

UL 963

ISBN 0-7629-0173-X

Sealing, Wrapping, and Marking Equipment

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Underwriters Laboratories Inc. (UL)
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UL Standard for Safety for Sealing, Wrapping, and Marking Equipment, UL 963

First Edition, Dated November 18, 1997

Revisions: This Standard contains revisions through and including March 9, 2007.

Summary of Topics

Addition to UL 963 of Requirements for Conducting the Normal Temperature Test on Household Food Sealers.

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Text that has been changed in any manner is marked with a vertical line in the margin. Changes in requirements are marked with a vertical line in the margin and are followed by an effective date note indicating the date of publication or the date on which the changed requirement becomes effective.

The revised requirements are substantially in accordance with UL's Proposal(s) on this subject dated May 3, 2006, August 1, 2006, and January 10, 2007.

The revisions dated March 9, 2007 include a reprinted title page (page1) for this Standard.

The UL Foreword is no longer located within the UL Standard. For information concerning the use and application of the requirements contained in this Standard, the current version of the UL Foreword is located on ULStandardsInfoNet at: <http://ulstandardsinfo.net/ulforeword.html>.

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The requirements in this Standard are now in effect, except for those paragraphs, sections, tables, figures, and/or other elements of the Standard having future effective dates as indicated in the note following the affected item. The prior text for requirements that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.

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

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This Standard consists of pages dated as shown in the following checklist:

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2B-3	July 11, 2001
4	March 15, 2006
5	May 23, 2003
6-6B	July 11, 2001
7-11	November 18, 1997
12-14	May 23, 2003
15	November 18, 1997
16-17	July 11, 2001
18	November 18, 1997
19-24B	May 23, 2003
25-30	November 18, 1997
31-32B	July 11, 2001
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40-40B	March 15, 2006
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81-82B	October 13, 2006
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UL 963

Standard for Sealing, Wrapping, and Marking Equipment

Prior to the first edition, the requirements for the products covered by this Standard were included in the Standard for Electric Heating Appliances, UL 499, and the Standard for Motor-Operated Appliances, UL 73.

First Edition

November 18, 1997

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

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

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INTRODUCTION

1 Scope

1.1 These requirements cover household, industrial, and commercial sealing, wrapping, and marking equipment rated at 600 volts or less for use in unclassified locations in accordance with the National Electrical Code, NFPA 70, such as laminators, label makers/applicators, stamping machines, taping machines, wrapping machines, shrink tunnels, bag sealers, bag tying machines, heat sealing irons, and vacuum packaging machines.

1.1 revised May 23, 2003

1.2 These requirements do not cover appliances and equipment that are covered by individual requirements that are separate from this standard, such as soldering irons, ink-jet printers, or photographic film printers.

1.3 *Deleted May 23, 2003*

2 General

2.1 Components

2.1.1 Except as indicated in 2.1.2, a component of a product covered by this standard shall comply with the requirements for that component.

2.1.2 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.

2.1.2 revised July 11, 2001

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

2.1.3 revised July 11, 2001

2.1.4 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.

2.1.4 revised July 11, 2001

2.2 Units of measurement

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

2.2.1 revised July 11, 2001

2.2.2 Unless otherwise indicated, all voltage and current values mentioned in this standard are root-mean-square (rms), and all pressures are calculated in per square inch (psi).

2.3 Undated references

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

3 Glossary

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

3.2 **AUXILIARY CONTROL** – A control that is intended primarily for time, temperature, or pressure regulation under conditions of intended operation, and not for protection against overload or excessive conditions resulting from abnormal operation.

3.3 **BRANCH CIRCUIT** – That portion of the building wiring system beyond the final overcurrent device on the power-distribution panel protecting the circuit to the field-wiring terminals in a permanently connected unit or to the receptacle outlet for cord-connected units.

3.4 **CABINET** – Refers to a housing of a unit that prevents access to a part that involves a risk of injury to persons as a result of hazardous moving parts or hot parts. The use of a cabinet to prevent access to a part that involves a risk of fire, electrical energy – high current levels, or electric shock is permitted.

3.5 **CORD-CONNECTED UNIT** – A unit intended for connection to the branch-circuit power line by means of a power-supply cord. By the nature of its construction, such a unit is intended to be removed for reasons of interchange or realignment of the unit of a system.

3.6 **ENCLOSURE** – Refers to a housing of a unit that prevents access to a part that involves a risk of fire, electrical energy at high current levels, or electric shock. The use of an enclosure to prevent access to a part that involves a risk of injury to persons which is present from hazardous moving parts or hot parts is permitted.

3.7 **FIELD-WIRING TERMINAL** – Any terminal to which a supply or other wire is to be connected by an installer in the field, unless the wire is provided as part of the unit and a connector, soldering lug, soldered loop, crimped eyelet, pressure terminal, or other means for making the connection is factory-assembled to the wire.

3.8 **FIXED EQUIPMENT** – Units that are:

- a) Intended for permanent connection to the branch circuit,
- b) Mechanically secured to the surface on which they are intended to be mounted, and
- c) Neither intended by the manufacturer nor constructed for easy removal by service personnel from their intended location for maintenance and repair.

3.9 FLAMMABLE LIQUID – Any liquid having a flash point in accordance with the Standard for Tests for Comparative Flammability of Liquids, UL 340.

3.10 FLASH POINT – The minimum temperature, corrected to a pressure of 101.3 kPa (14.69 psi), at which a liquid gives off vapor within a test vessel in enough quantity to form an ignitable mixture with air above the surface of the liquid.

3.11 GUARD – Refers to a part inside or outside of the enclosure which prevents access to a component that involves a risk of injury to persons.

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3.12 IGNITION TEMPERATURE – The minimum temperature to which any part of an air-vapor mixture must be raised by application of heat to produce self-sustained (autogenous) combustion, as indicated by the appearance of flame.

3.13 INTERNAL BARRIER – Refers to a part inside an enclosure which prevents access to a part that involves a risk of electric shock or injury to persons.

3.14 LINE-VOLTAGE CIRCUIT – A circuit involving a potential of not more than 600 volts and having circuit characteristics in excess of those of a low-voltage circuit. See 3.15.

3.15 LOW-VOLTAGE CIRCUIT – A circuit involving a potential of not more than 30 volts (42.4 volts peak) and supplied by:

- a) A battery,
- b) A standard Class 2 transformer, or
- c) A transformer with:
 - 1) A fixed impedance,
 - 2) A fuse,
 - 3) A non-adjustable manual-reset circuit-protective device, or
 - 4) A regulating network

which, as a unit, complies with all of the performance requirements of a Class 2 transformer. A circuit derived from a source of supply classified as a line-voltage circuit and a resistance in series with the supply circuit as a means of limiting the voltage and current is not determined to be a low-voltage circuit.

3.16 LOWER FLAMMABLE LIMIT – The minimum concentration of vapor in air below which propagation of flame does not occur on contact with a source of ignition. The lower flammable limit is expressed in terms of percentage by volume of gas or vapor in air based on atmospheric temperatures and pressures.

3.17 OPERATOR ACCESSIBLE AREA – All external surface areas, all internal areas that are capable of being entered without the use of tools, and all areas that the operator is instructed to enter regardless of whether or not tools are required to gain access.

3.18 OPERATOR SERVICING – Any form of servicing that is capable of being performed by personnel other than those who are trained to maintain the unit. Some examples of operator servicing are:

- a) The installation of accessories by means of attachment plugs and receptacles or by means of other separable connectors.
- b) Replacement of lamps and fuses and resetting of circuit breakers located in an operator-accessible area, unless the lamps, fuses, or circuit breakers are marked to indicate replacement or resetting only by qualified service personnel.
- c) The making of routine operating adjustments required to adapt the unit for its different intended functions.
- d) Routine cleaning or servicing.

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3.19 PRESSURE-RELIEF DEVICE – A pressure-actuated valve or rupture member intended to relieve excessive pressures automatically.

3.20 PRIMARY CIRCUIT – Wiring and components that are electrically connected to a branch-circuit or an alternating-current or direct-current motor/generator set installed separately from or included as a part of a unit or system.

3.21 RISK OF ELECTRIC SHOCK – A risk of electric shock is determined to occur at any part when the potential between the part and earth ground or any other accessible part is more than 42.4 volts peak or the continuous current flow through a 1500-ohm resistor connected across the potential exceeds 5 milliamperes.

3.22 RISK OF FIRE – A risk of fire is determined to exist at all components and conductors unless the components and conductors are within a circuit which complies with the criteria for Class 2 circuits.

3.23 RISK OF INJURY TO PERSONS – A risk of injury to persons is determined to exist when one or more of the following conditions occur:

- a) Moving parts such as gears and linkages are accessible during intended operation and are capable of resulting in a cut, crush, or laceration.
- b) Sharp edges, burrs, or projections are present that are capable of resulting in injury during use or operator servicing.
- c) The stability of a unit is such that it is capable of resulting in injury to persons.
- d) Moving parts are present for which there is a risk that a part of the body becomes endangered or that clothing becomes entangled by the moving part, resulting in an injury.
- e) Parts maintaining an elevated temperature that are subject to contact by persons by either intentional or casual fashion and capable of causing a burn.

3.24 SAFETY CIRCUIT – Any primary or secondary circuit that is relied upon to reduce the risk of fire, electric shock, injury to persons, or electrical energy at high current levels.

3.25 SAFETY INTERLOCK – A means relied upon to prevent access to an area that involves a risk of electric shock, electrical energy at high current levels, or injury to persons until the risk has been removed, or to remove automatically the risk when access is gained.

3.26 SECONDARY CIRCUIT – A circuit supplied from the secondary winding of an isolation transformer and that has no direct connection to the primary circuit (other than through the grounding means). Any circuit that has a direct connection to the line-connected circuit is evaluated as a primary circuit. A secondary circuit is capable of being a low-voltage circuit.

3.27 SUPPLY CORD – A separable cord set or a length of flexible cord, with one end connected to the primary-circuit wiring of the unit and the other end connected to the attachment plug for connection to branch-circuit power.

3.28 TEMPERATURE-LIMITING CONTROL – A control that functions only under conditions that produce abnormal temperatures. The malfunction of such a thermostat is capable of resulting in a risk of fire.

3.29 TEMPERATURE-REGULATING CONTROL – A control that functions only to regulate the temperature of the product under intended conditions of use, and whose malfunction does not result in a risk of fire.

3.30 TEMPERATURE-REGULATING AND -LIMITING CONTROL COMBINATION – A combination temperature-regulating and -limiting control that functions to regulate the temperature of the product under intended conditions of use, and also serves to reduce the risk of fire that results from conditions of abnormal operation.

3.31 THERMISTOR DEVICE – A thermally sensitive semiconductor resistor that is intended to be heated by an electric current and shows a sharp resistance increase over a small temperature range such as Positive Temperature Coefficients (PTC's) and Negative Temperature Coefficients (NTC's).

3.32 TOOL – A screwdriver, wrench, or any other object that is capable of being used to operate a screw, latch, bolt, or similar fastening means.

CONSTRUCTION

4 General

4.1 Only materials that have been evaluated for the particular use shall be used in these products. A product shall be made and finished with the degree of uniformity and grade of workmanship practicable in a well-equipped factory.

4.2 When the operation of a product involves the generation and confining under pressure of steam or other gas, risk of explosion incident to such operation shall be evaluated. For example, a product having immersed electrodes, where the electrolysis of water results in the accumulation of oxygen and hydrogen. The product does not comply with the intent of this standard unless its strength has been investigated with regard to any risk of explosion that is capable of occurring.

5 Frame and Enclosure

5.1 General

5.1.1 The frame and enclosure of a product shall resist the abuses to be encountered during intended use. The degree of resistance shall reduce the possibility of a condition that results in an increase in the risk of fire, electric shock, or injury to persons.

5.1.2 The strength and rigidity of the frame and enclosure shall comply with the tests described in 63.1 – 63.4, as applicable.

5.1.3 A product shall be provided with an enclosure made of material that has been determined to be capable for use in this application. The enclosure shall house all electrical parts, except a supply cord and a recessed open-wire-element unit as specified in 16.5, that are capable of resulting in a risk of electric shock or injury to persons under any condition of use. When a product is constructed for permanent installation and connection to the power supply, the enclosure shall be provided with means for mounting in the intended manner and shall be furnished with any required fittings, such as brackets or hangers.

5.1.4 When ventilation openings are provided in the enclosure of a product, they shall be located so that they do not vent into concealed spaces of a building structure, such as a false-ceiling space or hollow spaces in the wall when the product is installed.

5.1.5 Among the factors to be determined when evaluating an enclosure are its:

- a) Physical strength,
- b) Resistance to impact,
- c) Moisture-absorptive properties,
- d) Combustibility,
- e) Resistance to corrosion, and
- f) Resistance to distortion at temperatures to which the enclosure is capable of being subjected under conditions of use.

Except for (e), all of the preceding factors shall be used to determine the suitability of a nonmetallic enclosure. A sheet-metal enclosure shall be evaluated with regard to its size, shape, the thickness of metal, and the intended use of the product.

5.1.6 Cast and sheet-metal portions of the enclosure shall not have a thickness less than that indicated in Table 5.1 unless the enclosure complies with 5.1.5.

Table 5.1
Minimum thickness of metal enclosure

Metal	At small, flat, unreinforced surfaces, and at surfaces that are reinforced by curving, ribbing, and similar methods (or are otherwise of a shape and/or size to provide physical strength),		At surfaces to which a wiring system is to be connected in the field,		At large, unreinforced flat surfaces,	
	inch	(mm)	inch	(mm)	inch	(mm)
Die-cast	3/64	1.2	—	—	5/64	2
Cast-malleable iron	1/16	1.6	—	—	3/32	2.4
Other cast metal	3/32	2.4	—	—	1/8	3.2
Uncoated sheet steel	0.026 ^a	0.66 ^a	0.032	0.81	0.026	0.66
Galvanized sheet steel	0.029 ^a	0.74 ^a	0.034	0.86	0.029	0.74
Nonferrous sheet metal	0.036 ^a	0.91 ^a	0.045	1.14	0.036	0.91

^a Thinner sheet metal is not prohibited from being used when it has been determined to be suitable for its intended use when the enclosure is evaluated under considerations such as those specified in 5.1.4.

5.1.7 Electrical parts of a product shall be located or enclosed so as to provide protection against unintentional contact with uninsulated live parts.

5.1.8 The enclosure shall be constructed such that molten metal, burning insulation, or flaming particles are not capable of falling on combustible materials, including the surface upon which the enclosure is supported. The product shall be provided with a barrier of metal, phenolic, urea, ceramic, or similar material located:

- a) Under a motor unless:

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1) The structural parts of either the motor or the product are determined to be 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 product when the motor is energized under each of the following fault conditions:

- i) Open main winding,
- ii) Open starting winding, and
- iii) Short-circuited starting switch;

3) The motor is provided with a thermal motor protector that limits the motor winding temperature to maximum 125°C (257°F) under the maximum load under which the motor runs without causing the protector to cycle, and to maximum 150°C (302°F) with the rotor locked; and

4) The motor complies with the Standard for Overheating Protection for Motors, UL 2111.

b) Under wiring, unless the wiring complies with the VW-1 flame test in the Standard for Thermoplastic-Insulated Wires and Cables, UL 83.

5.1.9 The barrier specified in 5.1.8 shall be horizontal and shall be located and sized as indicated in Figure 5.1. Openings for drainage or ventilation are not prohibited as long as molten metal, burning insulation, or flaming particles are not capable of falling through the opening onto combustible material.

5.1.10 A component such as a switch, transformer, relay, solenoid, or similar components shall be individually and completely enclosed unless it is determined that malfunction of the component does not result in a fire, electric shock, or risk of injury to persons, or unless there are no openings in the bottom of the enclosure. An opening in the bottom of the enclosure does not comply with the intent of this requirement when it is located directly below field or factory-made splices or overload or overcurrent protective devices.

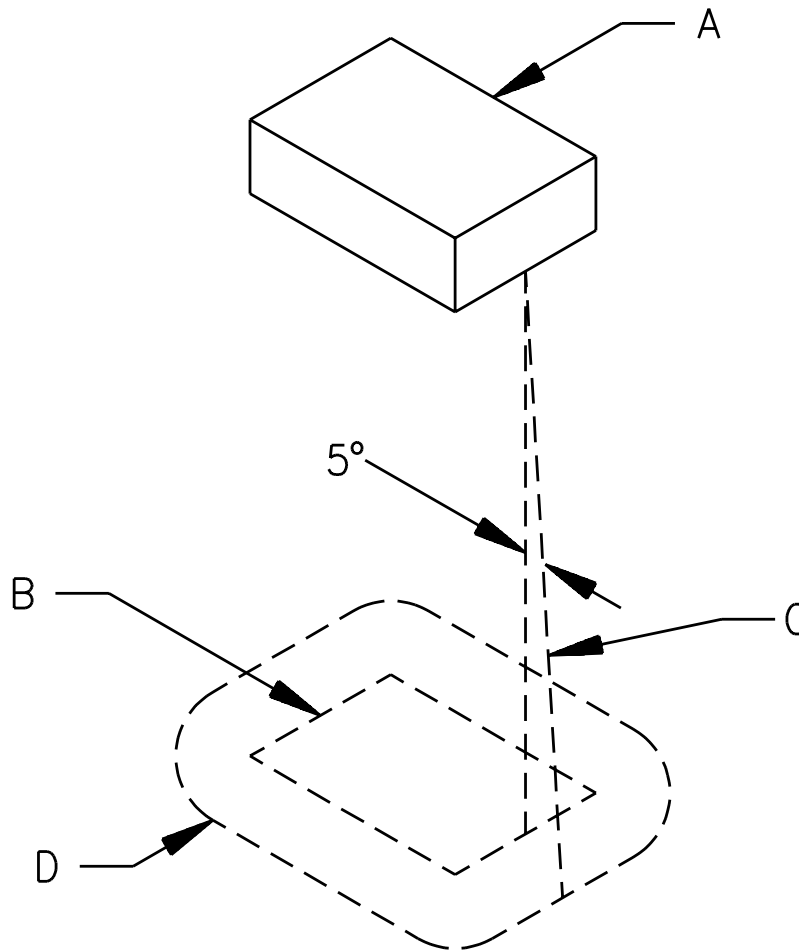
5.2 Accessibility

5.2.1 To reduce the risk of unintentional contact of uninsulated live parts of film-coated wire that is capable of involving a risk of electric shock or injury to persons, an opening in an enclosure shall comply with either of the following items:

- a) For an opening that has a minor dimension less than 1 inch (25.4 mm), such a part or wire shall not be contacted by the articulate probe illustrated in Figure 5.2 or
- b) For an opening that has a minor dimension of 1 inch or more, such a part or wire shall be spaced from the opening as specified in Table 5.2.

See 5.2.3 for a definition of the minor dimension of an opening.

Figure 5.1
Location and extent of barrier



SA0604-1

A – Region to be shielded by barrier. This consists of the entire component when it is not otherwise shielded and is to consist of the unshielded portion of a component that is partially shielded by the component enclosure or part that has been determined to be 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) Five (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.

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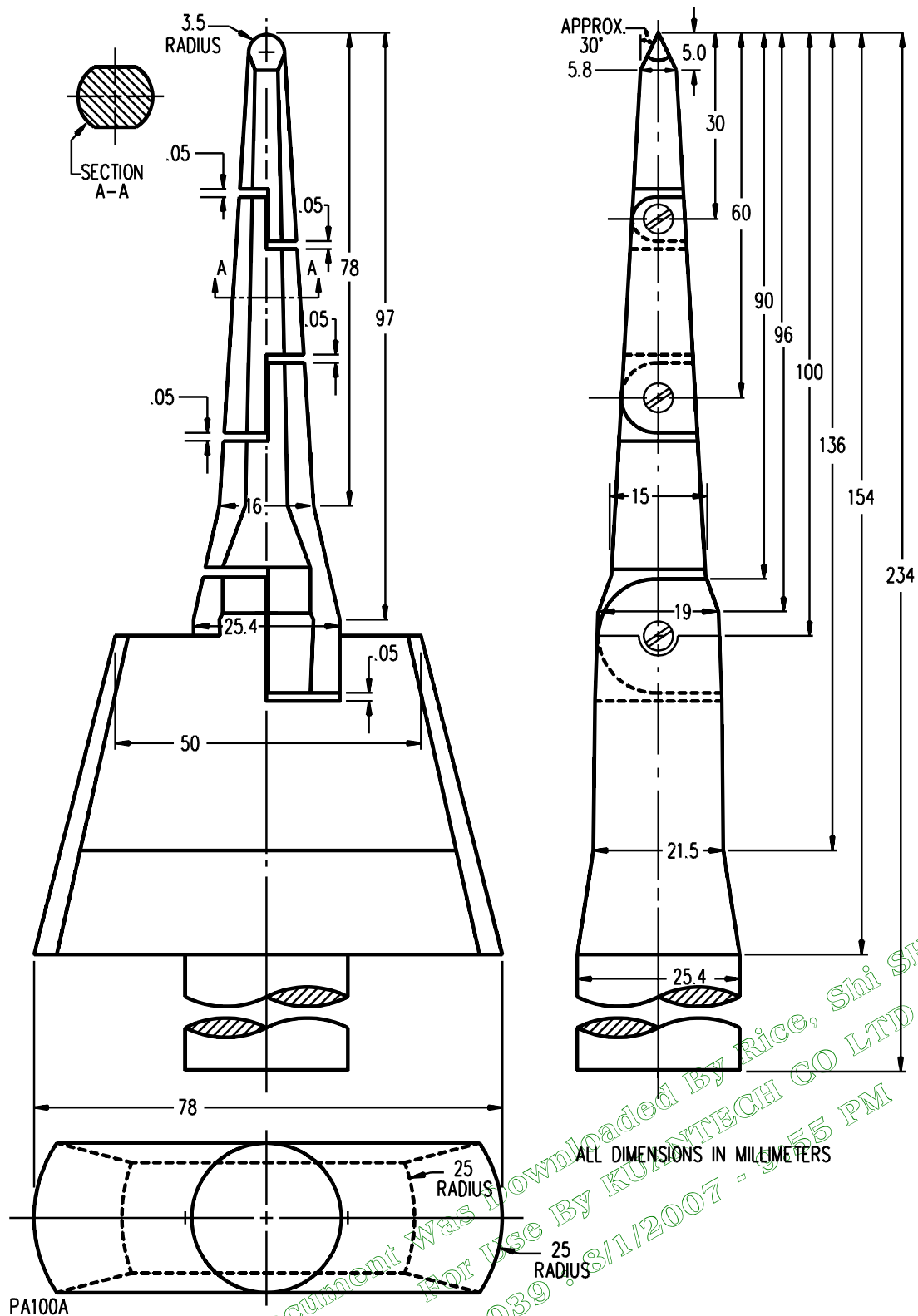
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Figure 5.2
Articulate probe with web stop



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Table 5.2
Minimum distance from an opening to a part that involves a risk of electric shock or injury to persons

Minor dimension of opening, ^a		Minimum distance from opening to part,	
inches ^b	(mm) ^b	inches	(mm)
1	25.4	6-1/2	165
1-1/4	31.8	7-1/2	190
1-1/2	38.1	12-1/2	318
1-7/8	47.6	15-1/2	394
2-1/8	54.0	17-1/2	444
6 ^c	152.0 ^c	30	762

^a See 5.2.3.
^b Between 1 and 2-1/8 inches, interpolation is to be used to determine a value between values specified in the table.
^c More than 2-1/8 inches, but not more than 6 inches (152 mm).

5.2.2 Unless otherwise specified, the probe illustrated in Figure 5.2 shall be applied to any depth that the opening permits, and shall be rotated or angled before, during, and after insertion through the opening to any position that is required to examine the enclosure. The probe shall be applied in any possible configuration; and, when required, the configuration shall be changed after insertion through the opening.

5.2.3 The minor dimension of an opening is the diameter of the largest cylindrical probe having a hemispherical tip that is capable of being inserted through the opening.

5.2.4 The probe illustrated in Figure 5.2 shall be used as a measuring instrument to evaluate the accessibility provided by an opening, and not as an instrument to evaluate the strength of a material; it shall be applied with the minimum force required to determine accessibility.

5.2.5 During the examination of the product for compliance with the requirements in this section, a part of the outer enclosure that is capable of being removed by the user without the use of tools is to be disregarded, that is, it is not to be assumed that the part in question affords protection against the risk of electric shock. A warning marking, such as that specified in 70.2, is not determined to eliminate this risk of electric shock.

5.2.6 A marking shall not draw the user's attention to an opening in the enclosure for the adjustment of a component or control when a 1/16 inch (1.6 mm) diameter rod is capable of contacting insulation or uninsulated live parts.

5.2.7 Moving parts shall be enclosed or guarded to reduce the risk of injury to persons. The degree of protection required of the enclosure depends upon the general construction and intended use of the product. The factors to be taken into consideration in evaluating the acceptability of exposed moving parts are:

- a) The degree of exposure;
- b) The sharpness of the moving parts;

- c) The risk of unintentional contact with the moving parts;
- d) The speed of movement of those parts; and
- e) The risk of fingers, arms, or clothing being drawn into the moving parts, such as at points where gears mesh, where belts travel onto a pulley, or where moving parts close in a pinching or shearing action.

5.2.8 The door or cover of an enclosure shall be provided with a means for securing it in place in the closed position. The door or cover of an enclosure shall be hinged or otherwise attached in a manner that has been determined to be equivalent when it gives access to any overload protective device whose functioning requires renewal, or when it is required to open the cover in connection with the operation of the protective device. Such a door or cover shall be provided with a latch or device that has been determined to be equivalent, and shall be tight-fitting or shall overlap the surface of the enclosure around the opening.

5.2.9 A component that requires inspection, replacement, cleaning, or other servicing shall be as accessible to the user as possible. The component shall be readily accessible without the use of special tools (those not available to other than service personnel) when it is intended to be manually operated or adjusted or periodically serviced.

5.2.10 When a product is intended primarily for use in public places, such as grocery stores or theaters:

- a) The construction is such that special tools are required to gain access to components that require inspection, replacement, cleaning, adjustment, or other servicing and
- b) A door or cover giving access to an overload protective device is not required to be provided with a hinge, latch, or part that has been determined to be equivalent when the cover must be in place to perform its function.

5.2.11 The bulb and capillary tube of a thermostat shall be protected from physical damage when such damage of the tube or bulb is capable of resulting in a risk of fire.

5.2.12 A cord-connected product that is provided with slots, notches, or holes for mounting the product on a wall shall be constructed in such a manner that the mounting means (screws, bolts, and similar parts) shall not be accessible without removing the product from the wall.

5.2.13 When determining compliance with 5.2.12, any part of the enclosure or barrier that is capable of being removed without the use of tools to gain access to the mounting means is to be removed prior to conducting an examination.

5.2.14 An opening in a product provided for mounting shall be located or guarded so that a nail or hook:

- a) Does not displace a part that creates a risk of fire or electric shock and
- b) Does not contact uninsulated live parts, magnet wire, internal wiring, moving parts, or other parts that create a risk of fire or electric shock.

5.3 External materials

5.3.1 Material such as steel, aluminum, glass, plastic, or other similar materials are not prohibited from being used for the enclosure, guard, or cabinet of a unit. Glass shall be heat-resistant, tempered, wired, or laminated.

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5.3.2 Plastic materials used for part or all of an enclosure shall comply with the requirements in this section and with the Standard for Polymeric Materials— Use in Electrical Equipment Evaluations, UL 746C. In applying the requirements in UL 746C, movable units having a mass less than 40 lbs (18.1 kg) shall be treated as portable equipment; other movable units shall be treated as stationary equipment.

5.3.3 Plastic materials used for a cabinet, a part of a cabinet, and for other external parts which do not serve as an enclosure, guard, or barrier shall have a minimum flame rating of HB. Small external parts that contribute a negligible amount of fuel to a fire are not required to be investigated.

5.3.4 An external surface of combustible material having an exposed area greater than 10 square feet (0.93 m²) or a single dimension larger than 6 feet (1.83 m) shall have a flame spread rating of 200 or less when tested in accordance with one of the following:

- a) The Standard for Tests for Surface Burning Characteristics of Building Materials, UL 723, or
- b) The requirements of the radiant panel flame spread test in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

5.3.5 The dimension limits specified in 5.3.4 refer to the exposed surface area of a single unbroken section. When two sides of a single unbroken section are exposed, only the larger side is to be evaluated in computing the area.

5.3.6 Conductive coatings applied to surfaces such as the inside surface of a cover or enclosure shall comply with the requirements for Ductile Coatings, Brittle Coatings, and Metallized Parts – Performance Considerations described in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, unless it is determined that flaking or peeling of the coating is not capable of resulting in the reduction of spacings or the bridging of live parts that is capable of presenting a risk of electric shock or fire.

5.4 Internal materials

5.4.1 All combustible materials used within an enclosure shall have a minimum flame rating of V-2 or HF-2.

Exception No. 1: The following materials may have a minimum flame rating of HB:

- a) Electrical components within Class 2 circuits, other than printed-wiring boards employing only Class 2 circuits, and*
- b) Tubing for air or fluid systems and containers for powders.*

Exception No. 2: Foamed plastics are not prohibited from having a minimum flame rating of HBF.

Exception No. 3: : The following materials are not required to have an established flame rating:

- a) Meter faces and cases (of the type required for mounting live parts) and indicator lamps and lenses;*
- b) Components within a unit that has a volume of not more than 2 cubic feet (0.57 m³) when they are totally enclosed in metal and have no ventilation openings;*
- c) Components within a sealed unit containing an inert gas;*

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d) Integrated circuit packages, transistor packages, opto-isolator packages, capacitors, and other parts of similar size when the parts are mounted on a material rated minimum V-1;

e) Components isolated from uninsulated electrical parts that involve a risk of fire by either:

1) At least 0.5 inch (12.7 mm) of air, or

2) A solid partition of material rated minimum V-1;

f) Gears, cams, belts, bearings, strain-relief bushings, and other parts that contribute negligible fuel; and

g) Motors, relays, capacitors, transformers, switches, insulating tubing or tape, and other electrical components when they comply with the requirements applicable to the component.

5.4.2 Barriers used in an operator accessible area shall comply with the Tests for Guards, Enclosures, and Operator-Accessible Barriers, Section 63.

5.5 Handles

5.5.1 A handle or handles intended for lifting or carrying a unit shall comply with the Handle Strength Test, Section 61.

5.6 Mounting means

5.6.1 A support bracket or hanger of a wall-mounted product shall comply with the Strength of Mounting Test, Section 62.

5.7 Stability

5.7.1 A non-hand-held product shall comply with the Physical Stability Tests, Section 60.

6 Assembly

6.1 A product, such as a sealing iron, that is intended to be placed on combustible material, or against which combustible material is capable of being laid, shall be provided with a stand, guard, or both, of noncombustible material upon which it shall be placed when not in use.

Exception: A stand or guard is not required for a product that complies with the surface temperature requirements of 44.21.

6.2 Uninsulated live parts shall be secured so that they are prevented from turning or shifting in position when such motion is capable of resulting in a reduction of spacings below the minimum values specified in Table 14.2.

6.3 Friction alone between surfaces shall not be used as a means to prevent shifting or turning of live parts. A toothed lock washer or similar device is not prohibited from being used to prevent shifting or turning of live parts.

6.4 A product shall be assembled so that it is not adversely affected by the vibration of normal operation. Brush caps shall be tightly threaded or otherwise constructed to prevent loosening. A rotating part that by loosening presents a risk of fire, electric shock, or injury to persons shall be assembled so that the direction of rotation tends to tighten the means that hold the rotating part in place.

Exception: A keyed part, a press fit, a part locked in place with a pin, or a method that has been determined to be equivalent is not prohibited from being used to hold a rotating part in place.

6.5 A switch, fuseholder, pilot-light, receptacle, motor-attachment plug, or other similar component is not prohibited from rotating when all the following conditions are met:

- a) The component is of a plunger or other type that does not tend to rotate when operated. A toggle switch is determined to be subject to forces that tend to turn the switch,
- b) The component mounting means is not subject to loosening as the result of operation,
- c) The spacings are not reduced below the values specified in Table 14.2 when the component rotates, and
- d) The operation of the component is by mechanical means rather than direct contact by persons.

7 Protection Against Corrosion

7.1 Except as noted in 7.2, iron and steel parts shall be protected against corrosion by enameling, galvanizing, plating, or other means, when the deterioration of such unprotected parts results in a risk of fire, electric shock, explosion, or injury to persons.

7.2 In equipment where the oxidation of steel is not accelerated due to the exposure of metal to air and moisture or other oxidizing influence (thickness of metal and temperature also being factors) surfaces of sheet steel within an enclosure are not be required to be protected against corrosion. A sheath used on a heating element operating in air and terminal parts attached directly to the heating element are not required to be protected against corrosion. Bearings, laminations, and minor parts of iron or steel, such as washers and screws, that are not relied upon for grounding are not required to be protected.

8 Supply Connections

8.1 Permanently-connected products

8.1.1 General

8.1.1.1 A product intended for permanent electrical connection to the power supply shall have provision for connection of one of the wiring systems that are intended for the product, in accordance with the National Electrical Code, ANSI/NFPA 70.

8.1.1.2 When supply connections are intended to be made directly to a motor provided with a product, the terminal compartment on the motor shall comply with the requirements for terminal compartments in the Standard for Electric Motors, UL 1004.

8.1.1.3 A terminal box or compartment intended for permanent connection to the power supply shall be located such that the connections are capable of being readily inspected after the product is installed as intended.

8.1.1.4 A terminal compartment intended for the connection of a supply raceway shall be secured to the product so that it does not turn with regard to the product.

8.1.1.5 An electrical component shall not be mounted on a part, such as the cover of a wiring-terminal compartment, that must be removed for the purpose of making or inspecting field-wiring connections.

Exception: A single electrical device (switch, pilot light, etc.) is not prohibited from being mounted on a wiring compartment cover as long as:

- a) The component connecting leads are of such length that they are not capable of being moved aside and do not obstruct the making, and examination, of field-wiring connections;*
- b) None of the component connections are to be field wired;*
- c) Strain relief is provided to prevent stress of wire movement from being transmitted to the component wiring terminations, and it complies with the Strain Relief Test, Section 58;*
- d) The minimum size of the component leads is 18 AWG (0.82 mm²);*
- e) Wiring terminations on the component are recessed or protected by barriers made from insulating material or material that has been determined to be equivalent that provides protection from either contact with wiring installed in the box or unintentional contact by persons during installation or inspection of field wiring; and*
- f) The component is located in a Class 2 circuit.*

8.1.1.5 revised May 23, 2003

8.1.2 Wiring terminals

8.1.2.1 A product intended for permanent connection to the power supply shall be provided with wiring terminals or leads for the connection of conductors having an ampere rating of not less than 125 percent of the current rating of the product when the load is continuous (3 hours or more) and not less than the current rating of the product when the load is to be intermittent.

8.1.2.2 For the purpose of these requirements, wiring terminals are determined to be terminals to which power-supply or control connections are made in the field when the product is installed. It is assumed that 60°C (140°F) wire is to be used for connections to:

- a) A continuous-load type of appliance rated at 80 amperes or less and
- b) An intermittent-load type of appliance rated at 100 amperes or less.

Wire rated for 75°C (167°F) is assumed to be used with products rated in excess of these values.

Exception: When temperatures at the points described in 69.9 exceed 60°C when tested in accordance with the Normal Temperature Test, Section 44, the product shall be marked in accordance with 70.9 to indicate the wire size and temperature rating that shall be used for the supply connections.

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8.1.2.3 A wiring terminal shall be provided with a soldering lug or with a pressure-wire connector securely fastened in place (i.e. bolted or held by a screw) except that a wire-binding screw is not prohibited from being employed at a wiring terminal intended to accommodate a 10 AWG (5.3 mm²) or smaller conductor when upturned lugs or parts that have been determined to be equivalent are provided to hold the wire in position.

8.1.2.3 revised May 23, 2003

8.1.2.4 A wiring terminal shall not turn or shift in position. The use of two screws or rivets, by square shoulders, by a dowel pin, lug, or offset, by a connecting strap or clip fitted into an adjacent part, or some other method that has been determined to be equivalent is not prohibited from being used to prevent a wiring terminal from turning or shifting. Friction between surfaces shall not be used as a means to prevent turning or shifting.

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

Exception No. 1: A No. 8 screw is not prohibited from being used at a terminal intended only for the connection of a 14 AWG (2.1 mm²) or smaller conductor.

Exception No. 2: A No. 6 screw is not prohibited from being used for the connection of a 16 or 18 AWG (1.3 or 0.82 mm²) control-circuit conductor.

8.1.2.5 revised May 23, 2003

8.1.2.6 A terminal plate tapped for a wire-binding screw shall be of metal not less than 0.050 inch (1.3 mm) thick, except that a plate not less than 0.03 inch (0.8 mm) thick shall be used when the tapped threads have reliable mechanical strength. Terminal plates that are not less than 0.03 inch thick shall comply with the requirements of the Torque Test, Section 65. There shall be two or more full threads in the metal, which is not prohibited from being extruded when required to provide the threads.

8.1.2.7 Upturned lugs or a cupped washer shall be capable of retaining a conductor under the washer or the head of the screw.

8.1.2.8 A wire-binding screw shall not thread into surfaces other than metal.

8.1.2.9 A product intended for connection to a grounded power supply shall have one terminal or lead identified for connection of the grounded conductor of the supply circuit as follows:

- a) The terminal shall be made of or plated with a metal white in color;
- b) The terminal shall have the word "white" or "neutral" located adjacent to the terminal and shall be readily distinguishable from the other terminals; or
- c) Proper identification of that terminal shall be clearly shown in some other manner, such as on a wiring diagram provided with the product.

A lead shall be finished to show a white or gray color and shall be distinguishable from the other leads.

8.1.2.9 revised May 23, 2003

8.1.2.10 The free length of a lead inside an outlet box or wiring compartment shall be 6 inches (152 mm) or more when the lead is intended for field connection to an external circuit. However, a lead that is less than 6 inches in length is not prohibited when it is evident that the use of a longer lead results in a risk of fire or electric shock.

8.2 Cord-connected products

8.2.1 General

8.2.1.1 A cord-connected product shall be provided with a power-supply cord for connection to the supply circuit. The length of the power-supply cord shall be as specified in Table 8.1. The power-supply cord shall be of a type specified in Table 8.2 and shall comply with the Standard for Cord Sets and Power-Supply Cords, UL 817.

8.2.1.1 revised May 23, 2003

Table 8.1
Lengths of supply cord

Type of product	Minimum length, ^a		Maximum length, ^a	
	feet	meters	feet	meters
Counter-top, bench-top, or table-top products intended for household use	2.0 ^b	0.6 ^b	7.0	2.1
All other products	6.0	1.8	—	—

^a Measured external to the product and including the fittings and excluding the blades of the attachment plug.
^b See 69.11 when cord length is less than 4.5 feet (1.4 m).

Table 8.2
Types of cord and applicable limitations on their use

Table 8.2 revised May 23, 2003

Type of product	Cords where temperatures exceed 121°C (250°F) on any surface that the cord touches when the product is used as intended	Cords where temperatures are 121°C (250°F) or less on any surface that the cord touches when the product is used as intended
Household, indoor use only	HPD, HPN, HSJ, or HSJO	HPD, HPN, HSJ, HSJO, SP-2, SPE-2, SPT-2, SV, SVO, SVE, SVOO, SVT, SVTO, SJ, SJO, SJE, SJOO, SJT, SJTO, SVTOO, or SJTOO
Commercial or industrial, indoor-use only	HSJ or HSJO	HSJ, HSJO, SJ, SJE, SJOO, SJT, SJO, SJTO, SJTOO, S, SO, SE, SOO, ST, STO, or STOO
Heat-sealing irons	HPD, HPN, HSJ, or HSJO	HPD, HPN, HSJ, HSJO, SJ, SJE, SJO, SJOO, SJT, SJTO, or SJTOO

8.2.1.2 For a product rated 15 amperes or less, the current and voltage rating of the cord and the fittings shall be no less than that of the product. For a product rated at more than 15 amps, the current rating of the cord and attachment plug shall not be less than 125 percent of the current rating of the product. When the load is continuous (3 hours or more), the current rating of the attachment plug shall be no less than 125 percent of the current rating of the product. The use of a 20-amp attachment plug for a product rated for no more than 2000 watts at 120 volts and rated for no more than 4000 watts at 240 volts is not prohibited.

8.2.1.3 Additional insulation, when used on a flexible cord, shall not extend more than 1/2 inch (13 mm) outside the product, unless provided with additional mechanical protection, shall not fray or unravel, and shall not adversely affect the strain relief means.

8.2.1.4 When the power source for a product is electrically separable from the product, both the power source and the product shall be marked in accordance with 69.14. The power source shall comply with the applicable requirements for that power equipment.

8.2.1.5 The attachment plug of a product intended to be connected to a nominal 120-volt circuit, and employing devices required to be connected to a specific supply conductor as specified in 21.5, 23.1, 23.2, and 27.2 shall be a polarized type (2-blade polarized or 3-wire grounding). The connections to the attachment plug shall be in accordance with Figure 8.1. The polarity identification of the supply cord shall be in accordance with Table 8.3. When a two-blade plug is used, the instruction manual shall include the warning marking described in 71.3. When a three-wire grounding-type plug is used, the product shall be marked in accordance with 70.3.

8.2.1.6 A product that is capable of being adapted for use on two or more different voltage ratings by field alteration of internal connections shall be provided with an attachment plug that has been determined to be capable for use at the voltage for which the product is connected when shipped from the factory. The product shall be marked in accordance with 69.5.

8.2.1.7 Products that are mechanically connected to the surface on which they are mounted, and are neither intended by the manufacturer nor constructed for easy removal by service personnel for maintenance and repair, are not determined to be cord-connected products.

8.2.2 Strain relief

8.2.2.1 A strain relief means shall be provided to restrict the transmission of mechanical stress from a power-supply cord to terminals, splices, or internal wiring. The means shall comply with the Strain Relief Test, Section 58.

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