to 7.9(i)(1), the convenience receptacle shall be permanently marked "___ Amperes maximum, ___ Watts maximum" or the equivalent adjacent to the convenience receptacle. The ampere and wattage values shall not exceed the rating of the immersion protective device minus that of the hand-