UL 1206

STANDARD FOR SAFETY

Electric Commercial Clothes-Washing Equipment

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UL Standard for Safety for Electric Commercial Clothes-Washing Equipment, UL 1206

Fourth Edition, Dated April 22, 2003

SUMMARY OF TOPICS

This revision of ANSI/UL 1206 dated June 14, 2021 was issued to add an alternative reference to the Standard for Adjustable Speed Electric Power Drive Systems, UL 61800-5-1; 20A.2.4

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 revised requirements are substantially in accordance with Proposal(s) on this subject dated April 16, 2021.

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UL 1206

Standard for Electric Commercial Clothes-Washing Equipment

Prior to the First edition, the requirements for the products covered by this standard were included in the Standard for Electric Home-Laundry Equipment, UL 560.

The First edition was titled Standard for Electric Coin-Operated and Commercial Clothes-Washing Equipment.

First Edition – February, 1974
Second Edition – August, 1979
Third Edition – January, 1994

Fourth Edition

April 22, 2003

This ANSI/UL Standard for Safety consists of the Fourth Edition including revisions through June 14, 2021.

The most recent designation of ANSI/UL 1206 as an American National Standard (ANSI) occurred on June 14, 2021. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

The Department of Defense (DoD) has adopted UL 1206 on June 14, 1989. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

Comments or proposals for revisions on any part of the Standard may be submitted to 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 commercial, industrial, and institutional clothes-washing equipment intended for use in accordance with the National Electrical Code. Equipment covered by this Standard is not intended for use by the general public, but only by trained or supervised personnel.

1.2 These requirements do not cover clothes dryers, coin-operated clothes washing appliances, flatirons, ironing machines, water heaters, water softeners, dry-cleaning machines, garment-finishing machines, appliances employing wringer mechanisms, or other equipment covered by requirements separate from this standard.

1.3 Appliances and field-attached accessories are investigated under these requirements and under such additional requirements as are applicable to the appliance under consideration.

2 References

2.1 In the following text, a requirement that applies only to a specific class of equipment is so identified by a specific reference in that requirement to the class or classes of appliances involved. Absence of such specific reference or use of the term appliance indicates that the requirement applies to all classes of appliances unless the context indicates otherwise.

2.2 In the following text, a specific requirement pertaining to a particular appliance takes precedence over a corresponding requirement specified as being applicable to all appliances.

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

3 Glossary

3.1 APPLIANCE, AUTOMATIC – An appliance is considered to be automatically controlled under one or more of the following conditions:

a) If repeated starting of the appliance, beyond one complete predetermined cycle of operation, to the point where some form of limit switch opens the circuit is independent of any manual control.

b) If, during any single predetermined cycle of operation, the motor is caused to stop and restart one or more times.

c) If, upon energizing the appliance, the initial starting of the motor may be intentionally delayed beyond normal, conventional starting.

d) If, during any single predetermined cycle of operation, automatic changing of the mechanical load may reduce the motor speed sufficiently to reestablish starting-winding connections to the supply circuit.

3.2 APPLIANCE, RECESSED – An appliance intended to be supported by the floor, and to sit immediately adjacent to a wall in the rear or to sit immediately adjacent to a wall, a cabinet, or another appliance on each side. If the design permits, a counter top may cover the appliance and adjacent cabinets and appliances. A recessed appliance is not intended for permanent attachment to the building structure or to adjacent cabinets or appliances.

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3.3 APPLIANCE, SEMI-AUTOMATIC – An appliance employing two or more motors is considered to be semiautomatically controlled if:

a) One or more motors are controlled in accordance with any of the conditions specified in 3.1, and

b) At least one motor is not controlled in accordance with any of the conditions specified in 3.1.

3.4 APPLIANCE, WALL-INSERT – An appliance intended to be mounted permanently in a wall or other vertical surface of a building or cabinet.

3.5 ENCLOSURE – The part of the product that:

a) Reduces the accessibility of all or any parts of the product that may otherwise result in a risk of electric shock or injury to persons; or

b) Retards propagation of flame initiated by electrical disturbances that may occur within the product.

3.6 PART, DECORATIVE – A part used for ornamental purposes only and not as an enclosure or as insulation of electrically live parts.

3.7 PART, FUNCTIONAL – A part that is necessary for the proper functioning of the product, and that is used in such a way that deterioration or breakage of the part would result in a risk of fire, electric shock, or injury to persons.

3.8 OPERATING CONTROL – Control, the operation of which starts or regulates the appliance during normal operation.

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3.9 PROTECTIVE CONTROL – Control, the operation of which is intended to prevent the risk of electric shock, fire, or injury to persons during normal or abnormal operation of the appliance.

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3.10 SAFETY CRITICAL FUNCTION – Control, protection and monitoring functions which are being relied upon to reduce the risk of fire, electric shock or injury hazards.

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3.11 TEMPERATURE-LIMITING DEVICE – A device that functions:

a) only under conditions that produce abnormal temperatures; and

b) that is not intended to function during normal operation of the appliance.

3.12 TEMPERATURE-REGULATING DEVICE – A device that:

a) regulates temperature; and

b) functions during normal operation of the appliance.

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3.13 TEMPERATURE-REGULATING AND -LIMITING (Combination) DEVICE – A device that functions to:

a) regulates the temperature under normal conditions of use; and

b) limit abnormal temperatures that might result from conditions of abnormal operation of the appliance.

4 Components

4.1 Except as indicated in 4.2, a component of a product covered by this standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components generally used in the products covered by this standard.

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

a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard, or

b) Is superseded by a requirement in this standard.

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

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

5 Units of Measurement

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

6 Field-Attached Accessories

6.1 The requirements in 6.2 – 6.9 apply to accessories intended for installation on or connection to an appliance for the purpose of modifying or supplementing the functions of the appliance or accessory.

6.2 An appliance that has provision for the use of an accessory to be attached in the field shall be constructed so that the use of the accessory will not introduce a risk of fire, electric shock, or injury to persons.

6.3 The installation of an accessory by the user shall be restricted to an arrangement that can be accomplished by means of receptacles and plug-in connectors of other than the general-use or specific-purpose type.

6.4 The installation of an accessory by a qualified electrician or serviceman is acceptable if connections are made to existing terminals by use of wire connectors.

6.5 Accessories intended to be field wired shall be provided with a means for connection to the power-supply circuit of the appliance as specified in 11.1.1.

6.6 An appliance that has provision for field connection of a dispenser or the like shall include a circuit that provides a programmed signal to the dispenser.

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6.7 Any installation that requires field rearrangement of components or wiring, cutting or splicing of wiring, or soldering of connections is not acceptable.

6.8 As part of the investigation, an accessory shall be tested and trial-installed to determine that installation is feasible, that the instructions are detailed and correct, and that the use of the accessory will not introduce a risk of fire, electric shock, or injury to persons.

6.9 An appliance that has provision for the field connection of an accessory and a field-attached accessory shall be marked as specified in 50.1 and 50.21 – 50.23, as applicable.

CONSTRUCTION

7 Frame and Enclosure

7.1 An appliance shall be formed and assembled so that it will have the strength and rigidity necessary to resist the abuses to which it may be subjected, without increasing the risk of fire, electric shock, or injury to persons due to total or partial collapse with resulting reduction of spacings, loosening or displacement of parts, or other serious defects.

7.2 An appliance shall be provided with an enclosure of material found by investigation to be acceptable for the application that shall house all parts that may present a risk of fire, electric shock, or injury to persons under any condition of use.

7.3 Among the factors that shall be taken into consideration when judging the acceptability of an enclosure material are its:

a) Mechanical strength,

b) Resistance to impact,

c) Moisture – absorptive properties,

d) Combustibility, and

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

7.4 An enclosure constructed of polymeric material shall comply with the requirements in Polymeric Materials, Section 44.

7.5 For an unreinforced, flat surface, cast metal shall not be less than 1/8-in (3.2-mm) thick, malleable iron shall not be less than 3/32-in (2.4-mm) thick, and die-cast metal shall not be less than 5/64-in (2.0-mm) thick.

Exception: Metal of lesser thickness but not less than 3/32 in, 1/16 in (1.6 mm), and 3/64 in (1.2 mm), respectively, may be acceptable provided the surface under consideration is:

a) Curved, ribbed, or otherwise reinforced to provide mechanical strength equivalent to that required; or

b) Of a size or shape that provides mechanical strength equivalent to that required.

7.6 An enclosure of sheet metal shall be judged with respect to size, shape, thickness of metal, and acceptability for the application considering the intended use of the complete appliance.

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7.7 For an enclosure of sheet metal, sheet steel shall have a minimum thickness of 0.026 in (0.66 mm), aluminum shall have a minimum thickness of 0.036 in (0.91 mm), and copper or brass shall have a minimum thickness of 0.033 in (0.84 mm).

Exception: This requirement does not apply to an area that is relatively small or a surface that is curved or otherwise reinforced.

7.8 At a point where the power-supply conductors enter the enclosure, sheet metal shall not be less than 0.032 in (0.81 mm) thick if uncoated steel, not less than 0.034 in (0.86 mm) if galvanized steel, not less than 0.044 in (1.12 mm) if aluminum, and not less than 0.043 in (1.09 mm) if copper or brass.

7.9 In an automatic free-standing or recessed appliance, provision shall be made to prevent molten metal, burning insulation, or the like from falling upon combustible materials, including the surface on which the appliance is supported.

Exception: This requirement does not apply to the supporting surface of an appliance that is:

a) Intended to be permanently bolted to an uncovered concrete floor,

b) Marked in accordance with 50.24, and

c) Provided with installation instructions that include a warning statement in accordance with 50.25.

7.10 The requirement in 7.9 will necessitate the use of a barrier of noncombustible material:

a) Under a motor unless:

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

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

i) Open main winding,

ii) Open starting winding,

iii) Starting switch short-circuited, and

iv) Capacitor of permanent-split capacitor motor 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 it is neoprene-or thermoplastic-insulated.

7.11 The requirement in 7.9 will also necessitate that a switch, a relay, a solenoid, or the like be individually and completely enclosed.

Exception No. 1: The terminals of a switch, a relay, a solenoid, or the like are not required to be individually and completely enclosed.

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Exception No. 2: This requirement does not apply if malfunction of the component would not result in a risk of fire.

Exception No. 3: This requirement does not apply if there are no openings in the bottom of the appliance enclosure.

7.12 The barrier mentioned in 7.10 shall be horizontal, shall be located as illustrated in Figure 7.1, and shall have an area in accordance with that illustration.

7.13 With reference to the barrier mentioned in 7.10, openings for drainage, ventilation, etc., may be employed in the barrier if such openings would not permit molten metal, burning insulation, or the like to fall on combustible material.

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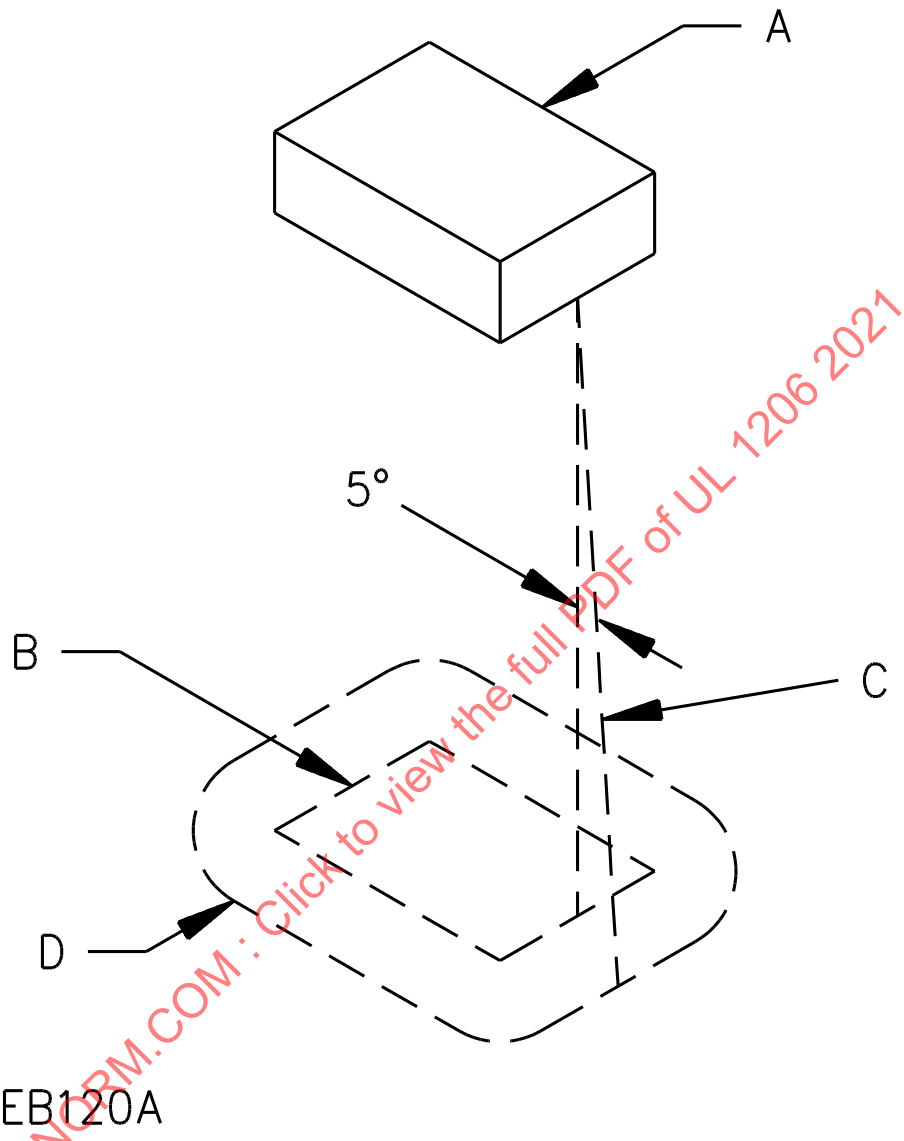
Figure 7.1

Location and extent of barrier



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NOTES –

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 that traces out minimum area of barrier. 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 Accessibility of Uninsulated Live Parts and Film-Coated Wire

8.1 To reduce the likelihood of unintentional contact that involves a risk of electric shock from an uninsulated live part or film-coated wire, an opening in an enclosure shall comply with either (a) or (b).

a) For an opening that has a minor dimension (see 8.5) less than 1 in (25.4 mm), such a part or wire shall not be contacted by the probe illustrated in Figure 8.1.

b) For an opening that has a minor dimension of 1 in or more, such a part or wire shall be spaced from the opening as specified in Table 8.1.

Exception: A motor need not comply with these requirements if the integral enclosure of the motor complies with the requirements in 8.2.

8.2 With respect to an integral enclosure of a motor as mentioned in the Exception to 8.1:

a) An opening that has a minor dimension (see 8.5) less than 3/4 in (19.1 mm) is acceptable if:

1) Film-coated wire cannot be contacted by the probe illustrated in Figure 8.3;

2) In a directly accessible motor (see 8.6), an uninsulated live part cannot be contacted by the probe illustrated in Figure 8.4; and

3) In an indirectly accessible motor (see 8.6), an uninsulated live part cannot be contacted by the probe illustrated in Figure 8.2.

b) An opening that has a minor dimension of 3/4 in or more is acceptable if a part or wire is spaced from the opening as specified in Table 8.1.

8.3 The probes mentioned in 8.1 and 8.2 and illustrated in Figure 8.1, Figure 8.2, Figure 8.3, and Figure 8.4 shall be applied to any depth that the opening will permit; and shall be rotated or angled before, during, and after insertion through the opening to any position that is necessary to examine the enclosure. The probes illustrated in Figure 8.1 and Figure 8.4 shall be applied in any possible configuration; and, if necessary, the configuration shall be changed after insertion through the opening.

8.4 The probes mentioned in 8.1 and 8.2 shall be used as measuring instruments to judge the accessibility provided by an opening, and not as instruments to judge the strength of a material; they shall be applied with the minimum force necessary to determine accessibility.

8.5 With reference to the requirements in 8.1 and 8.2, the minor dimension of an opening is the diameter of the largest cylindrical probe having a hemispherical tip that can be inserted through the opening.

8.6 With reference to the requirements in 8.2:

a) An indirectly accessible motor is a motor that is:

1) Accessible only by opening or removing a part of the outer enclosure, such as a guard or panel, that can be opened or removed without using a tool, or

2) Located at such a height or is otherwise guarded or enclosed so that it is unlikely to be contacted.

b) A directly accessible motor is a motor that:

1) Can be contacted without opening or removing any part, or

2) Is located so as to be accessible to contact.

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8.7 With reference to the requirements in 8.1 and 8.2, insulated brush caps are not required to be additionally enclosed.

Table 8.1
Minimum acceptable distance from an opening to a part that may involve a risk of electric shock

Minor dimension of opening[a]		Minimum distance from opening to part	
in[b]	(mm)	in[b]	(mm)
3/4[c]	(19.1)	4-1/2	(114.0)
1[c]	(25.4)	6-1/2	(165.0)
1-1/4	(31.8)	7-1/2	(190.0)
1-1/2	(38.1)	12-1/2	(318.0)
1-7/8	(47.6)	15-1/2	(394.0)
2-1/8	(54.0)	17-1/2	(444.0)
d		30	(762.0)

[a] See 8.5.

[b] Between 3/4 in and 2-1/8 in, interpolation is to be used to determine a value between values specified in the table.

[c] Any dimension less than 1 in applies to a motor only.

[d] More than 2-1/8 in, but not more than 6 in (152.0 mm).

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Figure 8.1

Articulate probe with web stop

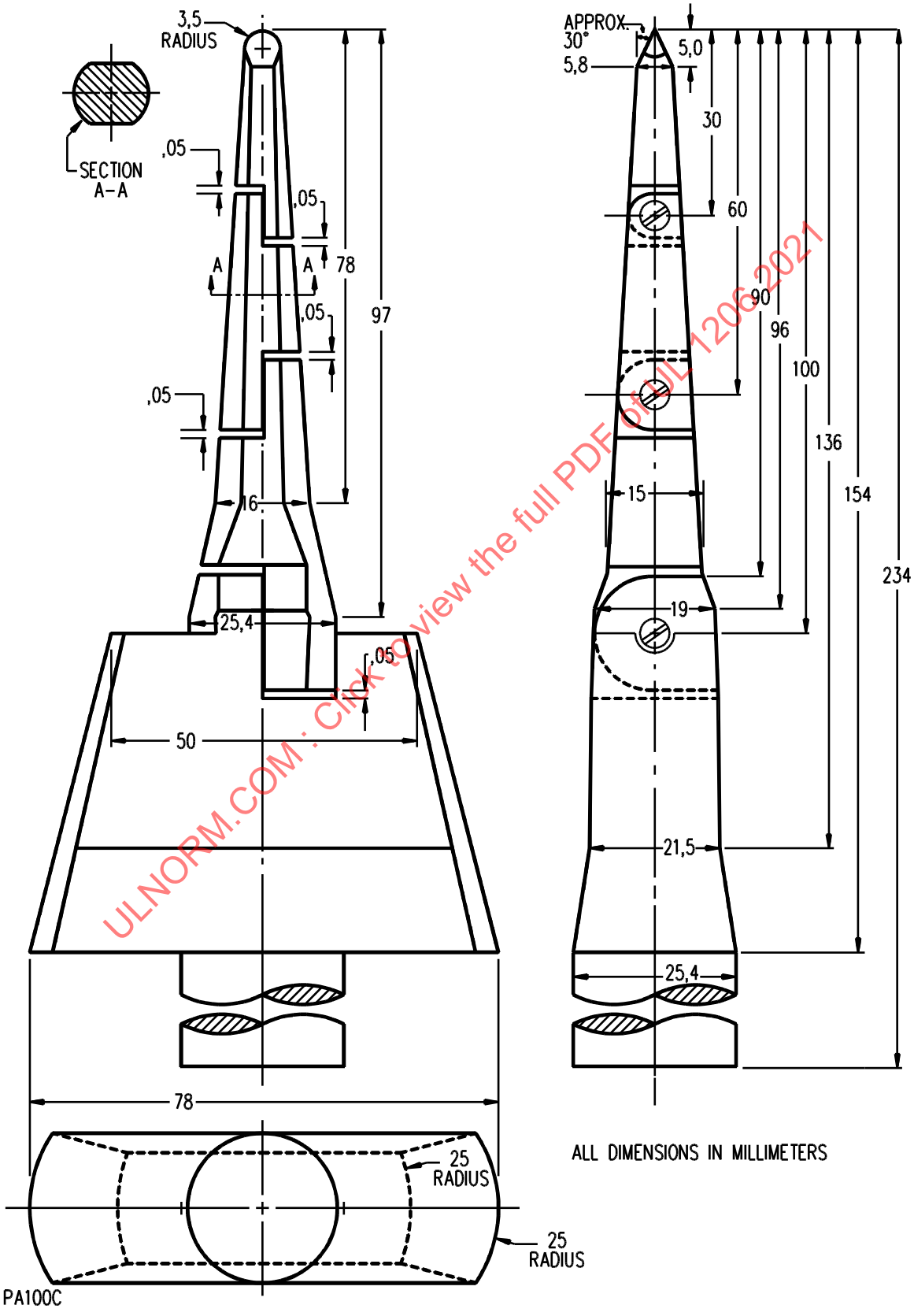

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Figure 8.2

Probe for uninsulated live parts

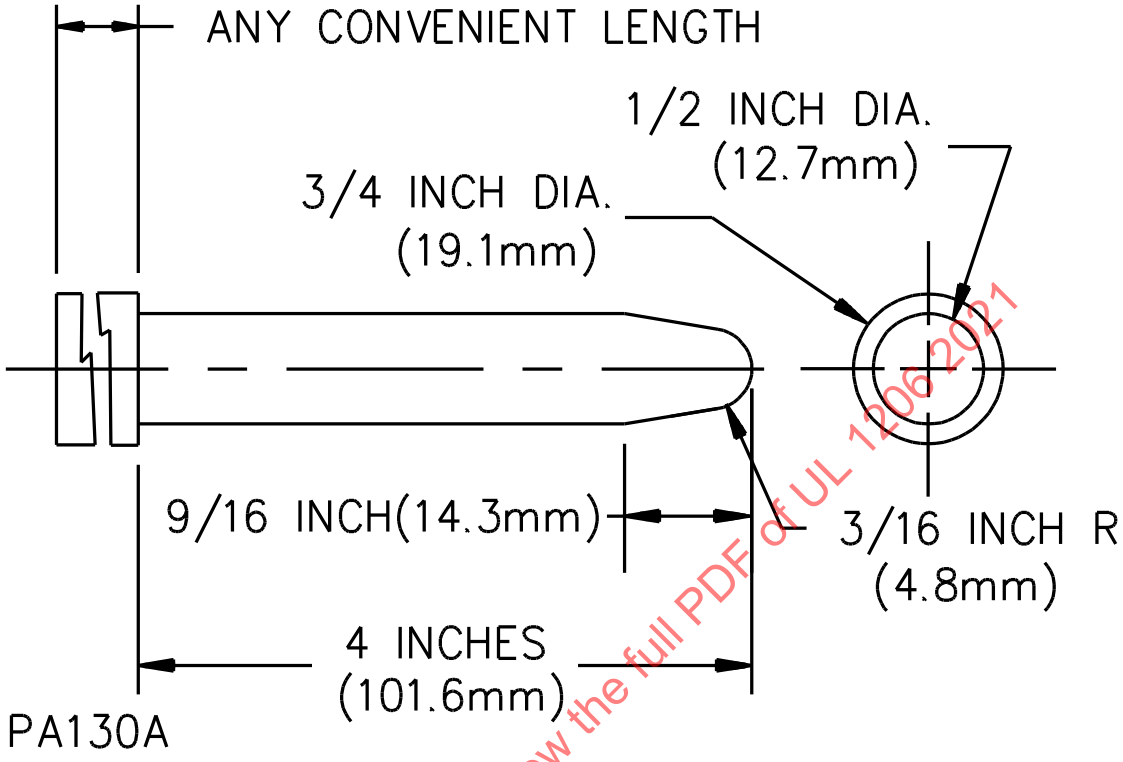

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Figure 8.3

Probe for film-coated wire

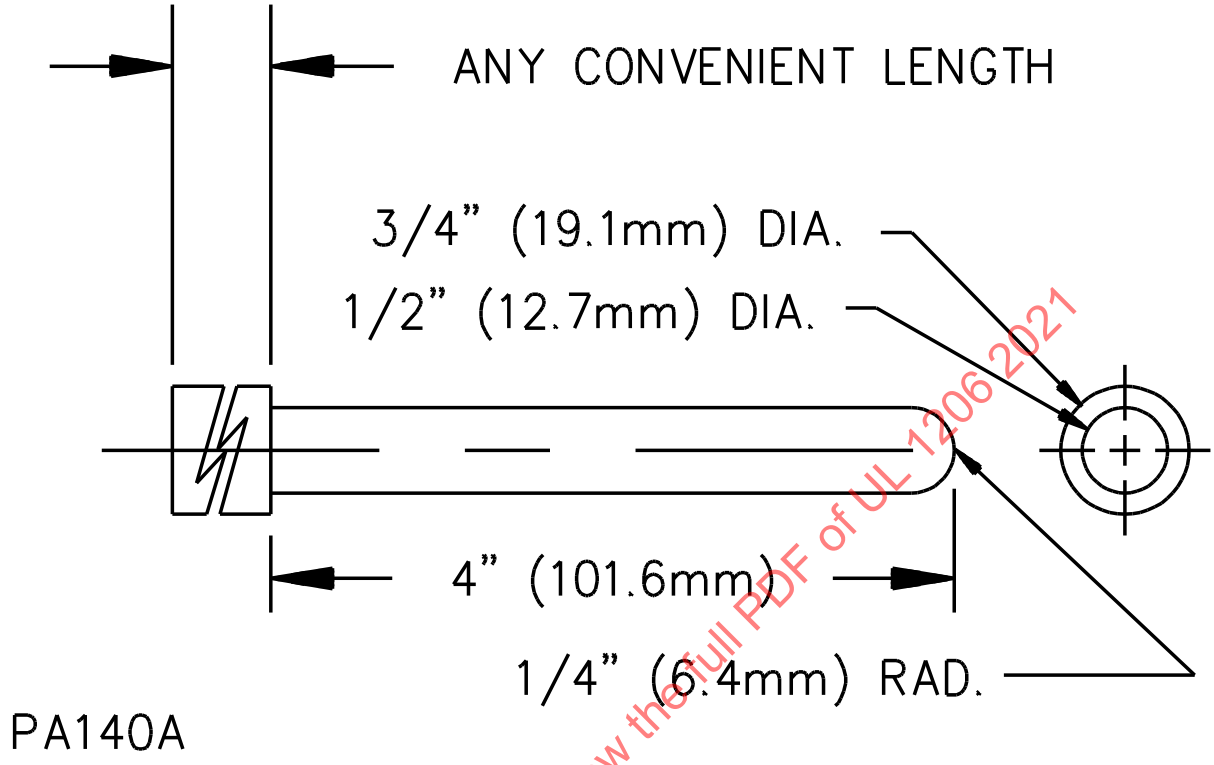
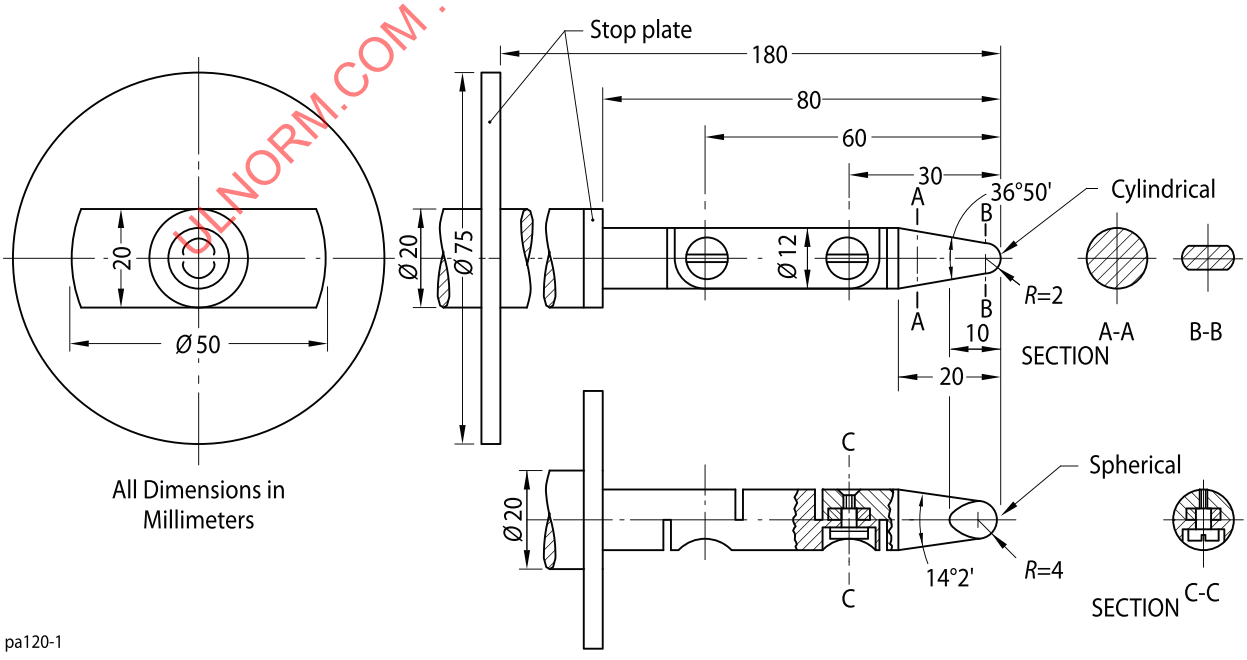


Figure 8.4

International Electrotechnical Commission (IEC) articulate accessibility probe with stop plate
Courtesy of IEC



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8.8 The requirements in 8.1, 8.2, and 28.2 apply to the back of a free-standing appliance and to the back and sides of a recessed appliance. They do not apply to the bottom of a free-standing or recessed appliance if the front, sides, and back of the appliance extend substantially to the surface upon which the appliance rests.

8.9 The bottom of the enclosure of a wall-insert appliance shall be complete and without openings.

8.10 A protective device, such as a fuse, the functioning of which requires renewal or replacement, shall be in a readily accessible location.

8.11 A protective device shall be wholly inaccessible from outside the appliance without opening a door or cover.

Exception: The operating handle of a circuit breaker, the operating button of a manually operable motor protector, and similar parts may project outside the appliance enclosure.

8.12 A door or a cover of an enclosure shall be hinged or otherwise attached in an equivalent manner 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.

8.13 Means shall be provided for holding the door or cover over a fuseholder in a closed position, and the door or cover shall be tight fitting.

9 Mechanical Assembly

9.1 An appliance shall be assembled so that it will not be adversely affected by the vibration of normal operation. Brush caps shall be tightly threaded or otherwise designed to prevent loosening.

9.2 A switch, a lampholder, an attachment-plug receptacle, a motor-attachment plug, or similar component shall be mounted securely and shall be prevented from shifting or turning.

Exception No. 1: A switch need not be prevented from turning if all four of the following conditions are met:

a) The switch is of a plunger or other type that does not tend to rotate when operated. A toggle switch is considered to be subject to forces that tend to rotate the switch during normal operation of the switch.

b) Means for mounting the switch make it unlikely that operation of the switch will loosen it.

c) Spacings are not reduced below the minimum acceptable values if the switch rotates.

d) Normal operations of the switch is by mechanical means rather than by direct contact by persons.

Exception No. 2: A lampholder of the type 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, need not be prevented from turning if rotation cannot reduce spacings below the minimum acceptable values.

9.3 Means for preventing the rotation mentioned in 9.2 is to consist of more than friction between surfaces – for example, a lock washer, properly applied, may be used to prevent turning of a small stem-mounted switch or other device having a single-hole mounting means.

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9.4 Electrical components shall be located so that there will be no collection of moisture on or flooding of such parts by condensed vapor dripping from pipes, tanks, etc.

10 Protection Against Corrosion

10.1 Surfaces of an iron or a steel part shall be protected against corrosion by enameling, galvanizing, plating, or other means that provide equivalent protection.

Exception No. 1: Bearings, balance weights, laminations, or minor parts of iron or steel such as washers, screws, etc are not required to comply.

Exception No. 2: A part of iron or steel is not required to comply if corrosion or breakage of such a part is not likely to result in a risk of fire, electric shock, or injury to persons.

11 Power-Supply Connections

11.1 General

11.1.1 An appliance shall be provided with wiring terminals or leads for the connection of conductors that will be connected in the field and means for connection of a wiring system.

Exception: An appliance other than a wall insert type may be provided with a flexible cord and an attachment plug for connection to the supply circuit.

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

11.2 Permanently connected appliances

11.2.1 Terminal compartments

11.2.1.1 An outlet or terminal box in which connections to the supply circuit will be made shall be located so that, after the appliance has been installed as intended, such connections will be readily accessible for inspection.

11.2.1.2 The requirement in 11.2.1.1 necessitates the terminal box of a wall-insert appliance be located so it will be accessible without moving the appliance after installation.

11.2.1.3 An outlet box, terminal box, wiring compartment, or the like in which connections to the supply circuit will be made in the field shall be free from any sharp edge, including screw threads, a burr, a fin, a moving part, or the like that could damage the insulation on a conductor.

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

11.2.2 Wiring terminals and leads

11.2.2.1 Wiring terminals or leads intended for connection of the conductors of the supply circuit shall be acceptable for the connection of conductors having an ampacity not less than the rating of the branch circuit marked on the appliance.

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11.2.2.2 A wiring terminal shall be provided with a soldering lug or with a pressure wire connector securely fastened in place – for example, firmly bolted or held by a screw. A connection device that depends on solder shall not be used for the connection of an equipment-ground-conductor.

Exception: A wire-binding screw may be employed 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.

11.2.2.3 A wiring terminal shall be prevented from turning.

11.2.2.4 A wire-binding screw shall thread into metal.

11.2.2.5 A wire-binding screw at a wiring terminal shall not be smaller than No. 10.

Exception: A No. 8 screw may be used at a terminal intended only for the connection of a 14 AWG (2.1 mm^2) conductor.

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

Exception: An alloy plate not less than 0.030-in (0.76-mm) thick may be used if the tapped threads have equivalent mechanical strength.

11.2.2.7 A terminal plate may have the metal extruded at the tapped hole to give the thickness necessary for not less than two full threads provided the thickness of the unextruded metal is not less than the pitch of the thread.

11.2.2.8 Upturned lugs or a cupped washer shall be capable of retaining a conductor of the size mentioned in 11.2.2.1 but not smaller than 14 AWG (2.1 mm^2), under the head of the screw or the washer.

11.2.2.9 The free length of a lead inside an outlet box or wiring compartment shall not be less than 6 in (150 mm) if the lead is intended for field connection to an external circuit.

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

11.3 For connection of grounded power-supply conductor

11.3.1 An appliance provided with wiring terminals or leads and rated 125 V or 125/250 V or less and employing:

a) A lamp- or element-holder of the Edison-screw-shell type,

b) A single-pole switch, or

c) A single-pole automatic control,

shall have one terminal or lead identified for connection of the grounded conductor of a supply circuit. The terminal or lead intended to be connected to a grounded conductor of a supply circuit shall be the one that is connected to screw shells of lamp- or element-holders, and to which are connected no single-pole switches or single-pole automatic controls.

11.3.2 A terminal for connection of the grounded conductor of a supply circuit shall be of or plated with a metal substantially white in color. Such a terminal shall be readily distinguishable from the other terminals;

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or identification of the terminal shall be clearly shown in some other way, such as on an attached wiring diagram.

11.3.3 A lead for connection of the grounded conductor of a supply circuit shall have a white or grey color and shall be readily distinguishable from the other leads.

11.4 For connection of equipment-grounding conductor

11.4.1 A terminal intended solely for connection of an equipment-grounding conductor shall be capable of securing a conductor of the size necessary for the application.

11.4.2 A wire-binding screw intended for the connection of an equipment-grounding conductor shall have a green-colored head that is hexagonal, slotted, or both. A pressure wire connector intended solely for the connection of such a conductor shall be marked in accordance with 50.14. The wire-binding screw or pressure wire connector shall be located so that it does not require removal during normal servicing of the appliance. A sheet-metal screw shall not be used for connection of an equipment-grounding conductor.

11.4.3 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.

11.5 Cord-connected appliances

11.5.1 Cords and plugs

11.5.1.1 A flexible cord shall have an ampacity not less than the current rating of the appliance.

11.5.1.2 An attachment plug shall have an ampacity not less than the rated current of the appliance, and shall have a voltage rating not less than the rated voltage of the appliance.

11.5.1.3 Flexible cord provided with an appliance shall be Type SJ, SJO, SJT, SJTO, S, SO, ST, or STO.

Exception: Type SP-3 or SPT-3 cord may be used on an automatic appliance not mounted on wheels, casters, or the equivalent.

11.5.1.4 If the point of entry of the flexible cord into a nonautomatic appliance or a semiautomatically controlled appliance is 30 in (0.76 m) or more above the floor, the cord shall not be less than 6 ft (1.83 m) long measured from the face of the attachment plug to the point of cord entry into the appliance.

11.5.1.5 If the point of entry of the flexible cord into a nonautomatic appliance or a semiautomatically controlled appliance is less than 30 in (0.76 m) above the floor, the length of the cord shall not be less than 8-1/2 ft (2.59 m) minus the vertical distance between the point of cord entry into the appliance and the floor.

11.5.1.6 For an automatic appliance, the flexible cord shall not be less than 6 ft (1.83 m) long measured from the face of the attachment plug to the point of entry into the appliance.

11.5.1.7 The flexible cord shall be prevented from being pushed into the appliance through the cord-entry hole if such displacement may subject the cord to mechanical damage or to exposure to a temperature higher than that for which the cord is rated; or may reduce spacings, such as to a metal strain-relief clamp, below the minimum acceptable values.

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11.5.2 Strain relief

11.5.2.1 A flexible cord shall be provided with strain relief so that stress on the cord will not be transmitted to terminals, splices, or internal wiring. The strain-relief means shall comply with the requirements in Strain Relief, Section 42.

11.5.2.2 If a knot in a flexible cord serves as strain relief, a surface against which the knot may bear or with which it may come in contact shall be free from projections, sharp edges, burrs, fins, etc., that may cause abrasion of the insulation of the cord.

11.5.3 Cord bushings

11.5.3.1 The edges of the entry hole for the power-supply cord, including the cord-entry hole in a bushing, shall be smooth and free from burrs, fins, or sharp edges.

11.5.3.2 If an insulating bushing is provided where the power-supply cord enters the enclosure, and if the bushing is of material other than ceramic, phenolic or cold-molded composition, fiber, or other material that has been investigated and found to be acceptable for the application, the hole in the metal in which the bushing is mounted shall be smooth and free from burrs, fins, or sharp edges.

12 Internal Wiring

12.1 For the purpose of these requirements, the internal wiring of an appliance is considered to be all the interconnecting wiring beyond the point where the power-supply cord of a cord-connected appliance enters the enclosure, or beyond the wiring terminals or leads for power-supply connection of a permanently connected appliance, even though some of such wiring may not be completely enclosed and even though some of it may be in the form of flexible cord.

12.2 The internal wiring and connections between parts of an appliance shall be protected or enclosed. A length of flexible cord may be employed for an external – unenclosed – connection between such parts if flexibility is necessary.

12.3 The protection of insulated wiring required by 12.2 is considered to exist if, when judged as though it were enameled wire, the wiring would be acceptable according to 8.2. Internal wiring not so protected may be accepted if it is secured within the enclosure so that it is unlikely to be subjected to stress or mechanical damage.

12.4 Unless it is to be judged as an uninsulated live part, insulated internal wiring of an appliance, including a grounding conductor, shall consist of wire that is acceptable for the application, when considered with respect to:

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

b) Exposure to oil, grease, or other substances that may have a deleterious effect on the insulation;

c) Exposure to moisture; and

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

12.5 If the wiring inside an appliance is located so that it may be in proximity to combustible material or may be subjected to mechanical damage, it shall be in armored cable, rigid metal conduit, electrical metallic tubing, or otherwise protected.

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12.6 Wiring shall be protected from sharp edges – including screw threads – burrs, fins, moving parts, and other agencies that may cause abrasion of the insulation on conductors.

12.7 A hole through which insulated wires pass in a sheet-metal wall within the overall enclosure of an appliance shall be provided with a smooth, rounded bushing of one of the materials mentioned in 11.5.3.2; or shall have smooth surfaces, free of burrs, fins, sharp edges, etc., upon which the wires may bear, to prevent abrasion of the insulation.

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

12.9 All splices and connections shall be mechanically secure and shall provide reliable electrical contact.

12.10 A soldered connection shall be made mechanically secure before being soldered when breaking or loosening of the connection may result in a risk of fire, electric shock, or injury to persons.

12.11 A wire-binding screw or nut shall be provided with a lock washer under the head of the screw or under the nut to prevent it from becoming loosened due to vibration, if such loosening may result in a risk of fire, electric shock, or injury to persons.

12.12 An open-end spade lug may not be used unless additional means are provided to hold the lug in place should the wire-binding screw or nut become loosened.

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

12.14 If the voltage involved is less than 250 V, insulation consisting of two layers of friction tape, of two layers of thermoplastic tape, or of one layer of friction tape on top of one layer of rubber tape may be used on a splice. In determining if splice insulation consisting of coated fabric, thermoplastic, or other type of tubing is acceptable, consideration is to be given to such factors as its dielectric properties, heat-resistant and moisture-resistant characteristics, etc. Thermoplastic tape wrapped over a sharp edge is not acceptable.

12.15 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 may be accomplished by use of pressure wire connectors, soldering lugs, crimped eyelets, soldering all strands of the wire together, or other equivalent means.

13 Live Parts

13.1 Current-carrying parts shall be of silver, copper, a copper alloy, or other material that has been investigated and found to be acceptable for the purpose.

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

a) The temperature of which during normal operation is more than 100°C (212°F),

b) Within a motor or associated governor, or

c) If acceptable in accordance with 4.1;

but unplated iron or steel may not be used. Stainless steel and other corrosion-resistant alloys may be used for current-carrying parts regardless of temperature.

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

13.4 Friction between surfaces is not acceptable as the sole means to prevent the turning of live parts, but a lock washer properly applied may be used for this purpose.

14 Electrical Insulation

14.1 An insulating washer, bushing, etc. and the base or support for the mounting of a live part shall be of a moisture-resistant material that will not be damaged by the temperatures to which it will be subjected under conditions of actual use – for example, porcelain, phenolic, cold-molded composition, or other material that has been investigated and found to be acceptable for the application.

14.2 Insulating material employed in an appliance is judged with respect to the application. Materials such as mica, some molded compounds, and certain refractory materials usually may be used as the sole support of live parts; and some other materials that are not acceptable for general use, such as asbestos and magnesium oxide, may be acceptable if used in conjunction with other acceptable insulating materials or if located and protected so that mechanical damage and the absorption of moisture are prevented. If an investigation is necessary to determine whether a material is acceptable, consideration is to be given to its mechanical strength, dielectric characteristics, insulation resistance, heat-resistant qualities, the degree to which it is enclosed or protected, and any other features that have a bearing on the risk of fire, electric shock, and injury to persons, in conjunction with the conditions of actual service.

14.3 A screw or other fastening used to mount or support a small, fragile, insulating part shall not be so tight as to crack or break such a part due to expansion and contraction. Generally, such a part should be slightly loose.

14.4 Ordinary vulcanized fiber may be used for an insulating bushing, a washer, a separator, and a barrier, but not as the sole support for an uninsulated live part if shrinkage, current leakage, or warpage may introduce a risk of fire or electric shock. Thermoplastic materials are not considered to be acceptable generally for the sole support of an uninsulated live part, but may be employed if shown to be acceptable by investigation.

14.5 A small molded part, such as a terminal block, shall have such mechanical strength and rigidity that it will withstand the stresses of actual service.

15 Thermal Insulation

15.1 Combustible or electrically conductive heat-insulating material shall not be located so that it contacts an uninsulated live part.

15.2 With reference to 15.1, some types of mineral-wool thermal insulation contain conductive impurities in the form of slag that may present a risk of fire or electric shock if in contact with an uninsulated live part.

16 Motors

16.1 A motor shall be acceptable for the application, and shall be capable of driving the maximum normal load of the appliance without introducing a risk of fire, electric shock, or injury to persons.

16.2 A motor winding shall be such as to resist the absorption of moisture, and shall be formed and assembled in a workmanlike manner.

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17 Overload Protection

17.1 If an appliance includes one or more attachment-plug receptacles intended for general use, and if the overcurrent protection of a branch circuit to which the appliance will properly be connected will be inadequate for the receptacle or receptacles, each receptacle circuit shall have overcurrent protection rated not more than 20 A provided as a part of the appliance.

17.2 A fuseholder or circuit breaker shall be acceptable for the application.

17.3 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.

17.4 A fuseholder shall be designed and installed so that an uninsulated live part, other than the screw shell or clips, will not be exposed to contact by persons removing or replacing fuses.

17.5 Fuses employed for motor overload protection shall be located in each ungrounded conductor; and in the case of a 3-phase, 3-wire, alternating-current motor, they shall be located in each of the three phases.

17.6 Devices employed for motor-overload protection, other than those that are inherent in a motor, shall be located in an ungrounded conductor of each phase.

17.7 An appliance shall have thermal or overcurrent protection if, when operated as described in 38.2 – 38.4 without such protection:

a) A motor other than a totally enclosed motor burns out; or

b) The windings of a motor exceed any of the temperatures specified in Table 17.1.

Table 17.1
Winding temperature for motors

Insulation system	Maximum temperature				Average temperature after first hour	
	During first hour		After first hour			
Class A	200°C	(392°F)	175°C	(347°F)	150°C	(302°F)
Class B or F	225°C	(437°F)	200°C	(392°F)	175°C	(347°F)

17.8 With reference to the requirements in 17.7 and 17.9 if, when tested as described in 38.2 – 38.4, the fuse in the supply circuit opens before the motor reaches any of the temperatures specified in Table 17.1, the appliance is considered as not requiring overload protection.

17.9 A semiautomatically controlled appliance shall have thermal or overcurrent protection for those motors considered as automatic per 3.1 (b), (c) and (d) if, when operated as described in 38.2 – 38.4 without such protection:

a) A motor, other than a totally enclosed motor burns out; or

b) The windings of a motor exceed any of the temperatures specified in Table 17.1.

17.10 The overload protection required by 17.7 or 17.9 shall prevent the occurrence of the conditions specified in (a) and (b) of those paragraphs. Motor overload protection that complies with one of the following is considered to comply with the following requirements:

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a) Appliances having a device, which may be integral with the control of the appliance, responsive to motor current, as required by the National Electrical Code (NEC), for overload and overheating;

b) Motors having inherent overheating protection in accordance with the requirements in the Standard for Thermally Protected Motors, UL 1004-3;

c) Motors employing impedance protection complying with the locked-rotor requirements specified in the Standard for Impedance Protected Motors, UL 1004-2; or

d) Motors employing electronic protection complying with the Standard for Electronically Protected Motors, UL 1004-7, or complying with the tests of UL 1004-3 and evaluated in accordance with Evaluation of Electronic Circuits, Supplement SA. See SA1.3.

17.11 The average temperatures specified in Table 17.1 are to be determined by taking the arithmetic mean of the maximum temperatures and the arithmetic mean of the minimum temperatures.

18 Lampholders

18.1 An Edison-base lampholder of a permanently connected appliance or an appliance equipped with a polarized attachment plug shall be wired so that the screw shell will be connected to the terminal or lead that is intended for the connection of the grounded conductor or a supply circuit.

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

Exception: This requirement does not apply if it is necessary to dismantle the appliance or remove a cover plate or other part by means of a tool in order to remove or replace a lamp.

19 Receptacles

19.1 An attachment-plug receptacle intended for general use shall be of the grounding type.

19.2 The face of a receptacle shall:

a) Be flush with or project beyond a nonconductive surrounding surface, or

b) Project at least 0.015 in (0.38 mm) beyond a conductive surrounding surface.

20 Switches

20.1 A switch shall be acceptable for the application, and shall have a current and voltage rating not less than that of the load that it controls when the appliance is operated normally.

20.2 A switch shall be located or protected so that it will not be exposed to mechanical damage during normal use.

20.3 If the handle of a switch is operated vertically rather than rotationally or horizontally, the up position of the handle shall be the on position.

20.4 A switch controlling one or more heating elements of an appliance shall be arranged so that opening of the switch will disconnect all the ungrounded conductors of the supply circuit.

Exception: This requirement does not apply if no live part is exposed to unintentional contact when the switch is open, or if the fact that such a part is live is definitely apparent.

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20.5 A switch or other device that controls a motor and that has not been investigated for the purpose shall comply with the requirements in 37.1.

20.6 A switch or other device that controls a solenoid, relay coil, or the like and that has not been investigated for the purpose shall comply with the requirements in 37.3.

20.7 If a cord-connected appliance employs a motor rated more than 1/3 horsepower (249 W output), a controller for the motor shall be provided in the appliance. See 23.8.

20A Controls

20A.1 General

20A.1.1 Components, wiring, printed wiring assemblies, insulating material, potting materials, and the like, and associated circuitry employed in controls, shall be investigated and found acceptable for the application in accordance with the specified component standards with respect to a risk of fire, electric shock, and injury to persons.

20A.1.2 Controls shall be so located or protected that they are not subjected to mechanical damage, excessive moisture, or excessive collection of lint.

20A.1.3 The operating mechanism of controls shall not subject electrical parts to undue strain.

20A.1.4 Electronic circuits that manage a Safety Critical Function (SCF) shall be:

a) Reliable as defined as being able to maintain the SCF in the event of single defined component faults; and

b) Not susceptible to electromagnetic environmental stresses encountered in the anticipated environments where the appliance will operate.

20A.2 Operating controls

20A.2.1 An operating control shall comply with:

a) Evaluation of Electronic Circuits, Supplement SA; or

b) The applicable requirements in the Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1 and the relevant Part 2.

20A.2.2 The cycle selection control, water level detection, out of balance detection, temperature-regulating devices and any control not relied upon to provide a required safety function are considered and to be tested and evaluated as operating.

20A.2.3 The minimum test parameters for the evaluation of an operating control to the Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1 and any applicable Part 2 are specified in Table 20A.1.

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Table 20A.1
Operating control correlation table

(See 20A.2)

Information	Operating control requirement
FMEA	Conduct a failure-mode and effect analysis (FMEA) to identify components the failure of which may result in a risk of fire or electric shock or injury to persons.
Operating ambient	Determined in accordance with Section 36, Temperature Test, of the appliance.
Endurance testing for electromechanical devices	6,000 cycles for temperature-regulating devices and other types of operating controls.
Overvoltage Category	Overvoltage Category II
Pollution degree	See 23A.4

20A.2.4 As an alternative to the requirements in 20A.2.1, power conversion equipment intended to control a variable speed motor load (e.g. a variable frequency drive) can comply with the Standard for Power Conversion Equipment, UL 508C or the Standard for Adjustable Speed Electric Power Drive Systems, UL 61800-5-1. See Section 17 for the motor-overload protection requirements.

20A.3 Controls that manage safety critical functions (protective controls)

20A.3.1 A control that manages a SCF shall comply with the requirements of:

a) Evaluation of Electronic Circuits, Supplement SA; or

b) The requirements in the Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1 and the relevant Part 2 applicable to a Protective Control.

20A.3.2 Controls that manage a SCF shall also be evaluated for reliability in accordance with:

a) Evaluation of Electronic Circuits, Supplement SA; or

b) The Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1 and any applicable Part 2.

20A.3.3 Electronic motor protection shall be evaluated in accordance with 17.10(d).

20A.3.4 Controls that manage a SCF and that does not rely on software shall comply with the standards specified in 20A.3.2 except for Controls Using Software, H.11.12, in the Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1. If software is relied upon to perform the protective control function, it shall be considered Software Class B as indicated in Table 20A.2.

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Table 20A.2
Protective control correlation table

(See 20A.3)

Information	Protective control requirement
FMEA	Conduct a failure-mode and effect analysis (FMEA) identifying component failures which may result in a risk of fire, electric shock or injury and confirming the protective function continues to operate as intended.
Operating ambient	Determined in accordance with Section 36, Temperature Test, of the appliance
Endurance testing for electromechanical devices	a) 6,000 cycles for controls as indicated in 20A.5, 20A.6, 20A.7, and for manual, non-self-resetting temperature-limiting devices, and other manual, non-self-resetting protective controls. b) 100,000 cycles, for automatic, self-resetting temperature-limiting controls, combination temperature-limiting and regulating controls, and other automatic, self-resetting protective controls
Overvoltage category	Overvoltage Category II
Pollution degree	See 23A.4
Radio-frequency electromagnetic field immunity to conducted disturbances	Test Level 3
Radio-frequency electromagnetic field immunity to radiated electromagnetic fields	Field strength of 3 V/m
Fast transient bursts	Test Level 3 applied for 1 minute in each polarity
Surge immunity	Installation Class 3
Electrostatic discharge	Severity Level 3
Thermal cycling for electronic devices	14 days, Assumed temperature range: 10.0 +2 °C to the operating ambient
Software class	Software Class B (See 20A.3.4)

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20A.3.5 A door or lid interlock, secondary function control, electronic braking means, motor overload protection, temperature-limiting devices, combination temperature-regulating and -limiting devices, and any control relied upon for compliance with abnormal operation testing requirements shall be tested and evaluated as a control managing a SCF in accordance with the applicable requirements in Evaluation of Electronic Circuits, Supplement SA.

20A.3.6 The minimum test parameters for the evaluation of a control managing a SCF (protective control to the Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1) and the relevant Part 2 are specified in Table 20A.2.

20A.4 Temperature-regulating and temperature-limiting devices

20A.4.1 A temperature sensing device, such as a positive temperature coefficient (PTC) thermistor and a negative temperature coefficient (NTC) thermistor, that is used in combination with an electronic control and that together with the control manages a SCF shall comply with the Standard for Thermistor-Type Devices, UL 1434.

20A.4.2 Protective temperature sensing controls shall have cut-in and cut-out temperatures that do not:

a) Deviate from the manufacturer's specified limits in the as-received condition by more than either 6°C or 5 percent, whichever is greater; and

b) Drift from the temperatures measured in the as -received condition by more than either 6°C or 5 percent, whichever is greater, after being subjected to the specified number of cycles in accordance with Table 20A.2 and, for electronic protective controls, the environmental stress tests in Section H.26 of the Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1.

20A.4.3 With respect to 20A.4.2, if a manufacturer declares a tighter tolerance, the deviation and drift shall remain within the manufacturer's declared values.

20A.5 Cycle selection controls

20A.5.1 Clock-operated switches incorporating mechanical clockwork, such as gears, springs, and motors, shall comply with the applicable requirements in one of the following standards:

a) Evaluation of Electronic Circuits, Supplement SA; or

b) Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Timers and Time Switches, UL 60730-2-7.

20A.5.2 A cycle selection control incorporating electronic timing or switching circuits, shall comply with the standards specified in 20A.2.1(b).

20A.6 Door/lid interlock or lock protective controls

20A.6.1 If a door-actuated or lid-actuated switch is employed to directly disconnect power to the motor, the switch shall comply with the Endurance Test as specified in 29.6 and with the applicable requirements in one of the following standards:

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

b) Standard for Industrial Control Equipment, UL 508.

20A.6.2 If a door-actuated or lid-actuated switch is employed as a sensor for an electronic control to disconnect power to the motor, the switch and control shall comply with 20A.3.

20A.6.3 Endurance testing of a door or lid interlock and the associated braking means shall be conducted in accordance with 29.6.

20A.7 Water level detection controls

20A.7.1 If a switch is employed as part of a water level detection mechanism, it shall comply with the applicable requirements in one of the following standards:

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

b) Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Automatic Electrical Air Flow, Water Flow and Water Level Sensing Controls, UL 60730-2-15.

20A.7.2 If a pressure or flow switch is employed as part of a water level detection mechanism, the switch shall comply with Flooding of Live Parts, Section 39 for gaskets or seals in contact with laundry detergent or bleach, Polymeric Materials, Section 44 for polymeric materials in contact with laundry detergent or bleach, and with the applicable requirements in one of the following standards:

a) Standard for Industrial Control Equipment, UL 508;

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b) Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Automatic Electrical Pressure Sensing Controls Including Mechanical Requirements, UL 60730-2-6; or

c) Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Automatic Electrical Air Flow, Water Flow and Water Level Sensing Controls, UL 60730-2-15.

21 Heating Elements

21.1 The voltage rating of a heating element employed in an appliance shall not be:

a) Less than 110 V if connected in a circuit in which the potential across the heating element is a nominal 120 V,

b) Less than 191 V if connected in a circuit in which the potential across the heating element is a nominal 208 V,

c) Less than 220 V if connected in a circuit in which the potential across the heating element is a nominal 240 V,

d) Less than 254 V if connected in a circuit in which the potential across the heating element is a nominal 277 V,

e) Less than 440 V if connected in a circuit in which the potential across the heating element is a nominal 480 V, and

f) Less than the voltage rating of the circuit if connected in a circuit in which the potential across the heating element is more than 480 V.

21.2 A sheathed heating element in an appliance shall comply with the requirements in the Standard for Sheathed Heating Elements, UL 1030, as applicable.

22 Capacitors

22.1 A capacitor provided as a part of a capacitor motor or a capacitor connected across the line, such as a capacitor for elimination of radio-frequency interference, shall be housed within an enclosure or container that will protect the plates against mechanical damage and that will prevent the emission of flame or molten material resulting from malfunction of the capacitor. The construction shall comply with one of the following:

a) The capacitor container or enclosure shall be of sheet steel not less than 0.020-in (0.51-mm) thick, or shall be constructed to afford equivalent protection.

b) A capacitor having a sheet steel container or enclosure thinner than 0.020 in or of other material shall be mounted in an enclosure that houses other parts of the appliance and that is acceptable for the enclosure of live parts.

22.2 If a capacitor that is not part of a permanent-split-capacitor motor or a part of a capacitor-start motor is connected in an automatic appliance so that capacitor malfunction 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 the likelihood of such a condition.

22.3 The total capacitance of capacitors connected from one side of the line to the frame or enclosure of an appliance shall not permit the flow of more than 5 mA in the grounding conductor.

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22.4 The voltage rating of a capacitor, other than a motor-starting capacitor, shall not be less than the maximum steady-state potential to which the capacitor is subjected during operation of the appliance.

23 Spacings

23.1 The spacings at wiring terminals shall not be less than the values specified in the Table 23.1. See 11.1.2 and 23.9.

Table 23.1
Spacings at wiring terminals

Potential involved, V	Minimum spacings, in (mm)					
	Between wiring terminals of opposite polarity, and between a wiring terminal and a dead metal part other than the enclosure				Between a wiring terminal and the enclosure, through air or over surface	
	Through air		Over surface			
250 or less	1/4	(6.4)	3/8	(9.5)[a]	1/2	(12.7)[a]
More than 250	3/8	(9.5)	1/2	(12.7)[b]	1/2	(12.7)[b]

[a] A spacing of not less than 1/4 in is acceptable if a terminal box is provided for field-wiring connections and the box is integral with the motor.

[b] A spacing of not less than 3/8 in through air and over surface is acceptable at wiring terminals in a wiring compartment or terminal box if the compartment or box is integral with a motor.

23.2 Except as noted in 23.5 and 23.6, the spacings between uninsulated live parts of opposite polarity, and between an uninsulated live part and a dead metal part, other than at wiring terminals, in a motor circuit, or inside a motor, shall not be less than the values specified in Table 23.2. If an uninsulated live part is not rigidly fixed in position by means other than friction surfaces, or if a movable dead metal part is in proximity to an uninsulated live part, the construction shall be such that the acceptable minimum spacing will be maintained. See 23.9.

Table 23.2
Spacings at other than wiring terminals, in a motor circuit, or inside a motor

Potential involved, V	Minimum through air or over surface spacings, in (mm)	
	in	(mm)
0 – 125	1/16	(1.6)
126 – 250	3/32	(2.4)[a]
251 – 600	1/4	(6.4)

[a] Spacings not less than 1/16 in are acceptable at a heating element.

23.3 Except as noted in 23.1, 23.4, 23.5 and 23.6, the spacing between uninsulated live parts of opposite polarity, and between an uninsulated live part and a dead metal part in a motor circuit but not including the inside of the motor, shall not be less than the value specified in Table 23.3. If an uninsulated live part is not rigidly fixed in position, by means other than friction between surfaces, or if a movable dead metal part is in proximity to an uninsulated live part, the construction shall be such that the minimum acceptable spacing will be maintained. See 23.9.

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Table 23.3
Spacings in a motor circuit other than inside the motor

Potential involved, V	Minimum spacings, in (mm)							
	Appliance employing a motor having a diameter 7 in (178 mm) or less[a]				Appliance employing a motor having a diameter more than 7 in (178 mm) through 11 in (279 mm)[a]			
	Over surface		Through air		Over surface		Through air	
0 – 125	3/32	(2.4)[b]	3/32	(2.4)[b]	1/4	(6.4)[c]	1/8	(3.2)[c]
126 – 250	3/32	(2.4)	3/32	(2.4)	1/4	(6.4)[c]	1/4	(6.4)[c]
251 – 600	1/2	(12.7)[c]	3/8	(9.5)[c]	1/2	(12.7)[c]	3/5	(9.5)[c]

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

[b] For an appliance only employing motors rated 1/3 horsepower (249 W output) or less, these spacings may be not less than 1/16 in (1.6 mm).

[c] A spacing of not less than 3/32 in over surface and through air between film-coated wire, rigidly supported and held in place on a coil, and a dead metal part is acceptable.

23.4 A motor circuit may be judged under the requirements in 23.2 if the only motor load is a timer motor and if investigation of the motor circuit shows that such spacings are acceptable.

23.5 The spacing requirements specified in 23.3 do not necessarily apply to the inherent spacings of a component of the appliance, such as a snap switch. Such spacings shall comply with the requirements for the component in question if they are smaller than the values specified in Table 23.3.

23.6 At closed-in points, such as the screw-and-washer construction of an insulated terminal mounted in metal, a spacing shall not be less than 3/64 in (1.2 mm). Within a thermostat, other than at the contacts, the spacing between uninsulated live parts on opposite sides of the contacts shall not be less than 1/32 in (0.8 mm) through air and 3/64 in over the surface of insulating material when the construction is such that the spacings will be maintained permanently.

23.7 Enameled wire is regarded as an uninsulated live part when spacings are being considered.

23.8 In applying 20.5 and 35.1 and Table 23.3 to a motor not rated in horsepower, use is to be made of the appropriate table of the National Electrical Code, ANSI/NFPA 70, that gives the relationships between horsepower and full-load currents for motors.

23.9 At terminal screws and studs to which connections may be made in the field by means of wire connectors, eyelets, etc., as described in 11.1.2, the spacings shall not be less than those specified in Table 23.3 when the connectors, eyelets, etc. are in such position that minimum spacings – opposite polarity and to dead metal – exist.

23.10 An insulating liner or barrier of vulcanized fiber or similar material employed in lieu of spacings shall not be less than 1/32-in (0.8-mm) thick; and shall be located or of such material so that it will not be adversely affected by arcing.

Exception: Fiber not less than 1/64-in (0.4-mm) thick may be used in conjunction with an air spacing of not less than 50 percent of the spacing required for air alone.

23A Alternative Spacings – Clearances and Creepage Distances

23A.1 As an alternative to the spacing requirements specified in Spacings, Section 23, spacings shall be in accordance with the requirements in the Standard for Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment, UL 840, except:

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a) Between field wiring terminals; and

b) Between uninsulated current-carrying parts and a metal enclosure.

23A.2 Appliances shall be considered Overvoltage Category 2 as specified in the Standard for Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment, UL 840.

23A.3 Printed wiring boards constructed of Type XXXP, XXXPC, G-10, FR-2, FR-3, FR-4, FR-5, CEM-1, CEM-3, GPO-2, or GPO-3 industrial laminates in accordance with the Standard for Polymeric Materials – Industrial Laminates, Filament Wound Tubing, Vulcanized Fiber, and Materials Used in Printed Wiring Boards, UL 746E, shall be considered to have a minimum comparative tracking index of 100 as specified in the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A.

23A.4 The internal microenvironment of the enclosure shall be considered Pollution Degree 2 as specified in the Standard for Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment, UL 840, unless steps have been taken to achieve Pollution Degree 1 at a creepage distance by encapsulation or hermetic sealing. For printed wiring boards, coatings may be used to achieve Pollution Degree 1 provided that the coating satisfies the performance criteria specified in UL 840, and is used within the approved thickness.

23A.5 With respect to 23A.4, Pollution Degree 1 is considered an environment where no pollution or only dry, nonconductive pollution occurs. The pollution has no influence. Pollution Degree 2 is considered an environment where normally only nonconductive pollution occurs, except occasionally a temporary conductivity caused by condensation is to be expected.

23A.6 In order to evaluate clearances where the levels of overvoltage are controlled, control of overvoltage shall be achieved by providing an overvoltage device or system as an integral part of the appliance. The appliance shall be evaluated for the rated impulse withstand voltage specified in the Standard for Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment, UL 840.

23A.7 An overvoltage control having exposed low-voltage outputs shall be provided with a mechanism to indicate the malfunction of the overvoltage-protective control or system where the control outputs:

a) May be contacted during normal operation or user servicing; and

b) Have clearances between the low-voltage circuit and an overvoltage as specified in the Standard for Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment, UL 840, and protected line-voltage circuits that have been evaluated in accordance with Clearance B requirements as specified in UL 840.

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24 Grounding

24.1 In an appliance intended to be permanently connected to the power supply by a metal-enclosed wiring system, such as rigid metal conduit or armored cable, all exposed dead metal parts that may become energized and all dead metal parts inside the enclosure that are exposed to contact during any user-servicing operation and that may become energized shall be conductively connected to the point of attachment of the wiring system.

24.2 In an appliance intended to be permanently connected to the power supply by means other than a metal-enclosed wiring system, such as nonmetallic-sheathed cable:

a) An equipment-grounding terminal or lead shall be provided, and

b) All exposed dead metal parts that may become energized and all dead metal parts inside the enclosure that are exposed to contact during any user-servicing operation and that may become energized shall be conductively connected to such terminal or lead.

24.3 A power-supply cord of an appliance shall include an equipment-grounding conductor.

Exception: A portable appliance with a system of double insulation as mentioned in 24.6 is not required to comply.

24.4 An equipment-grounding conductor of a flexible power-supply cord:

a) Shall be provided with insulation having an outer surface that is green with or without one or more yellow stripes,

b) Shall be connected to the grounding blade of an attachment plug of the grounding type, and

c) Shall be conductively connected to all exposed dead metal parts that may become energized and all dead metal parts within the enclosure that are exposed to contact during any user servicing operation and that may become energized.

Exception: The grounding conductor of the power-supply cord of a nonautomatic appliance may be connected to the motor frame only – and not to the enclosure of the appliance – provided:

a) The only electrical components of the appliance are the motor and power-supply cord;

b) The power-supply cord enters the motor without being attached to or passing through any other part of the appliance; and

c) The motor is mounted in resilient mounting rings that provide between the frame of the motor and all other dead metal parts of the appliance:

1) A spacing of not less than 1/8 in (3.2 mm), and

2) Insulation resistance of not less than 50,000 ohms.

24.5 With reference to the requirements in 24.4(c), the connection shall be made by a screw or other means not likely to be removed during servicing not involving the power-supply cord. Solder alone shall not be used for making this connection.

24.6 A portable, cord-connected appliance intended to be used on a circuit operating at not more than 150 V to ground may be provided with a system of double insulation in lieu of a means for grounding.

24.7 An appliance provided with a system of double insulation shall not be provided with a means for grounding.

24.8 A 2-wire appliance marked 120/240 V or otherwise marked to indicate that it is to be connected to a circuit operating at 150 V or less to ground may be double insulated.

24.9 If an appliance is intended to be grounded and is provided with means for separate connection to more than one power supply, each such connection shall be provided with a means for grounding.

25 Overflow Pipes

25.1 An overflow pipe or the like shall be secured if the flow of liquid from the pipe can be misdirected so as to wet uninsulated live parts, enameled wiring, or electrical insulation.

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25.2 The acceptability of the means of securing an overflow pipe or the like shall be judged with respect to its reliability, suitability, and the likelihood of its being defeated.

PROTECTION AGAINST RISK OF INJURY TO PERSONS

26 Automatic Restarting of Motor

26.1 If an automatically reset protective device is employed in an appliance, automatic restarting of the motor shall not result in a risk of injury to persons.

26.2 The requirement in 26.1 necessitates the use of an interlock in the appliance if moving parts or the like may cause injury to persons upon automatic restarting of the motor.

27 Stability

27.1 Freestanding appliances

27.1.1 An appliance other than a fixed or wall-insert appliance shall be tested as described in 27.1.2. The appliance shall not overturn.

Exception: An appliance that is intended to be fastened to the floor need not be subjected to the tests in this section.

27.1.2 The empty appliance is to be placed on a flat surface inclined at an angle of 10 degrees from the horizontal. The loading door of the appliance is to be in the position most likely to cause the appliance to tip over. Casters, wheels, and other supporting means are to be positioned so as to result in the least stability. If adjustable feet are provided, they are to be adjusted to the same height.

27.2 Appliance stands

27.2.1 Hardware

27.2.1.1 An appliance stand shall contain all of the hardware needed to assemble the stand and to install the appliance on it.

Exception: A readily available part, such as a nail, a screw, or a piece of lumber, need not be provided if the instructions accompanying the kit include a description of the part and specify how the part is to be used.

27.2.2 Overturning

27.2.2.1 When installed as intended, the appliance shall be reliably attached to the stand assembly and shall not overturn when tested as described in 27.2.2.2 and 27.2.2.3.

27.2.2.2 An appliance/stand assembly that has been assembled as specified in the instructions is to be placed on a flat surface inclined at an angle of 10 degrees from the horizontal. A loading door is to be in the position most likely to cause the appliance to tip over. If the stand permits stacking of a dryer on top of a washing machine, the test is to be conducted both with and without the top appliance installed. The appliance stand assembly is to be rotated on the inclined surface so that all positions are evaluated. The assembly is to be blocked to prevent sliding, and the appliances are to be loaded as described in 30.3 with test cloths that are wet until they have absorbed a weight of water equal to the dry weight of the cloths, or unloaded, whichever results in the more severe test.

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27.2.2.3 An appliance/stand assembly is to be assembled in accordance with the instructions. A fastener provided for anchoring the stand to a wall is not to be used if a tool is required to attach the appliance or the stand to the fastener or the fastener to the wall. The assembly is to be subjected to the tests specified in (a) and (b). If the stand permits stacking of a dryer on top of a washing machine, the tests are to be conducted both with and without the bottom appliance installed. The appliance or appliances are to be either loaded as described in 30.3 with test clothes that are wet until they have absorbed a weight of water equal to the dry weight of the cloths, or unloaded, whichever results in the most severe test.

a) A 50-lb (22.6-kg) weight is to be suspended from the front of the upper appliance or from the front edge of the loading door. The weight and the loading door are to be positioned to produce the most severe loading condition. The weight is to remain suspended for 1 min.

b) A hollow rubber ball 75 to 78 cm in circumference is to be filled with sand to a total weight of 20 lb (9.1 kg). The weight is to fall from rest as a pendulum through the distance necessary to strike with an impact of 30 ft•lbf (40.7 J). The ball is to strike the appliance-stand assembly 5 ft (1.5 m) above floor level or at the top of the upper appliance, whichever is less. All four sides of the appliance-stand assembly are to be subjected to the impact.

28 Sharp Edges, Projections, and Moving Parts

28.1 An enclosure, an opening, a frame, a guard, a knob, a handle, or the like shall not be sufficiently sharp to cause a risk of injury to persons in normal use and routine user-maintenance of the appliance.

28.2 A moving part, such as a rotor of a motor, a pulley, a belt, and a gear, shall be enclosed or guarded to reduce the risk of unintentional contact by persons.

29 Centrifugal-Extraction Appliances

29.1 A centrifugal-extraction appliance or combination washer-dryer shall be provided:

a) With a means to prevent opening of the clothes loading-and-unloading door during the spin portion of the cycle; or

b) With an interlock that, when the clothes loading-and-unloading door is opened 2 in (50 mm) or more during the spin portion of the cycle, will:

1) Remove the driving force from the clothes basket, and

2) Stop the movement of all accessible moving parts within 7 s with the appliance loaded as described in 30.3.

29.2 An appliance is considered to comply with the requirements in 29.1 if a deliberate action is required to defeat the lid-locking mechanism or basket-braking means. A deliberate action includes disconnecting the power-supply cord, manually advancing the timer to the end of the complete cycle, pulling the timer knob out, or manually rotating a rotary switch. In addition to defeating the lid-locking mechanism or basket-braking means, the deliberate action must also remove the driving force from the basket. Other than as noted in 29.3, pushing the timer knob in, actuating a toggle switch, or actuating any type of push-to-operate switch is not considered a deliberate action.

29.3 For a front-loading appliance with the controls in a console located at the rear of the top surface of the appliance, pushing the timer knob in, actuating a toggle switch, or actuating any type of push-to-operate switch is considered a deliberate action.

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29.4 If an interlock provided on a top-loading appliance is not recessed or guarded to reduce the risk of inadvertent operation when the lid is opened, a secondary function control, manually operated from the outside of the appliance, shall be provided.

29.5 With reference to 29.1(b), the basket shall not rotate until the clothes loading-and-unloading door is closed to less than 2 in (50 mm) of opening. A front-loading appliance shall not operate until a secondary function control, manually operated from outside the appliance, is actuated.

29.6 With reference to 29.1(b), a brake mechanism or other means that is employed to stop the rotation of the basket shall be subjected to a 6000-cycle endurance test consisting of starting and stopping the basket after it has reached its maximum speed or rotation. The test shall be conducted at the rate of three times an hour; however, with the concurrence of those concerned, a faster rate may be employed. A mechanical load twice that of the maximum dry-weight load specified by the manufacturer shall be equally distributed around the periphery of the basket. The construction complies with the requirements if, after 6000 cycles of operation, the stopping time is not more than 10 s.

29.7 In a front-loading appliance, a means shall be provided to prevent the flow of water into the tub under normal conditions unless the door is closed.

29.8 In a front-loading appliance, if the normal at-rest level of water with a clothes load as prescribed in 30.3 extends above the lower rim of the door opening, a means shall be provided for latching the door in the closed position until the water has been drained to the lower rim of the door opening.

29.9 A solenoid or similar component that is employed to hold the door latched in the closed position shall be subjected to a 6000-cycle endurance test consisting of energizing and de-energizing the component. There shall be no malfunction of the locking means or component as a result of this test.

29.10 If opening and closing the door affects mechanical operation of the component, the test is to be conducted in the normal manner. The test is to be conducted at the rate of six times per minute unless a slower rate is dictated by design factors inherent in the appliance.

PERFORMANCE

30 General

30.1 The fabric used for tests is to be bleached, preshrunk cotton suiting, warp 55 threads per in (25.4 mm) and filling 48 threads per in (25.4 mm). Individual cloths are to be 24 in (610 mm) by 36 in (915 mm), double hemmed to a size of 22 in (560 mm) by 34 in (865 mm). A small number of smaller cloths – 12 in (305 mm) by 12 in (305 mm), double hemmed to a size of 10 in (255 mm) by 10 in (255 mm) – may be used if necessary to make the total weight of cloth correct.

30.2 Unless otherwise noted in the individual requirements, all tests are to be conducted with the appliance connected to a supply circuit of rated frequency, and having a potential of:

a) 120 V, for an appliance rated from 110 V to 120 V, inclusive;

b) 240 V, for an appliance rated from 220 V to 240 V, inclusive; and

c) The maximum rated voltage of the appliance, for an appliance other than as mentioned in (a) or (b).

30.3 The test load is to:

a) Consist of cloths as described in 30.1, and

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b) Have a dry weight equal to the maximum load recommended by the manufacturer.

31 Input

31.1 When operated as described in 31.2, the current input to an appliance shall not be more than 110 percent of the marked rating.

31.2 To determine whether an appliance complies with the requirements in 31.1, it is to be connected to a supply circuit, as described in 30.2 and is to be loaded as described in 30.3. Only the steady-state current input during any condition of normal operation is to be measured – for example, washing, wringing, idling, etc.; the input during a period of acceleration is not to be measured.

32 Starting Current

32.1 When operated as described in 32.2, an appliance provided with a 15-A attachment plug shall start and operate normally without:

a) Tripping an overload protector provided as part of the appliance; or

b) Opening the fuse, when connected to a circuit protected by a 15-A fuse of other than the time-delay type.

Exception: A 15-A time-delay fuse may be employed provided the appliance is marked in accordance with 50.17.

32.2 To determine whether an appliance complies with the requirements in 32.1, the appliance is to be connected to a supply circuit as described in 30.2. The circuit is to be protected by a fuse as specified in 32.1. The appliance is to be loaded as described in 30.3 and is to be at room temperature at the beginning of the test. The appliance is to be started three times. Each start of the appliance is to be made under conditions representing the beginning of normal operation – the beginning of the normal operating cycle in the case of an automatic appliance. The motor of the appliance is to be allowed to come to full speed after each start, and to come to rest between successive starts.

33 Insulation Resistance

33.1 An appliance employing insulating material that may be adversely affected by moisture under conditions of normal use shall be conditioned for 24 h in moist air having a relative humidity of 85 ±5 percent at a temperature of 32 ±2° C (90 ±4° F). After the conditioning the appliance shall have an insulation resistance of not less than 50,000 ohms between live parts and interconnected dead metal parts.

33.2 Ordinarily, insulation resistance is to be measured by means of a high-resistance voltmeter using a 250-V, direct-current circuit.

34 Physical Properties of a Liquid Seal or Diaphragm

34.1 If the deterioration or breakage of a liquid seal or the like could increase the risk of electric shock, the seal or the like shall be investigated to determine that it is resistant to deterioration from the liquid intended to be used in contact with that component.

34.2 The test procedure for determining whether a component complies with the requirement in 34.1 depends upon the material of which it is composed, its size and shape, the mode of application in the appliance, and other factors. The test procedure may include visual inspection, for determination of

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cracks, deformation, and the like, after artificial aging, as well as comparison of hardness, tensile strength, and elongation before and after artificial aging.

34.3 With reference to 34.1 and 34.2, a component of rubber or a rubber like material, when tested to compare its tensile strength and elongation before and after artificial aging, is acceptable if these properties are found to be not less than the minimum corresponding values specified in Table 34.1, corresponding to the temperature of the component during the temperature test.

Table 34.1
Artificial-aging test for rubber and rubber-like materials

Temperature of component during temperature test		Artificial-aging procedure[a]	Minimum acceptable percent of value obtained for unaged samples[b]	
°C	°F		Tensile strength	Elongation
60 or less	140 or less	Aged in air oven for 70 h at 100 ±2°C (212 ±3.6°F)	60	60
61 – 75	141 – 167	Aged in air oven for 168 h at 100 ±2°C (212 ±3.6°F) at atmospheric pressure	50	50
76 – 90	168 – 194	Aged in full-draft, air-circulating oven for 168 h at 121.0 ±1.0°C (249.8 ±1.8°F)	50	50
91 – 105	195 – 221	Aged in full-draft, air-circulating oven for 168 h at 136.0 ±1.0°C (276.8 ±1.8°F)	50	50
	c	Immersion for 168 h in boiling solution of commercial washing detergent – 25 g/L of water – and bleach – 50 mL/L of water[d]	50	50

[a] Each procedure is to be performed on three samples.

[b] Tensile strength and elongation are to be determined using the test methods and apparatus described in ASTM D412-92.

[c] All samples regardless of temperature are to be subjected to this test.

[d] AHAM detergent, or any other detergent having these properties, is an acceptable laundry detergent. Commercially available liquid chlorine bleaches for household use containing 5 ± 1 percent of sodium hypochlorite is acceptable.

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35 Dielectric Voltage Withstand

35.1 An appliance shall withstand for 1 min without breakdown the application of a DC potential or a 60-Hz essentially sinusoidal potential between live parts and dead metal parts or between live parts of opposite polarity for a test on a capacitor as mentioned in (c). The test potential shall be:

a) 1,000 V AC or 1400 V DC for an appliance employing a motor rated 1/2 horsepower (373 W) or less and 250 V or less. See 23.8.

b) 1,000 V AC plus twice rated voltage or 1400 V DC plus 2.8 times rated voltage for an appliance employing a motor rated more than 1/2 horsepower or more than 250 V. See 23.8.

c) 1,000 V AC, or 1,000 V AC plus twice the rated voltage – depending upon the value of the test potential applied to the appliance as a whole – for a radio-frequency-interference-elimination or arc-suppression capacitor.

35.2 To determine whether an appliance complies with the requirements in 35.1, the appliance is to be tested by means of a 500-V-A or larger-capacity transformer – the output voltage of which is essentially sinusoidal and can be varied. The applied potential is to be increased from zero until the required test level is reached, and is to be held at that level for 1 min. The increase in the applied potential is to be a uniform rate and as rapid as is consistent with its value being correctly indicated by a voltmeter. The appliance is to be at the maximum operating temperature reached in normal use.

36 Temperature

36.1 An appliance shall be tested as described in 36.4 – 36.12 and shall not:

a) Reach a temperature, at any point, high enough to cause a risk of fire or to damage any material used in the appliance, or

b) Exceed the temperature rises specified in Table 36.1.

36.2 A motor-protective device shall not operate during the temperature test described in 36.4 – 36.12.

36.3 A thermal- or overcurrent-protective device shall not open the circuit during the temperature test described in 36.4 – 36.12.

36.4 An appliance that has a single frequency rating is to be tested at that frequency. An appliance rated 50 – 60 Hz is to be tested on 60-Hz alternating current.

36.5 All values for temperature rises in Table 36.1 are based on an assumed ambient temperature of 25°C (77°F); however, tests may be conducted at any ambient temperature within the range of 10 – 40°C (50 – 104°F).

36.6 A temperature is considered to be constant when three successive readings taken at intervals of 10 percent of the previously elapsed duration of the test, but not less than 5 min, indicate no change.

36.7 Ordinarily, coil or winding temperatures are to be measured by thermocouples unless the coil is inaccessible for mounting these devices – for example, a coil immersed in sealing compound – or unless the coil wrap includes thermal insulation, such as asbestos, or more than two layers – 1/32 in (0.8 mm) maximum – of cotton, paper, rayon, or the like. For a thermocouple-measured temperature of a coil of an alternating-current motor other than a universal motor (10 and 13 in Table 36.1) having a frame diameter (see Note c of Table 36.1) of 7 in (178 mm) or less, the thermocouple is to be mounted on the integrally applied insulation of the conductor.

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Table 36.1
Maximum acceptable temperature rises

Materials and components		Degrees C	Degrees F
1.	Varnished-cloth insulation	60	108
2.	Fuses		
	a. Class G, J, L, T, and CC		
	Tube	100	180
	Ferrule or Blade	85	153
	b. Others[g]	65	117
3.	Fiber employed as electrical insulation	65	117
4.	Wood or other combustible material, including the inside surfaces of the test enclosure and the surface supporting the appliance	65	117
5.	Class 105 insulation systems on coil windings of an a-c motor having a frame diameter of more than 7 in (178 mm), of a d-c motor, and of a universal motor[a,b,c]:		
	a. In an open motor:		
	Thermocouple method	65	117

Table 36.1 Continued on Next Page

Table 36.1 Continued

Materials and components	Degrees C	Degrees F
Resistance method	75	135
b. In a totally enclosed motor:		
Thermocouple method	70	126
Resistance method	80	144
6. Phenolic composition employed as electrical insulation or as a part the deterioration of which could result in a risk of fire or electric shock[d]	125	225
7. Insulated wire and cord[d]	35	63
8. At any point within a terminal box or wiring compartment of a permanently connected appliance	35	63
9. Capacitor:		
Electrolytic[e]	40	72
Other types[f]	65	117
10. Class 105 insulation systems on coil windings of an a-c motor having a frame diameter of 7 in or less, not including a universal motor[a,b,c]		
a. In an open motor:		
Thermocouple or resistance method	75	135
b. In a totally enclosed motor:		
Thermocouple or resistance method	80	144
11. Class 130 insulation systems, other than as specified in items 12 and 13[a]:		
Thermocouple method	85	153
12. Class 130 insulation systems on coil windings of an a-c motor having a frame diameter of more than 7 in, of a d-c motor and of a universal motor[a,b,c]:		
a. In an open motor:		
Thermocouple method	85	153
Resistance method	95	171
b. In a totally enclosed motor:		
Thermocouple method	90	162
Resistance method	100	180
13. Class 130 insulation systems on coil windings of an a-c motor having a frame diameter of 7 in or less not including a universal motor[a,b,c]:		
a. In an open motor and on vibrator coils:		
Thermocouple or resistance method	95	171
b. In a totally enclosed motor:		
Thermocouple or resistance method	100	180
14. Class 155 insulation systems on coil windings of an a-c motor having a frame diameter of 7 in or less, not including a universal motor[c]:		
In an open motor:		
Thermocouple or resistance method	120	216

[a] At a point on the surface of a coil where the temperature is affected by an external source of heat, the temperature rise, as determined by means of a thermocouple, may be more than the maximum acceptable temperature rise specified in this table provided the temperature rise as determined by the resistance method is not more than that specified. The temperature rise as determined by means of a thermocouple may be more than the specified value by:

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Table 36.1 Continued

Materials and components	Degrees C	Degrees F
Item	**Additional Temperature Rise**	
Subitem a, item 5	15°C (27°F)	
Subitem a, item 10	5°C (9°F)	
Subitem a, item 12	20°C (36°F)	
Subitem a, item 13	10°C (18°F)	

[b] For an automatic appliance, the maximum acceptable temperature rises may be more than the values specified in this table for short intervals during the cycle provided an analysis indicates that the insulation systems will not be adversely affected by the higher temperature. See 36.8 and 36.9.

[c] This is the diameter measured in the plane of the laminations of the circle circumscribing the stator frame, excluding lugs, fins, boxes, etc., used solely for motor mounting, cooling, assembly, or connection.

[d] Phenolic composition and other insulation that has been investigated and found acceptable for use at higher temperatures may be used at those temperatures.

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

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

[g] These limitations do not apply to compounds and components that have been investigated and found to be acceptable for use at higher temperatures.

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36.8 For a motor employing a Class 105 or Class 130 insulation system, the conditions under which the analysis mentioned in Note b of Table 36.1 may be undertaken are:

a) The appliance or combination washer-dryer normally follows a predetermined duty cycle automatically scheduled by the appliance control; it is not intended that the user govern the behavior of the appliance, other than to de-energize it, after the normal cycle of operation has been initiated.

b) No temperature rise is more than 115°C (207°F) for a Class 105 insulation system or 140°C (284°F) for a Class 130 insulation system regardless of the duration of such temperature.

c) The properties of the insulation used are known over a wide range of temperatures.

36.9 With reference to Note b of Table 36.1, for a motor employing a Class 105 or Class 130 insulation system, the analysis to determine whether insulation systems will be adversely affected by higher temperatures is to be conducted as follows:

a) The values of motor winding temperatures obtained during one complete cycle of operation are to be plotted using the temperatures as ordinates and the times as abscissas, and the curve is to be drawn.

b) The axis of abscissas is to be divided into intervals by erecting ordinates at equally spaced points. The number of such points is to be adequate to represent clearly all significant variations represented by the curve.

c) From the curve, the maximum value of temperature for each interval is to be determined; and from each maximum-temperature value, the maximum-temperature rise for each interval is to be determined by subtracting the ambient temperature.

d) For each maximum-temperature rise, the value of expected percent of normal life is to be determined from Figure 36.1.

e) Each value of expected percent of normal life is to be divided by 100, and the reciprocal of this quotient is to be taken.

f) The sum of the reciprocals is to be divided by the number of intervals obtained in (b). If the result is less than unity, the insulation systems can be expected to have a life greater than normal, and are not considered to be adversely affected by the higher temperature. If the result is more than unity, the insulation systems are considered to be adversely affected by the higher temperature.

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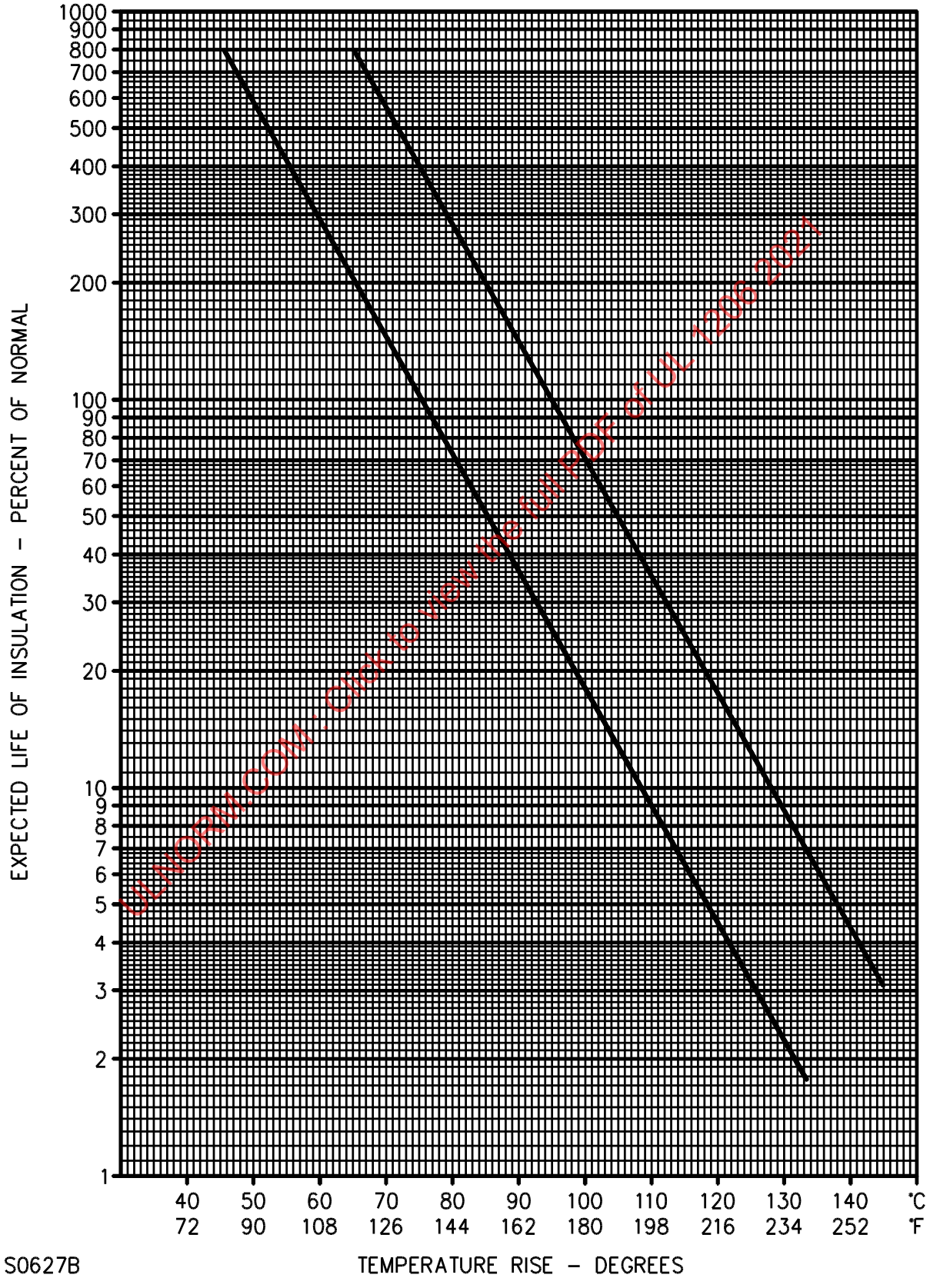
Figure 36.1

Expected life of insulation vs. temperature rise



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36.10 Thermocouples are to consist of wires not larger than 24 AWG (0.21 mm^2). However, when thermocouples are used in the determination of temperatures in connection with the heating of electrical devices, it is common practice to employ thermocouples consisting of 30 AWG (0.05 mm^2) iron and constantan wires and a potentiometer-type indicating instrument; and such equipment is to be used whenever referee temperature measurements by thermocouples are necessary.

36.11 A wall-insert or recessed appliance is to be mounted in an enclosure constructed of nominal 3/8-in thick plywood painted black; and is to consist of a bottom, a back, two sides, and a top. However, the top is to be omitted for the test on a recessed appliance if its construction is such that a counter top could not be used. Each of these areas is to be brought into an intimate contact with the corresponding surface of the appliance as the configuration of the appliance will permit. Temperatures are to be measured at points on each of these enclosing surfaces.

36.11.1 An appliance, other than a recessed or wall-insert appliance, shall be placed on a horizontal surface and located within an enclosure formed by three flat-black-painted, vertical surfaces of nominal 9.5 mm thick plywood. The spacings to each enclosure surface shall be as specified by the installation instructions. If no spacings are specified in the installation instructions, the enclosure surfaces shall be located as close to the back and both sides of the appliance as possible. The sides shall extend not less than 610 mm beyond the physical limits of the front and the top of the appliance. Temperatures are to be measured at points on the inside surface of the test enclosure.

36.12 An appliance intended to be operated in cycles is to be operated for successive operations of the machine through the complete cycle dictated by the control. If the appliance has more than one cycle selection or the cycle parameters may be adjusted, the complete program cycle(s) that results in the highest temperature rises shall be used. A 4-min interval is to be allowed between successive cycles to permit rearrangement of the clothes load. Hot water is to be supplied to the appliance at a temperature of 82°C (180°F), and both hot and cold water are to be supplied to the appliance at a pressure of 40 – 60 psi (276 – 414 kPa). If the appliance is intended to be drained to an opening above floor level, the outlet of the hose from the drain pump is to be 36 in (914 mm) above the floor on which the appliance rests. With the concurrence of those concerned, laundry detergent in accordance with the operating instructions may be added to the appliance at the beginning of each cycle.

36.13 An appliance intended to be operated continuously, including during automatic loading of clothes, is to be operated continuously at a duty cycle representative of normal use.

37 Switches

37.1 A switch or other device that controls a motor and that has not been investigated for the purpose for which it is used shall be tested as described in 37.2. As a result of the test, there shall be no electrical or mechanical malfunction or breakdown of the switch or other device, nor welding or undue pitting or burning of the contacts. The fuse in the grounding connection shall not open.

37.2 In a test to determine whether a switch or other control device complies with the requirement in 37.1, the appliance is to be connected to a grounded supply circuit as specified in 30.2. The rotor of the motor is to be locked. During the test, exposed dead metal parts of the appliance are to be connected to ground through a 3-A plug fuse, and the connection is to be such that any single-pole, current-rupturing device is in an ungrounded conductor of the supply circuit. If the appliance is intended for use on direct current, 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 switch or other device is to be operated for 50 cycles at a rate of not more than 10 cycles per minute; however, with the concurrence of those concerned, a faster rate of operation may be employed.

37.3 A switch or other device that controls a solenoid, relay coil, or the like and that has not been investigated for the purpose for which it is used shall be tested as described in 37.4. As a result of the test,

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there shall be no electrical or mechanical malfunction or breakdown of the switch or other device nor welding or undue pitting or burning of the contacts. The fuse in the grounding connection shall not open.

37.4 In a test to determine whether a switch or other control device complies with the requirement in 37.3, the appliance is to be connected to a supply circuit of rated frequency and 110 percent of maximum rated voltage. The load on the device under test is to be the same as that which it is intended to control in normal service. The device is to be operated for 50 cycles at a rate of not more than 10 cycles per minute; however, with the concurrence of those concerned, a faster rate of operation may be employed.

38 Overload Protection

38.1 When tested as described in 38.2 – 38.4, thermal or overcurrent protection provided for the motor of an appliance shall prevent:

a) Burnout of other than a totally enclosed motor, and

b) The windings of the motor from exceeding any of the temperatures specified in Table 17.1.

38.2 To determine whether an appliance complies with the requirement in 38.1, the appliance is to be connected to a circuit protected by a time-delay fuse having a current rating of at least 30 A. If the appliance is rated 125 V or less and if a 30-A fuse is used, it is to be a plug fuse.

38.3 The appliance is to be tested under locked-rotor conditions, with the applied voltage as specified in 30.2. The test is to be conducted with the appliance at room temperature or at its normal operating temperature, whichever results in higher motor temperatures.

38.4 The duration of the test of an appliance is to be in accordance with the normal operation of timer switches and other limiting devices with which the appliance is equipped.

39 Flooding of Live Parts

39.1 Flooding as a result of deterioration or damage of a boot or diaphragm

39.1.1 To determine whether deterioration or damage of a boot, diaphragm, or the like of rubber or similar material will result in a risk of electric shock after conditioning as described in 39.1.2 or in 39.1.3 and 39.1.4, an appliance:

a) Shall not permit obvious wetting, as mentioned in 39.1.5 of any electrical component that is likely to occur during any such conditioning;

b) Shall comply with the dielectric voltage-withstand requirements in 35.1; and

c) Shall, when evaluated as described in 33.2, have an insulation resistance between current-carrying parts and exposed dead metal parts of not less than 50,000 ohms.

Exception: A boot or diaphragm that is acceptable when tested in accordance with the requirements in Physical Properties of a Liquid Seal or Diaphragm, Section 34 is considered to comply with this requirement.

39.1.2 To determine whether an appliance complies with the requirements in 39.1.1, the appliance is to be leveled and water is to be supplied to it at a temperature of 82° C (180° F). The appliance is to be operated through one complete cycle of normal operation with the boot, diaphragm, or the like removed; or it is to be conditioned as described in 39.1.3 and 39.1.4. After conditioning as described in this paragraph or in 39.1.3 and 39.1.4, it is to be tested for compliance with the requirements in 39.1.1.

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39.1.3 To determine whether an appliance complies with the requirements in 39.1.1, the appliance is to be leveled and operated through one complete cycle of normal operation, after which, the boot, diaphragm, or the like is to be removed. A solution of 5 g of a low-sudsing detergent per liter of water is to be placed in the vessel described in 39.1.4, and maintained at the maximum at-rest level of the water and clothes load in the appliance during operation. The free end of the flexible tube, pointed in any direction, is to be held at points within the body enclosed by the outer surface of the boot, diaphragm, or the like when in position.

39.1.4 The vessel mentioned in 39.1.3 is to be flat-bottomed, of any convenient dimensions, and is to have a 1/16-in (1.6-mm) diameter hole in the bottom. A tube of rubber or similar flexible material is to be attached to the bottom of the vessel beneath the hole. The tube is to have an inside diameter of 3/8 in (9.5 mm), and is to be of whatever length is necessary for conditioning as described in 39.1.3.

39.1.5 Obvious wetting signifies wetting by a stream, spray, or dripping of water on the component that obviously will be repeated during each flooding test, but does not signify wetting by random drops of water that may wet the component by chance.

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39.2 Flooding as a result of malfunction or breakdown of a timer switch or a float- or pressure-operated switch

39.2.1 To determine whether malfunction or breakdown of a timer switch, float- or pressure-operated switch, or the like will result in a risk of electric shock, after conditioning as described in 39.2.2 and 39.2.3, an appliance:

a) Shall not permit obvious wetting, as mentioned in 39.1.5, of any electrical component that is likely to occur during any such conditioning;

b) Shall comply with the dielectric withstand requirements in 35.1; and

c) Shall, when evaluated as described in 33.2, have an insulation resistance between current-carrying parts and exposed dead metal parts of not less than 50,000 ohms.

39.2.2 To determine whether an appliance complies with the requirements in 39.2.1, the appliance is to be connected to a water supply of the temperature and pressure specified in 36.12 and operated through one complete cycle of normal operation, after which the timer switch is to be defeated and the water-temperature-selector switch is to be placed in the position resulting in the maximum flow of water to the appliance. A low-sudsing detergent amounting to 5 g/L of water at the maximum level of fill during normal operation is to be placed in the tub, and the appliance is then to be filled in the intended manner. If no means is provided to prevent over-filling of the appliance, the fill is to be continued for an additional 15 min following the first evidence of overflow of the tub. If a float- or pressure-operated switch is provided to prevent over-filling, actuation of the fill switch to terminate the fill will also terminate the test. If both a timer and fill switch are provided, a second test is to be conducted as described above with the timer operating normally and with the fill switch defeated. After conditioning, the appliance is to be tested for compliance with the requirements in 39.2.1.

39.2.3 A rubber barrier or rim seal of a washer tub is not to be removed when a test is being conducted to simulate malfunction or breakdown of a timer switch or of a float- or pressure-operated switch.

40 Oversudsing

40.1 To determine whether oversudsing will result in a risk of electric shock, after conditioning as described in 40.2 and 40.3, an appliance:

a) Shall comply with the dielectric voltage-withstand requirements in 35.1; and

b) Shall, when evaluated as described in 33.2, have an insulation resistance between current-carrying parts and exposed dead metal parts of not less than 50,000 ohms.

40.2 To determine whether an appliance complies with the requirements in 40.1, the appliance is to be leveled prior to the test and is to be operated through one complete cycle of normal operation. This is to be followed by an additional cycle, with the selector switches set to give the maximum flow of water at the maximum temperature. A high-sudsing detergent is to be gradually added during the fill portion of the cycle or during the first 3 min of agitation in whatever amount is required to cause oversudsing. Oversudsing is considered to occur when the suds overflow the stationary tub, if possible, or come up and out of the loading opening or any other opening. After conditioning, the appliance is to be tested for compliance with the requirements in 40.1.

40.3 A rubber barrier or rim seal of a washer tub is not to be removed prior to the test.

41 Overflow of Auxiliary Reservoirs

41.1 Liquid overflowing from an auxiliary reservoir – such as a reservoir for bleach, a rinse additive, or a cleaning agent – shall not wet uninsulated live parts or enameled wire, and shall not wet electrical insulation that may be adversely affected by the liquid normally used in the reservoir.

41.2 To determine whether an appliance complies with the requirement in 41.1, water is to be poured into the reservoir through an orifice 3/8 in (9.5 mm) in diameter. The reservoir is to be filled to the level recommended by the manufacturer, if such level is plainly marked; otherwise, the reservoir is to be filled to maximum capacity. Additional water, equal to 50 percent of the volume just mentioned but not more than 1 pt (0.47 L), is then to be poured into the reservoir. Ordinarily, determination of whether uninsulated live parts have become wet as a result of the overflow is to be by means of visual inspection but this may be supplemented by an insulation-resistance test, a dielectric voltage-withstand test, or both if necessary.

41.3 Unless all live parts are located or protected so that they will not be subject to dripping if the reservoir fails, an auxiliary reservoir shall:

a) Be adequately resistant to corrosion from the liquid intended for use in it; and

b) Not develop cracks as a result of aging.

42 Strain Relief

42.1 When tested as described in 42.2, a strain-relief device shall withstand for 1 min, without displacement, a direct pull of 35 lbf (156 N) applied to the cord, with the connections within the appliance disconnected.

42.2 A 35-lb (16 kg) weight is to be suspended on the cord and supported by the appliance so that the strain-relief device will be stressed from any angle that the construction of the appliance permits. The strain relief is not acceptable if there is movement of the cord, at the point of disconnection of the conductors, to indicate that stress would have resulted on the connections.

43 Permanence of Marking

43.1 A pressure-sensitive label or a label secured by cement or adhesive shall comply with the applicable requirements for indoor use labels exposed to high humidity and occasionally to water specified in the Standard for Marking and Labeling Systems, UL 969.

43.2 If the labels are exposed in service to solutions, such as fabric softeners, bleach additives, detergents, or the like, three samples of the label applied to test surfaces as intended are to be

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conditioned for 24 h in a controlled atmosphere maintained at 23 ±2°C (73 ±4°F) and a relative humidity of 50 ±5 percent. The samples are then to be immersed for 48 h in a solution representative of service and maintained at the temperature the solution would attain in service, but not less than 23 ±2°C (73 ±4°F). Following the immersion, the labels are to be investigated in the same manner as labels subjected to the water immersion test described in UL 969.

44 Polymeric Materials

44.1 General

44.1.1 The requirements in 44.1 – 44.13 apply to polymeric materials, including thermoset materials, used as enclosures, functional parts, decorative parts, and liquid containers.

44.1.2 A test may be eliminated or modified if specimen testing, as part of another test program, indicates that the polymeric material is acceptable for the property being investigated.

44.1.3 A summary of the tests applicable to polymeric materials are identified in Table 44.1. The tests applicable to the particular polymeric part being evaluated are specified in Table 44.2. The tests applicable to a polymeric part that is subjected to a solution or solution vapor are specified in Table 44.3.

Table 44.1
Polymeric materials test summary

Test No.	Test
1	Long-term exposure, 44.2.
2	Immersion test No. 1 (1000 h, dilute solution), 44.3.
3	Immersion test No. 2 (1000 h, 100 percent solution), 44.3.
4	Immersion test No. 3 (168 h, dilute solution), 44.3.
5	Mold stress relief distortion (7 h), 44.4.
6	Horizontal burning; HB, 44.5.
7	Flammability, 44.6.
8	Resistance to impact, 44.7.
9	Crushing resistance, 44.8.
10	Hot-wire ignition, 44.9.
11	Thermal aging, 44.10.
12	Volume resistivity, 44.11.
13	Enclosure flammability – large mass consideration, 44.12.
14	High current arc resistance to ignition, 44.13.

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Table 44.2
Tests on a polymeric part

Group[a]	Description	Applicable test number[b]
1	A decorative part	6, 13[c,d]
2	A functional polymeric part subjected to a temperature of not more than 65°C (149°F) and not subjected to impact	5, 6, 13[c,d]
3	A functional polymeric part subjected to a temperature of not more than 65°C (149°F) and subjected to impact	5, 6, 8, 13[c,d]
4	A functional polymeric part subjected to a temperature of more than 65°C (149°F) and not subjected to impact	5, 6, 11[h], 13[c,d]
5	A functional polymeric part subjected to a temperature of more than 65°C (149°F) and subjected to impact	5, 6, 8, 11[h], 13[c,d]
6	A part serving as an enclosure or supplementary enclosure and subjected to a temperature of not more than 65°C (149°F)	5, 7[e,g], 8, 9[c], 10, 13 [c,d]
7	A part serving as an enclosure or supplementary enclosure and subjected to a temperature of more than 65°C (149°F)	5, 7[e,g], 8, 9[c], 10, 11[h], 13[c,d]
8	A part spaced less than 12.7 mm (1/2 in) through air or over surface from an uninsulated current-carrying part	14[f], 15

[a] If a polymeric part falls into more than one test group, separate samples shall be subjected to the tests required for each group.

[b] These requirements do not fully cover a plated plastic part if loss of bond strength between the plastic substrate and the metal coating can result in a reduction of electrical spacings, reduction in mechanical strength, or reduction in resistance to flammability. A plated plastic part shall be the subject of a separate investigation.

[c] These tests do not apply to an appliance readily movable from one place to another.

[d] This test shall be conducted only on an external part having a dimension greater than 6 ft or a projected surface area greater than 10 ft^2.

[e] An enclosure provided with a liner of vulcanized fiber, metal foil, or other material intended to reduce the flammability of the enclosure shall be tested with the liner in place and the flame shall be applied to the liner.

[f] Additional consideration shall be given to an appliance protected by an overcurrent device rated more than 30 A.

[g] Wash water tubs need only comply with Test No. 6 if the material for the lid complies with Test No. 7. A lid need only comply with Test No. 6 if the material of the wash water tub complies with Test No. 7.

[h] Materials used within its temperature index based on historical data or a long term thermal aging program need not be subjected to Test No. 11.

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44.2 Long-term exposure

44.2.1 A polymeric material, the deterioration of which could result in a risk of fire, electric shock, or injury to persons, shall be resistant to solutions to which it is exposed during normal use of the appliance.

44.2.2 The material is to be subjected to tensile strength and tensile impact energy tests conducted on specimens as described in 44.2.3. The average tensile strength and tensile impact energy of the conditioned specimens shall not be less than 50 percent of that of the as-received specimens for each condition.

44.2.3 Each specimen is to be approximately 8 in (203 mm) by 3 in (76 mm) having a thickness equal to the minimum thickness of the polymeric material as used in the part. The average tensile strength of five as-received specimens is to be determined as described in 44.2.4, and the average tensile impact energy of five as-received specimens is to be determined as described in 44.2.5. Additional specimens are to be subjected to the following conditioning:

a) For a part subjected to wash water, 30 specimens (10 for each period) are to be immersed for 30, 60, and 138 days at 180°F (82°C) in 2.5 percent by weight, aqueous laundry detergent solution.

b) For a part subjected to laundry bleach, 10 specimens are to be immersed for 1000 h at 212°F (100°C) in 100 percent bleach.

c) Forty (40) specimens measuring approximately 8 in by 3 in having a thickness equal to the minimum thickness of the polymeric material as used in the part are to be used. Twenty (20) of these specimens are to be cross-hatched with parallel lines scribed 1/16 in (1.6 mm) apart using a razor blade with an applied force of 1 lbf (4.45 N). Three groups of ten (10) specimens, each group consisting of five (5) cross-hatched and five (5) plain specimens, are to be immersed in laundry detergent and bleach solution at 180°F (82°C) for periods of 30, 60, and 138 days. The laundry detergent and bleach solution is to consist of 1.75 oz. (50 g) of non-concentrated powdered laundry detergent and 3 fl. oz. (100 ml) of bleach per 2.1 pints (1 L) of water.

44.2.4 After conditioning the materials as specified in 44.2.3 (a), (b), or (c), the tensile strength is to be determined in accordance with the Standard for Test Method for Tensile Properties of Plastic, ASTM D638, using Type I specimens.

44.2.5 After conditioning the materials as specified in 44.2.3 (a) or (b), the tensile impact energy is to be determined in accordance with the Standard for Test Method for Tensile-Impact Energy to Break Plastics and Electrical Materials, ASTM D1822, using Type S specimens.

44.3 Immersion

44.3.1 A polymeric part shall show no cracking, leakage, or deterioration, upon visual examination or reassembly into the appliance, that would result in a risk of fire, electric shock, or injury to persons when subjected to one of the following exposures in accordance with Table 44.3:

a) Test No. 1: Three samples of the complete assembly are to be immersed in a solution for 1000 h at a temperature 50°F (10°C) above that temperature to which the part is subjected, but not less than 128°F (70°C). The solution is to consist of 0.875 oz. (25 g) of powdered laundry detergent and 1.5 fl. oz. (50 ml) of laundry bleach per 2.1 pints (1 L) of water.

b) Test No. 2: Three samples of the complete assembly are to be immersed in one of the following solutions for 1000 h at a temperature 50°F (10°C) above that temperature to which the part is subjected, but not less than 128°F (70°C):

1) A 100 percent laundry bleach solution.

2) A saturated aqueous solution (the most concentrated solution that can persist in the presence of an excess of the solute) of a powdered laundry detergent at atmospheric pressure.

3) A solution of 100 percent concentration of any other agent under investigation.

c) Test No. 3: Three samples of the complete assembly are to be immersed in a solution for 168 h at a temperature 50°F (10°C) above that temperature to which the part is subjected, but not less than 128°F (70°C). The solution is to be 0.875 oz. (25 g) of powdered laundry detergent and 1.5 fl. oz. (50 ml) of laundry bleach per 2.1 pints (1 L) of water.

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Table 44.3
Immersion tests

Group[a]	Description	Applicable test number[b,c]
A	A part that serves as a wash-water tub	1
B[d]	A part that serves as a wash-water carrier, hose fitting, sump, pump drain valve, diverter valve, or the like	2
C	A part, such as a dispenser, subjected to concentrated detergents or other solutions	3
D	A part subjected to casual splashing of water or vapor or a part subjected to wash-water or vapor during intended operating conditions	4

[a] If a polymeric part falls into more than one test group, a separate sample shall be subjected to the test required for each group.

[b] These requirements do not fully cover a plated plastic part if loss of bond strength between the plastic substrate and the metal coating can result in a reduction of electrical spacings, reduction in mechanical strength, or reduction in resistance to flammability. A plated plastic part shall be the subject of a separate investigation.

[c] A complete assembly, consisting of the part to be evaluated and associated fittings, may need to be tested to evaluate resistance to liquid leakage.

[d] Tests for this group may be omitted if the part complies with Long Term Exposures, 44.2.

44.4 Mold stress-relief distortion

44.4.1 A polymeric part is to be tested as specified in the Mold Stress Relief Distortion Test in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. As a result of this test:

a) Spacings shall not be reduced to less than those specified in 27.1 – 27.2;

b) Current-carrying parts or internal wiring shall not be exposed as determined in accordance with 8.1 – 8.9;

c) There shall be no damage that would increase the risk of fire, electric shock, or injury to persons; and

d) A part exposed to liquid shall not crack or leak upon visual examination or reassembly into the appliance.

Exception: This test may be waived if the part is required to be subjected to the Thermal Aging Test, 44.13.

44.5 Horizontal burning; HB

44.5.1 A polymeric part shall comply with the Horizontal Burning Test; HB in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94. The test specimens may be flat stock of the thickness of the end use part or cut from the part.

44.6 Flammability

44.6.1 Specimens of a polymeric part are to be subjected to the tests specified in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, and shall have a flammability rating of 5VA or 5VB.

Exception: Materials not rated 5VA or 5VB may be tested in accordance with the 5-inch (127-mm) flame test in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C using parts molded from the polymeric material.

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44.7 Resistance to impact

44.7.1 A polymeric part is to be subjected to the impact test specified in 44.7.2. As a result of the impacts:

a) Spacings shall not be reduced to less than those specified in 27.1 – 27.2;

b) Current-carrying parts or internal wiring shall not be exposed as determined in accordance with 8.1 – 8.9; and

c) There shall be no damage that would increase the risk of fire, electric shock, or injury to persons.

44.7.2 Samples of the polymeric part shall be subjected to the Resistance to Impact Test described in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. Each sample is to be subjected to three impacts per surface at different points. The points chosen on the second and third samples are to be different from those chosen on the first sample.

Three samples are to be tested from each group as follows:

a) Group A is to be tested in as-received condition.

b) For Group B, the tests are to be performed on samples that have been subjected to Mold Stress-Relief Distortion, 44.4, and cooled to room temperature prior to the impact test.

c) For Group C, the tests are to be performed on samples that have been conditioned to the low temperature conditioning specified in UL 746C for indoor equipment. The samples are to be subjected to the impact while still cold.

Exception: If the size of the surface is such that the results of a second or third impact would be affected by previous impacts, only one impact is to be performed.

44.8 Crushing resistance

44.8.1 Three complete as received samples of the polymeric enclosure shall comply with the Crushing Resistance Test described in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. As a result of the test:

a) Spacings shall not be reduced to less than those specified in 27.1 – 27.2;

b) Current-carrying parts or internal wiring shall not be exposed as determined in accordance with 8.1 – 8.9; and

c) There shall be no damage that would increase the risk of fire, electric shock, or injury to persons.

44.9 Hot-wire ignition

44.9.1 A polymeric material shall have a performance level category (PLC) of 3 or less in accordance with the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A.

Exception: A polymeric material that complies with the Abnormal Overload Test in the Standard for Polymeric Materials– Use in Electrical Equipment Evaluations, UL 746C is acceptable.

44.10 Thermal aging

44.10.1 A polymeric part is to be tested as described in 44.10.2. As a result of the test:

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a) Spacings shall not be reduced to less than those specified in 27.1 – 27.2;

b) Current-carrying parts or internal wiring shall not be exposed as determined in accordance with 8.1 – 8.9;

c) A condition shall not be produced that would increase the risk of fire, electric shock, or injury to persons; and

d) A part exposed to liquids shall not crack or leak.

44.10.2 Three complete samples of the polymeric part are to be placed in an oven for 1000 h at the temperature specified in Table 44.4. The parts are to be removed from the oven, cooled to room temperature, and examined for compliance with 44.3.

Table 44.4
Temperatures for oven conditioning

Maximum operating temperature of polymeric enclosure part, °C (°F)		Oven temperature, °C (°F)
More than	Not more than	
65 (149)	75 (167)	85 (185)
75 (167)	85 (185)	95 (203)
85 (185)	95 (203)	105 (221)
95 (203)	–	a

[a] A polymeric part subjected to a temperature higher than 95°C (203°F) shall have a temperature index, based on historical data or a long-term thermal-aging program, that indicates its acceptability for use at the temperature involved. This part is to be the subject of a separate investigation.

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44.11 Volume resistivity

44.11.1 The resistance per unit volume (volume resistivity) of a polymeric material shall comply with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. The volume resistivity is to be determined in accordance with the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A.

44.12 Enclosure flammability – large mass consideration

44.12.1 The flame-spread rating of a large mass polymeric enclosure part shall not exceed 200 when tested as described in the Standard for Test for Surface Burning Characteristics of Building Materials, UL 723, or the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

44.13 High current arc resistance to ignition (HAI)

44.13.1 A polymeric material shall have a performance level category (PLC) of 2 or less in accordance with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

Exception: A polymeric material that complies with the End-Product Arc Resistance Test as specified in the requirements for High Current Arc Resistance to Ignition (HAI) in UL 746C are considered to comply with this requirement.

MANUFACTURING AND PRODUCTION TESTS

45 Plumbing System Leakage

45.1 The manufacturer shall determine, by a routine production-line test, that the plumbing system of each appliance produced does not leak. The test shall consist of filling the appliance with a sufficient amount of water and operating the appliance in a manner that will permit any leakage from the plumbing system to be observed.

46 Grounding Continuity

46.1 Each appliance that has a power-supply cord having a grounding conductor shall be tested, as a routine production-line test, to determine that grounding continuity exist between the grounding blade of the attachment plug and the accessible dead metal parts of the appliance that may become energized.

46.2 Any indicating device, such as an ohmmeter, a battery-and-buzzer combination, or the like, may be used to determine compliance with the requirement in 46.1.

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

47 Dielectric Voltage Withstand

47.1 Each appliance shall withstand without electrical breakdown, as a routine production-line test, the application of a DC potential or an AC potential at a frequency within the range of 40 – 70 Hz, between the primary wiring, including connected components, and accessible dead metal parts that are likely to become energized, and between primary wiring and accessible low-voltage – 42.4 V peak or less – metal parts, including terminals.

47.2 The production-line test shall be in accordance with either Condition A or Condition B of Table 47.1.

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Table 47.1
Production-line test conditions

Appliance rating, V	Condition A			Condition B		
	Potential, V		Time, s	Potential, V		Time, s
	AC	DC		AC	DC	
≤ 250	1000	1400	60	1200	1700	1
> 250 ≤ 600	1000+2V[a]	1400 + 2.8V[a]	60	1200+2.4V[a]	1700 + 3.4V[a]	1

[a] V = maximum marked voltage but not less than 240 V.

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

47.4 The test 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 a friction-fit knob, that would interfere with conducting the test need not be in place.

Exception No. 2: The test may be conducted before final assembly if the test represents that for the completed appliance.

47.5 An appliance employing a solid-state component that may be damaged by the dielectric potential may be tested before the component is electrically connected provided a random sampling of production each day is tested at the potential specified in Table 47.1. 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.

47.6 The test equipment shall include a transformer having a DC or an AC essentially sinusoidal output, a means of indicating the test potential, an audible or visual indicator of electrical breakdown, and either a manually reset device to restore the equipment after electrical breakdown or an automatic reject feature of any unacceptable unit.

47.7 If the output of the test-equipment transformer is less than 500 V-A, the equipment shall include a voltmeter in the output circuit to directly indicate the test potential.

47.8 If the output of the test-equipment transformer is 500 V-A or larger, the test potential may be indicated:

a) By a voltmeter in the primary circuit or in a tertiary-winding circuit,

b) By a selector switch marked to indicate the test potential, or

c) In the case of equipment having a single test-potential output, by a marking in a readily visible location to indicate the test potential.

When marking is used without an indicating voltmeter, the equipment shall include a positive means, such as an indicator lamp, to indicate that the manually reset switch has been reset following a dielectric breakdown.

47.9 Test equipment other than that described in 47.7 and 47.8 may be used if found to accomplish the intended factory control.

47.10 During the test, 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, etc. – having circuitry not subject to excessive secondary-voltage build-up in case of electrical breakdown during the test may be tested with a single-pole primary switch, if used, in the off position, or with 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: The primary switch is not required to be in the on position if the testing means applies full test potential between primary wiring and dead metal parts with the switch not in the on position.

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RATING

48 General

48.1 An appliance shall be rated in volts and in amperes; however, it may be rated in watts or kilowatts instead of amperes if the overall power factor is 80 percent or more. The number of phases shall be included in the ratings if the appliance is intended for connection to a polyphase circuit, and the ratings shall include the frequency – expressed in one of the following terms: hertz, Hz, cycles-per-second, cps, cycles/second, or c/s.

48.2 If an appliance includes an attachment-plug receptacle intended for use as a general-use outlet, the added load that the receptacle may impose on the appliance and its supply connections, but not less than 660 W or amperes, shall be included in the electrical ratings of the appliance.

48.3 The rating of an appliance that is fastened or otherwise secured at a specific location and is intended to be connected to a supply circuit protected by a 15-A or a 20-A overcurrent-protective device shall not exceed 50 percent of the supply-circuit current rating.

Exception: The rating may exceed 50 percent of the supply-circuit current rating provided the appliance is marked in accordance with 50.18.

MARKING

49 General

49.1 Other than as noted in 49.2, a cautionary marking that is required to be permanent shall be located on part that:

a) Would require the use of a tool for removal,

b) Cannot be removed without impairing the operation of the appliance, or

c) Would not be removed during normal servicing of the appliance.

49.2 A cautionary marking may be located on a front-panel that is removed for normal servicing if tools are required for the panel's removal.

49.3 A marking that is required to be permanent shall be molded, die-stamped, paint-stenciled; stamped or etched metal that is permanently secured; or indelibly stamped on pressure sensitive labels, secured by adhesive, that comply with the requirements for Permanence of Marking in Section 43. Ordinary usage, handling, storage, etc. of the appliance shall be considered in the determination of the permanence of the marking.

49.4 A cautionary marking intended to instruct the operator shall be legible and visible by the operator during normal operation of the appliance. A marking giving servicing instructions shall be legible and visible when such servicing is being performed.

49.5 A cautionary marking shall be prefixed by the word "Caution," "Warning," or "Danger" in letters not less than 1/8 in (3.2 mm) high. The remaining letters of such marking shall not be less than 1/16 in (1.6 mm) high.

49.6 A marking on a readily removable part is not acceptable.

50 Details

50.1 An appliance and a field-attached accessory intended to be used with the appliance shall each have a permanent, legible marking that will be readily visible after the appliance has been installed as intended – without the necessity of moving the appliance, if of the wall-insert type; and that includes:

a) The manufacturer's name, tradename, trademark, or other descriptive marking by which the organization responsible for the product can be identified – hereinafter referred to as the manufacturer's name;

b) The catalog number or the equivalent;

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