



UL 499

Underwriters Laboratories Inc. Standard for Safety

Electric Heating Appliances



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UL Standard for Safety for Electric Heating Appliances, UL 499

Thirteenth Edition, Dated November 17, 2005

Summary of Topics

The revisions dated November 18, 2009 were issued to incorporate the following new and revised requirements:

- ***Open-Wire Heating Elements and Switches***
- ***Addition of UL 60730 as an Alternative Control Standard***

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. 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 new and revised requirements are substantially in accordance with Proposal(s) on this subject dated July 3, 2009.

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The following table lists the future effective dates with corresponding reference.

Future Effective Date	References
May 31, 2011	27.8, 47.38 – 47.40, and Sections 62 – 67
August 15, 2011	39.1.6 and Section 39.18

November 17, 2005
(Title Page Reprinted: November 18, 2009)



ANSI/UL 499-2009

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UL 499

Standard for Electric Heating Appliances

First Edition – October, 1930
Second Edition – October, 1933
Third Edition – December, 1936
Fourth Edition – May, 1940
Fifth Edition – January, 1949
Sixth Edition – August, 1956
Seventh Edition – June, 1962
Eighth Edition – July, 1968
Ninth Edition – January, 1972
Tenth Edition – December, 1978
Eleventh Edition – June, 1987
Twelfth Edition – March, 1997

Thirteenth Edition

November 17, 2005

This ANSI/UL Standard for Safety consists of the Thirteenth Edition, including revisions through November 18, 2009.

The most recent designation of ANSI/UL 499 as an American National Standard (ANSI) occurred on November 18, 2009. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, or effective date information.

The Department of Defense (DoD) has adopted UL 499 on August 17, 1987. 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 <http://csds.ul.com>.

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INTRODUCTION

1 Scope

1.1 These requirements cover heating appliances rated at 600 V or less for use in unclassified locations in accordance with the National Electrical Code (NEC), ANSI/NFPA 70.

1.2 These requirements do not cover electric heating equipment or appliances that are covered by individual requirements that are separate from this Standard.

1.3 For the purposes of this Standard, a heating appliance is defined as an electrically energized product that directly or indirectly generates heat to perform its intended function.

1.4 These requirements also cover electrically energized products that generate steam for other than space heating purposes and have an electrical power rating of 15 kW or less per steam generating vessel.

1.5 Steam generating products of the type described in 1.4 having an electrical input power rating of more than 15 kW per steam generating vessel are to be evaluated by the requirements in the Standard for Heating, Water Supply, and Power Boilers – Electric, UL 834.

1.6 Each steam generating vessel in a multi-vessel unit shall comply with these requirements. The unit shall also be provided with the marking in 47.37.

2 Components

2.1 Except as indicated in 2.2, 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.

2.2 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.

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

2.4 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.

3 Units of Measurement

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

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

4 Undated References

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

CONSTRUCTION

5 General

5.1 A heating appliance intended for use in a hazardous location is judged on the basis of its compliance with the requirements in this Standard, and further appropriate examination and tests to determine whether it is acceptable for the purpose.

5.2 Only materials that are acceptable for the particular use shall be used in a heating appliance. A heating appliance shall be made and finished with the degree of uniformity and grade of workmanship practicable in a well-equipped factory.

5.3 If the operation of a heating appliance involves the generation and confining under pressure of steam or other gas, consideration is to be given to the possibility of risk of explosion incident to such operation. This applies in the case of a product having immersed electrodes, where the electrolysis of water may result in the accumulation of oxygen and hydrogen. The product is not acceptable unless its strength has been investigated with respect to any risk of explosion that may be involved.

6 Frame and Enclosure

6.1 The frame and enclosure of a heating appliance shall be strong and rigid to resist the abuses to be encountered during intended use. The degree of resistance inherent in the product shall preclude total and partial collapse with the attendant reduction of spacings, loosening or displacement of parts, and other defects which alone or in combination constitute an increase in the risk of fire, electric shock, or injury to persons.

6.2 A vaporizer water reservoir of glass or similar material that might, upon breaking, cause skin lacerations shall be resistant to thermal-shock and impact.

6.3 A heating appliance shall be provided with an enclosure of material acceptable for the application, that shall house all electrical parts, except a supply cord and a recessed open-wire-element unit as mentioned in 14.3, that may result in risk of electric shock or injury to persons under any condition of use. If a heater is for permanent installation (intended for permanent connection to the power supply), the enclosure shall be provided with means for mounting in the intended manner and shall be furnished with any necessary fittings, such as brackets, hangers, or the like.

6.4 If openings for ventilation are provided in the enclosure of a heating appliance or in an externally mounted component intended for permanent connection to the power supply, they shall be so located that they will not vent into concealed spaces of a building structure, such as into false-ceiling space, into hollow spaces in the wall, and the like, when the product is installed.

6.5 Among the factors when an enclosure is being considered for acceptability, are its:

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

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

6.6 Cast- and sheet-metal portions of the enclosure shall be no thinner than indicated in Table 6.1 unless the enclosure complies with 6.5 and 6.7.

Table 6.1
Minimum acceptable thicknesses of enclosure material

Metal	At small, flat, unreinforced surfaces and at surfaces that are reinforced by curving, ribbing and the like or are otherwise of a shape and/or size to provide physical strength		At surfaces to which a wiring system is to be connected in the field		At relatively large unreinforced flat surfaces	
	inches	(mm)	inches	(mm)	inches	(mm)
Die-cast	3/64	(1.2)	—	—	5/64	(2.0)
Cast malleable iron	1/16	(1.6)	—	—	3/32	(2.4)
Other cast metal	3/32	(2.4)	—	—	1/8	(3.2)
Uncoated sheet steel	0.026 ^a	(0.66) ^a	0.032	(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 may be employed if found to be acceptable when the enclosure is judged under considerations such as those mentioned in 6.5.						

6.7 In addition to the factors in 6.5, an enclosure of sheet metal is to be considered with respect to its size and shape, the thickness of metal and the intended use of the product.

6.8 Electrical parts of a heating appliance, including open-wire elements, shall be so located or enclosed that protection against unintentional contact with uninsulated live parts will be provided (see also 24.6). Insulated motor brush caps do not require additional enclosure.

6.9 The enclosure shall be such that molten metal, burning insulation, flaming particles, or the like, is not likely to fall on combustible materials, including the surface upon which the enclosure is supported.

6.10 The requirement in 6.9 necessitates use of a barrier of metal, phenolic, urea, ceramic or similar material:

a) Under a motor unless:

1) The structural parts of the motor or of the product 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 product when the motor is energized under each of the following fault conditions:

i) Open main winding;

ii) Open starting winding; and

iii) Starting switch short-circuited.

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

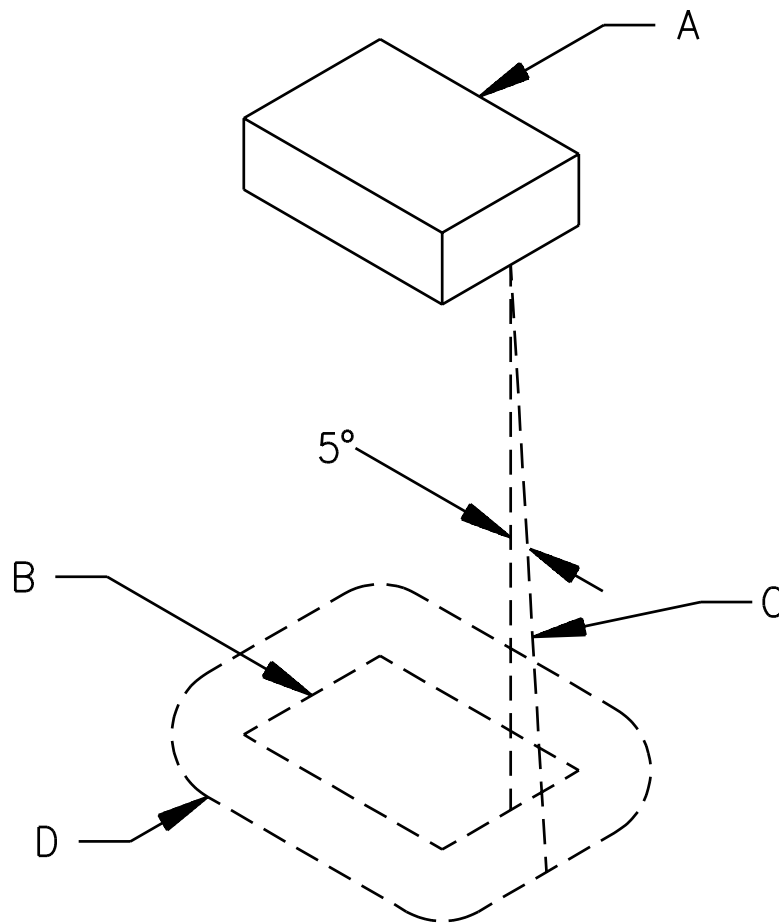
4) The motor complies with the requirements for impedance-protected motors.

b) Under wiring, unless it complies with the VW-1 (Vertical-Specimen) Flame Test described in the Reference Standard for Electrical Wires, Cables, and Flexible Cords, UL 1581.

6.11 The requirement in 6.9 also necessitates that a switch, transformer, relay, solenoid, or the like, be individually and completely enclosed except at terminals, unless it can be shown that malfunction of the component is not likely to result in a fire, or unless there are no openings in the bottom of the enclosure. An opening in the bottom of the enclosure is not acceptable if it is located directly below field- or factory-made splices or overload or overcurrent protective devices.

6.12 The barrier mentioned in 6.10 shall be horizontal, shall be located as indicated in Figure 6.1, and shall not have an area less than that described in that illustration. Openings for drainage, ventilation, and the like, may be employed provided molten metal, burning insulation, or the like, is not likely to fall through the opening onto combustible material.

Figure 6.1
Location and extent of barrier



SA0604-1

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 that is partially shielded by the component enclosure or equivalent.

B – Projection of outline of component on horizontal plane.

C – Inclined line that traces out minimum area of barrier. The line is always:

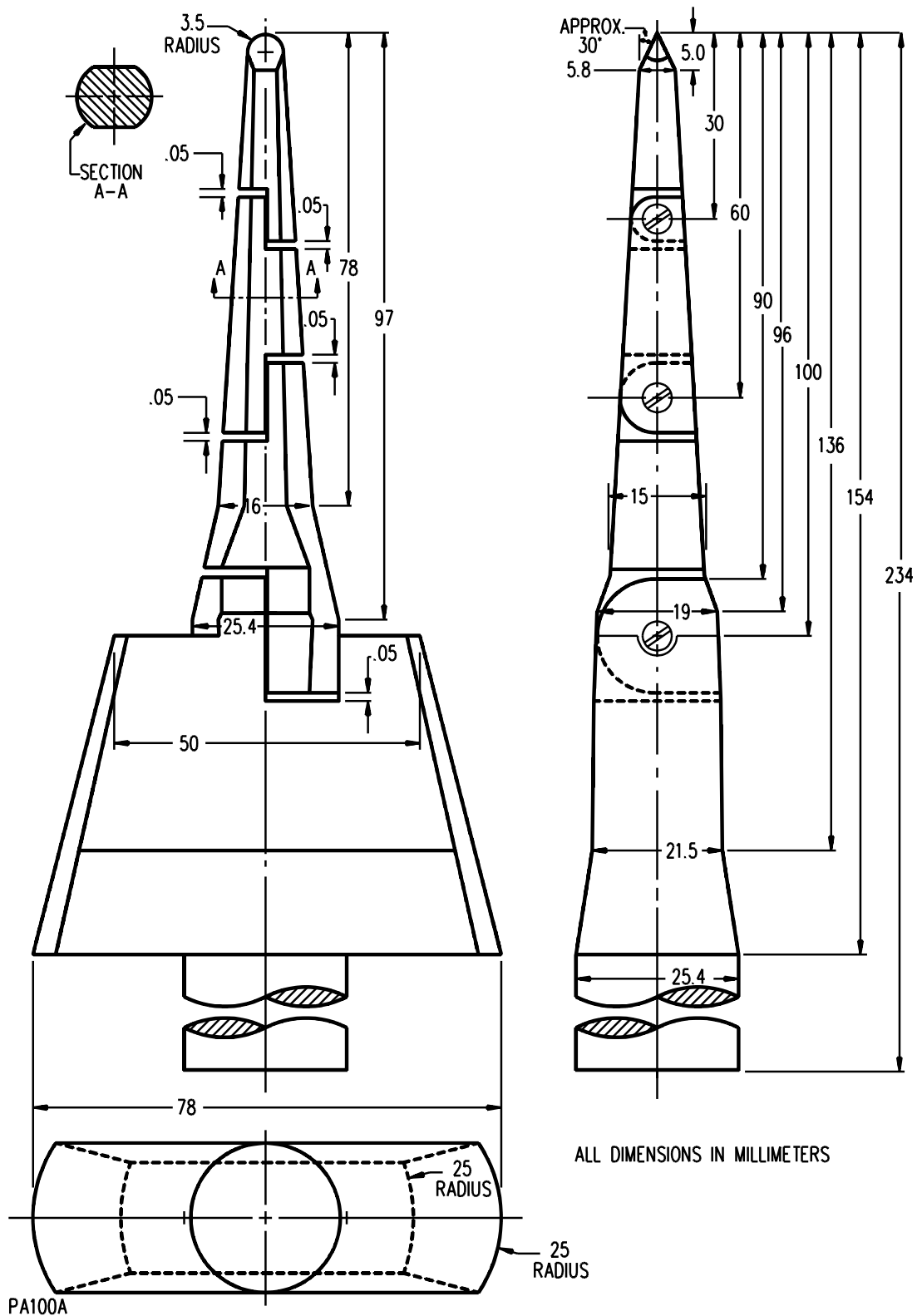
- 1) tangent to the component;
- 2) 5 degrees from the vertical; and
- 3) so oriented that the area traced out on a horizontal plane is maximum.

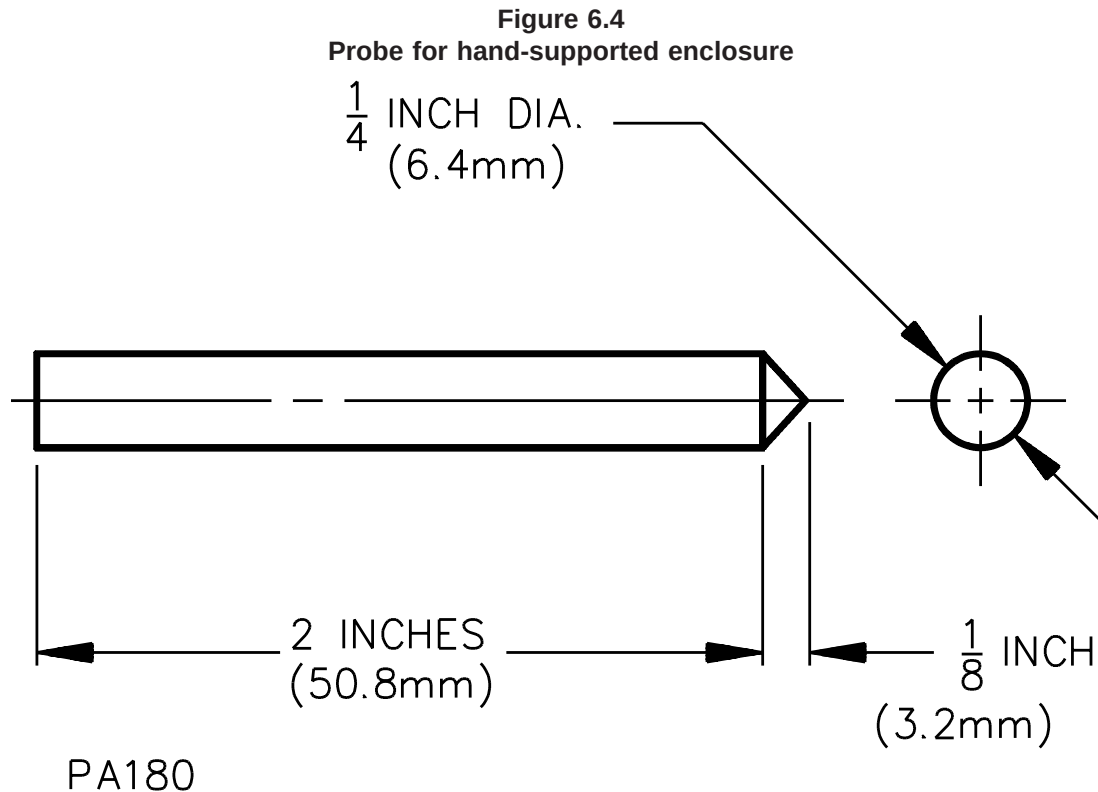
D – Location (horizontal) and minimum area for barrier. The area is that included inside the line of intersection traced out by the inclined line C and the horizontal plane of the barrier.

6.13 The criteria for judging a heating appliance enclosure, other than as described in 6.8, are given in 6.15 and 6.16 and in the following items and related illustrations:

- a) An opening in the enclosure is acceptable if the probe (illustrated in Figure 6.2), when inserted into the opening, cannot be made to touch any uninsulated live part of film-coated wire that involves a risk of electric shock. The probe is to be applied to any depth that the opening will permit; and shall be rotated and articulated in all possible configurations before, during and after insertion.
- b) An opening that will not prevent entrance of the probe as mentioned in (a) is acceptable under the conditions described in Figure 6.3.

Figure 6.2
Articulate probe with web stop





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

6.17 During the examination of a heating appliance in connection with the requirements in 6.8 – 6.13, a part of the outer enclosure that may be removed without the use of tools by the user of the product (for the attachment of accessories, for access to means for making operating adjustments, or for other reasons) is to be disregarded – that is, it is not to be assumed that the part in question affords protection against risk of electric shock. A warning marking, such as that specified in 47.6 is not considered to eliminate this risk of electric shock.

6.18 Any moving parts, such as rotors of motors, chains, pulleys, belts, and gears, shall be enclosed or guarded to reduce the risk of injury to persons.

6.19 With reference to the requirement in 6.18, the degree of protection required of the enclosure depends upon the general design and intended use of the product. The factors to be taken into consideration in judging the acceptability of exposed moving parts are:

- a) The degree of exposure;
- b) The sharpness of the moving parts;
- c) The likelihood of unintentional contact with the moving parts;
- d) The speed of movement of those parts; and

- e) The likelihood 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.

6.20 The door or cover of an enclosure shall be provided with a means for securing it in place in the closed position.

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

6.22 A component of a heating appliance that is likely to need inspection, replacement, cleaning, or other servicing shall be as accessible as possible. Except as noted in 6.23, the component shall be readily accessible without the use of special tools – tools not available to other than service personnel – if it is intended to be manually operated or adjusted or periodically serviced.

6.23 If a product is intended primarily for use in public places, such as gas stations, theaters, bus terminals, or the like:

- a) The construction may be such that special tools are required to gain access to components that are likely to need inspection, replacement, cleaning, adjustment, or other servicing.
- b) A door or cover giving access to an overload protective device need not be provided with a hinge, latch, or equivalent if the cover intended must be in place to perform its function.

6.24 The bulb and capillary tube of a thermostat shall be protected from physical damage if such damage of the tube or bulb may result in a risk of fire.

6.25 The mounting means of a wall-mounted insecticide vaporizer shall be such that:

- a) The product will be secured against tipping or dislodgement as a result of unintentional contact with the body of the product itself or with the power-supply cord; and
- b) The removal of the vaporizer can be accomplished readily, if it is necessary that the vaporizer be removed from its mounting for cleaning, refilling, or other servicing.

6.26 With reference to the requirement in 6.25, a simple keyhole slot or hanger ring is not acceptable as a mounting means unless other provisions are made, such that spillage of the insecticide will not result from tipping or dislodgement of the product.

6.27 If the enclosure of an insecticide vaporizer for wall mounting is of porcelain, glass, or other similarly brittle material, it shall not break or crack to the extent that uninsulated live parts will be exposed to contact, when dropped on a hardwood surface. The height through which the product is to be dropped is to be 8 ft (2.44 m) for a commercial-type vaporizer, and 6 ft (1.83 m) for a household product.

6.28 The sheath employed to enclose the heating element of an immersion-type heater for use with fuel oil shall be of steel, stainless steel, or other metal resistant to corrosion in fuel oil; brass, bronze, or copper is not considered acceptable for this application. The sheath employed to enclose the heating element of an immersion-type water heater shall be of a metal resistant to corrosion in water.

6.29 Openings provided in a soldering tool, such as for ventilating purposes, shall be of such size and orientation with respect to the soldering tip that entry of falling or dripping molten solder, or unintentional insertion of solder wire is not likely to contact, bridge, or otherwise reduce the spacings between uninsulated live parts of opposite polarity, or uninsulated live parts and accessible dead metal parts. Consideration shall be given to the orientation of the soldering tool during use.

6.30 A cord-connected product that is provided with keyhole slots, notches, hanger holes, or the like, for mounting the product on a wall shall be constructed in such a manner that the mounting means shall not be accessible without removing the product from the supporting means.

6.31 When determining compliance with 6.30, any part of the enclosure or barriers that can be removed without the use of tools to gain access to the mounting means are to be removed.

6.32 A keyhole slot, notch, or hanger hole shall be located so that the supporting screws or the like cannot damage any electrical insulation or contact uninsulated current-carrying parts of the product.

7 Assembly

7.1 A soldering iron, or other cord-connected heating appliance that is likely to be laid on combustible material shall be provided with a stand of noncombustible material upon which it may be placed when not in use, unless the temperature attained by the product is not high enough to cause the ignition of the combustible material.

7.2 The stand may be a separate device or attached to the product, except that an integral type of stand is required for a charcoal ignitor.

7.3 A switch, lampholder, attachment-plug receptacle, or plug-type connector provided as a part of a heating appliance shall be secured so that it is not likely to turn.

7.4 Uninsulated live parts shall be so secured to the base or surface that they are not likely to turn or shift in position as the result of stresses if such motion results in a reduction of spacings below the minimum required in 26.1.1.1 – 26.1.1.4.

7.5 Friction between surfaces is not acceptable as a means to keep live parts or components from shifting or turning. A lock washer, properly applied, is acceptable for this purpose.

8 Stability

8.1 The stability of a heating appliance shall be such that it will not be overturned readily during use.

8.2 A portable household heating appliance in which liquid is heated to a temperature greater than 115°F (46°C) is to be placed on a plane inclined at an angle of 15 degrees to the horizontal. The product is to be positioned and loaded with whatever combination of separable components, liquid, or other media (material) that results in the maximum tendency to overturn under conditions of intended use. The product is to contain at least 5 oz (148 mL) of liquid. The product is to be prevented from sliding on the inclined surface. The product shall not overturn as a result of this test.

8.3 To determine if a vaporizer in which water is heated complies with the requirements of 8.1, the product shall not overturn when subjected to the test described in 8.4.

8.4 The vaporizer is to be placed at any position of use on a plane inclined at an angle of 30 degrees to the horizontal. For this test the product is to be assembled and filled with liquid in any condition simulating operating conditions, so as to result in the maximum tendency to overturn. The product is to be supported so that it does not slide on the inclined plane.

9 Corrosion Protection

9.1 Except as noted in 9.2, iron and steel parts shall be protected against corrosion by enameling, galvanizing, plating, or other means, if the deterioration of such unprotected parts would be likely to result in risk of fire or electric shock.

9.2 In certain equipment where the oxidation of steel is not likely to be accelerated due to the exposure of metal to air and moisture or other oxidizing influence – thickness of metal and temperature also being factors – surfaces of sheet steel within an enclosure may not be required to be protected against corrosion. Cast-iron parts are not required to be protected against corrosion. A sheath employed on a heating element operating in air and terminal parts attached directly to the heating element need not be protected against corrosion.

9.3 The aging characteristics of plating or other finish used in a heating appliance shall be such that deterioration of the finish will not result eventually in unacceptable performance of the product.

10 Supply Connections – Permanently-Connected Products

10.1 General

10.1.1 Except as noted in 10.1.2 and 11.1.2, a product intended for permanent connection electrically to the power supply shall have provision for connection of one of the wiring systems that in accordance with the National Electrical Code, ANSI/NFPA 70, would be acceptable for the product.

10.1.2 An insecticide vaporizer intended for wall mounting may employ a flexible cord for connection to the power supply, provided that the length of the cord is not more than 3 ft (0.9 m) for a commercial product and not more than 6 ft (1.8 m) for a household product.

10.1.3 The location of a terminal box or compartment in which power-supply connections to a heating appliance intended to be permanently connected electrically are to be made shall be such that these connections may be readily inspected after the product is installed as intended.

10.1.4 A terminal compartment intended for the connection of a supply raceway shall be so attached to the product that it shall not turn with respect to the product.

10.1.5 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 component, such as a switch, a pilot light, or the like, may be mounted on a wiring compartment cover provided that:

- a) The component connecting leads are of such length to provide for the making, and examination, of field-wiring connections;*
- b) None of the component connections is to be field wired;*
- c) Strain relief is provided to prevent stress from being transmitted to the component wiring terminations, and complies with the strain relief test in 41.2;*
- d) The minimum size of the component leads is 18 AWG (0.82 mm²); and*
- e) Wiring terminations on the component are recessed or protected by barriers of insulating material or the equivalent that will provide protection from contact with wiring installed in the box, or unintentional contact during installation or inspection of field wiring.*

10.2 Wiring terminals

10.2.1 A heating appliance intended for permanent connection to the power supply shall be provided with wiring terminals or leads for the connection of conductors having an ampacity 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 will be intermittent.

10.2.2 For the purpose of these requirements, wiring terminals are considered to be terminals to which power-supply or control connections will be made in the field when the product is installed. It is to be assumed that 60°C (140°F) wire will be used for connections to a continuous-load type of heating appliance rated at 80 A or less and an intermittent-load type of heating appliance rated at 100 A or less. Wire rated for 75°C (167°F) will be assumed to be used with product rated in excess of these values.

10.2.3 A wiring terminal shall be provided with a soldering lug or with a pressure wire connector securely fastened in place for example, bolted or held by a screw, except that a wire-binding screw may be employed at a wiring terminal intended to accommodate a 10 AWG (5.3 mm²) or smaller conductor if upturned lugs or the equivalent are provided to hold the wire in position.

10.2.4 A wiring terminal shall not turn or shift in position. Friction between surfaces is not an acceptable means. An acceptable means may be by the use of two screws or rivets, by square shoulders or mortises, by a dowel pin, lug or offset, by a connecting strap or clip fitted into an adjacent part, or by some other equivalent method.

10.2.5 A wire-binding screw at a wiring terminal shall not be smaller than No. 10, except that a No. 8 screw may be used at a terminal intended only for the connection of a 14 AWG (2.1 mm²) or smaller conductor, and a No. 6 screw may be used for the connection of a 16 or 18 AWG (1.3 or 0.82 mm²) control-circuit conductor.

10.2.6 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 0.030 inch (0.8 mm) thick is acceptable if the tapped threads have acceptable mechanical strength. There shall be two or more full threads in the metal, which may be extruded if necessary to provide the threads.

10.2.7 Upturned lugs or a cupped washer shall be capable of retaining a conductor of the size mentioned in 10.2.1, but not smaller than 14 AWG (2.1 mm²), under the head of the screw or the washer.

10.2.8 A wire-binding screw shall thread into metal.

10.2.9 A heating appliance intended for connection to a grounded power-supply conductor and employing:

- a) A lampholder 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 the supply circuit. The identified terminal or lead shall be the one that is connected to screw shells of lampholders or element holders, and with no connection to single-pole switches or single-pole automatic controls, except as noted in 25.2.

10.2.10 A terminal provided for the connection of a grounded circuit conductor shall be made of or plated with a metal white in color, or have the word "white" located adjacent to the terminal and shall be readily distinguishable from the other terminals, or proper identification of that terminal shall be clearly shown in some other manner, such as on an attached wiring diagram. A lead intended for the connection of a grounded circuit conductor shall be finished to show a white or gray color and shall be distinguishable from the other leads.

10.2.11 Except as noted in 10.2.12, the free length of a lead inside an outlet box or wiring compartment shall be 6 inches (152 mm) or more if the lead is intended for field connection to an external circuit.

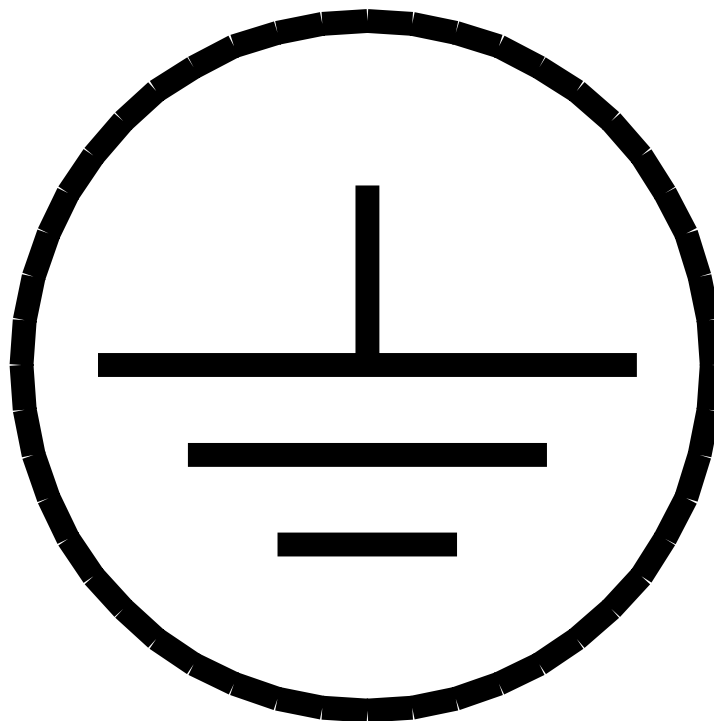
10.2.12 A lead may be less than 6 inches (152 mm) in length if it is evident that the use of a longer lead might result in a risk of fire or electric shock.

10.2.13 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 in the field wiring area shall be so identified.

10.2.14 A wire-binding screw intended for the connection of an equipment-grounding conductor shall be identified by:

- a) Use of a green-colored head that is slotted or hexagonal, or both; or
- b) The grounding symbol illustrated in Figure 10.1 on or adjacent to the terminal or on a wiring diagram provided on the product.

Figure 10.1
Grounding symbol



10.2.15 A pressure-wire connector intended for connection of such a conductor shall be plainly identified by:

- a) Being marked "G", "GR", "GND", "Ground", "Grounding" or the like;
- b) A marking on the wiring diagram provided on the heating appliance; or
- c) The grounding symbol illustrated in Figure 10.1 on or adjacent to the terminal or on a wiring diagram provided on the product.

10.2.16 The wire-binding screw or pressure-wire connectors shall be so located that it is unlikely to be removed during the servicing of the product.

10.2.17 A terminal intended solely for connection of an equipment-grounding conductor shall be capable of securing a conductor of the size acceptable for the particular product, in accordance with the National Electrical Code, ANSI/NFPA 70.

11 Supply Connections – Cord Connected Products

11.1 General

11.1.1 A cord-connected heating appliance shall be provided with a length of attached flexible cord and an attachment plug for connection to the supply circuit, or shall have male pin terminals that accommodate a detachable power-supply cord. The length of the cord shall be within the limits indicated in Table 11.1. All detachable power-supply cords and permanently-connected power-supply cords shall comply with the requirements of the Standard for Cord Sets and Power-Supply Cords, UL 817.

Table 11.1
Lengths of cord connection

Type of heating appliance	Kind of cord connection	Minimum acceptable length ^a		Maximum acceptable length ^a	
		ft	(m)	ft	(m)
Counter-top, bench-top, or table-top appliances intended for household use	Attached cord or detachable power-supply cord	2.0 ^b	(0.6) ^b	7.0	(2.1)
Soldering iron, guns, wood burning pencils	Attached cord	4.5	(1.4)	–	–
Soldering station	Attached cord or detachable power-supply cord	2.5 ^b	(0.8) ^b	–	–
Stock tank water heater (except floatation type), bucket heater, deicer and similar appliances used out of doors	Attached cord	2.0	(0.6)	6.0	(1.8)
Adhesive guns (hot melt), brooders, incubators, water stills	Attached cord	5.0	(1.5)	–	–
All other heating appliances intended for outdoor use	Attached cord or detachable power-supply cord	1.0 ^c	(0.3) ^c	–	–
All heating appliances not covered above	Attached cord or detachable power-supply cord	6.0	(1.8)	–	–
^a Measured external to the appliance and including the fittings but excluding the blades on the attachment plug. ^b See 47.12 when cord length is less than 4.5 ft (1.4 m). ^c See 47.33 when cord length is less than 6 ft (1.8 m).					

11.1.2 A cord-connected heating product intended to be fastened in place or located in a dedicated space may be acceptable if provided with a short length of flexible cord and an attachment plug for supply connection. The investigation of such a feature will include consideration of the utility of the product and the necessity of having it readily detachable from its source of supply by means of the attachment plug.

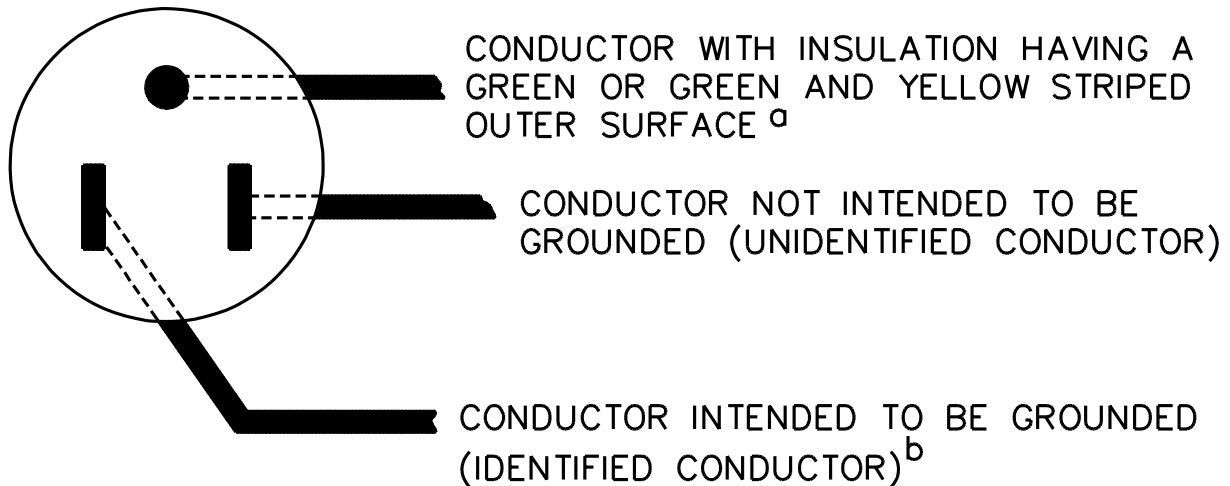
11.1.3 For a cord-connected heating appliance, the rating (both current and voltage) of the cord and the fittings, for a product rated at 15 A or less, shall not be less than that of the product. For a product rated at more than 15 A, the ampacity of the cord and fittings shall not be less than the current rating of the product. The current rating of the attachment plug shall not be less than 125 percent of the current rating of the product when the load will constitute a continuous load (3 hours or more), except that a 20-A attachment plug is acceptable for a product rated at no more than 4000 W at 240 V.

11.1.4 The attachment plug of the power-supply cord of an appliance provided with a 15- or 20-ampere general-use receptacle shall be of the 3-wire grounding type. The attachment plug of the power-supply cord of an appliance provided with either a manually operated, line-connected, single pole switch for appliance on-off operation or an Edison-base lampholder shall be of the 2-wire polarized or 3-wire grounding type.

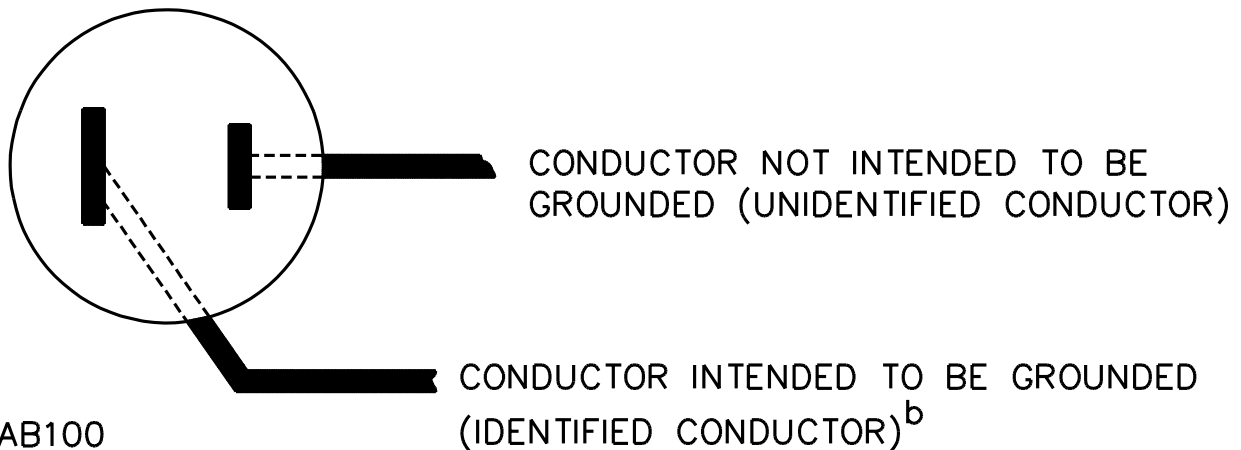
11.1.5 If a 3-wire grounding-type attachment plug or a 2-wire polarized attachment plug is provided, the attachment plug connections shall comply with Figure 11.1 and the polarity identification of the flexible cord shall comply with Table 11.2.

Figure 11.1
Connection to attachment plugs

CONNECTIONS OF CORD CONDUCTORS TO GROUNDING – TYPE
ATTACHMENT PLUG (FACE OF PLUG REPRESENTED)



CONNECTIONS OF CORD CONDUCTORS TO POLARIZED
ATTACHMENT PLUG (FACE OF PLUG REPRESENTED)



AB100

NOTES –

- 1) The blade to which the green conductor is connected may have a U-shaped or circular cross section.
- 2) Signifies a conductor identified in accordance with Table 11.2.

Table 11.2
Polarity identification of flexible cords

Method of identification	Acceptable combinations	
	Wire intended to be grounded ^a	All other wires ^a
Color of braids on individual conductors	A Solid white or gray – without tracer	Solid color other than white or gray – without tracer
	B Color other than white or gray, with tracer in braid	Solid color other than white or gray – without tracer
Color of insulation on individual conductors	C ^b Solid white or gray	Solid color other than white or gray
	C1 ^c Light blue	Solid color other than light blue, white, or gray
Color of separators	D ^d White or gray	Color other than white or gray
Other means	E ^e Tin or other white metal on all strands of the conductor	No tin or other white metal on the strands of the conductor
	F A stripe, ridge, or groove on the exterior surface of the cord	
^a A wire finished to show a green color with or without one or more yellow stripes or tracers is to be used only as an equipment grounding conductor. See 11.1.5 and Figure 11.1. ^b Only for cords – other than Types SP-1, SP-2, and SPT-1– having no braid on any individual conductor. ^c For jacketed cord. ^d Only for Types SP-1, SP-2, SPT-1, and SPT-2 cords. ^e Only for Types SPT-1 and SPT-2 cords.		

11.1.6 The conductor of the power-supply cord that is intended to be grounded, identified by Table 11.2, shall have the following items connected to it:

- a) The screw shell of an Edison-base lampholder; and
- b) The terminal or lead of a receptacle intended to be grounded.

11.1.7 A cord-connected product that is provided with keyhole slots, notches, hanger holes, brackets, or the like, for mounting to a wall shall be considered as not intended to be moved.

11.1.8 If a commercial-type heating appliance intended for cord connection does not have an attached cord, the male pins shall not accommodate a conventional flatiron or appliance plug, see 11.3.7 and Table 11.4, and a detachable power-supply cord shall be provided with the product.

11.1.9 An attached power-supply cord and the cord in a detachable power-supply cord that is provided with a heating appliance shall be of a type indicated in Table 11.3, or shall have such properties that it will be at least as serviceable for the particular application.

Table 11.3
Acceptable types of cord and applicable limitations of their use

Appliance on which the cord is to be used	Cords acceptable where temperatures are more than 121°C (250°F) on any surface that the cord is likely to touch when the appliance is used as intended	Cords acceptable where temperatures are 121°C (250°F) or less on any surface that the cord is likely to touch when the appliance is used as intended
Except as noted below, household heating appliances that are not intended for use outdoors	HPD, HPN, HSJ, HSJOO, or HSJO	HPD, HPN, HSJ, HSJOO, HSJO, SP-2, SPE-2, SPT-2, SV, SVO, SVE, SVOO, SVT, SVTO, SVTOO, SJ, SJO, SJE, SJOO, SJT, SJTO, or SJTOO
Except as noted below, poultry incubators and brooders, sterilizers, glue pots, solder pots, tire vulcanizers, insecticide vaporizers, and other commercial heating appliances that are not intended for use outdoors	HSJ, HSJOO, or HSJO	HSJ, HSJOO, HSJO, SJ, SJO, SJE, SJOO, SJT, SJTO, SJTOO, S, SO, SE, SOO, ST, STO, or STOO
Counter- or table-top laboratory appliances that are not intended for use outdoors, and have a mass not exceeding 1-1/4 lb (0.567 kg) ^a	HPN, HSJ, HSJOO, HSJO	HPN, HSJ, HSJOO, HSJO, SV, SVO, SVE, SVOO, SVT, SVTO, or SVTOO
Barbecue-spit motor	SJO, SJE, SJOO, SJT, SJTO, or SJTOO	SJO, SJE, SJOO, SJT, SJTO, or SJTOO
Wood-burning appliances (pencils), and 1/2 lb (0.227 kg) and lighter soldering irons, guns or adhesive guns (hot melt) ^a	TP or TPT maximums: 8 ft (2.4 m) cord, 50 W, and 1/2 lb (0.227 kg)	TP or TPT maximums: 8 ft (2.4 m) cord and 50 W
	SP-1, SPE-1, or SPT-1 (36 AWG or 0.127 mm strands are required)	SP-1, SPE-1, or SPT-1 (36 AWG or 0.127 mm strands are required)
	HPD	HPD
	XT (36 AWG or 0.127 mm strands, 20 AWG cord, and the parallel 2-conductor construction are required)	XT (36 AWG or 0.127 mm strands, 20 AWG cord, and the parallel 2-conductor construction are required)
Soldering irons or guns and adhesive guns (hot melt), heavier than 1/2 lb (0.227 kg) ^a	SP-2, SPE-2, or SPT-2 (36 AWG or 0.127 mm strands are required)	SP-2, SPE-2, or SPT-2 (36 AWG or 0.127 mm strands are required)
	SV, SVO, SVE, SVOO, SVT, SVTO, or SJTOO	SV, SVO, SVE, SVOO, SVT, SVTO, or SVTOO
	HPD, HPN, SJ, SJO, SJE, SJOO, SJT, SJTO, or SJTOO	HPD, HPN, SJ, SJO, SJE, SJOO, SJT, SJTO, or SJTOO
Heat-sealing irons	HPD, HPN, HSJ, HSJOO, or HSJO	HPD, HPN, HSJ, HSJOO, HSJO, SJ, SJO, SJE, SJOO, SJT, SJTO, or SJTOO
Household vaporizers	HPN, HSJ, HSJOO, or HSJO	HPN, HSJ, HSJOO, HSJO, SP-1, SPE-1, SPT-1, SP-2, SPE-2, or SPT-2
^a The weight of the appliance is to be determined without the power-supply cord and, for an adhesive gun, with the adhesive installed.		

Table 11.4
Pins of appliance and flatiron plugs

Type and rating of plug that accommodates the pins	Configuration of pins			Dimensions of pins	
	Number	Arrangement	Spacing between centers, inch (mm)	Diameter, inch (mm)	Length, inch (mm)
Appliance plug rated 5 A at 250 V and 10 A at 125 V	2	In line	1/2 (12.7)	0.156 ±0.005 (4.0±0.13)	9/16 – 5/8 (14.3 – 15.9)
Flatiron plug rated 5 A at 250 V and 10 A at 125 V	2	In line	11/16 (17.5)	0.188 ±0.005 (4.8 ±0.13)	3/4 – 7/8 (19.0 – 22.2)
Jumbo appliance plug rated 10 A at 250 V and 15 A at 125 V	2	In line	1-1/16 (27.0)	0.188 ±0.005 (4.8 ±0.13)	3/4 – 7/8 (19.0 – 22.2)
Reversible plug (for two-heat control) rated 10 A at 250 V and 15 A at 125 V ^a	3	In line	7/8 (22.2)	0.188 ±0.005 (4.8 ±0.13)	3/4 – 7/8 (19.0 – 22.2)
Reversible plug (for two- or three-heat control) rated 10 A at 250 V and 15 A at 125 V ^a	3	One pin at apex of an equilateral triangle	7/8 (22.2)	0.188 ±0.005 (4.8 ±0.13)	3/4 – 7/8 (19.0– 22.2)
^a Usually this plug is made without a contact in one of the holes.					

11.1.10 A vaporizer intended for use with glycol shall not employ thermoplastic-insulated flexible cord if the construction is such that the cord is likely to be exposed to the vapor.

11.1.11 The flexible cord provided with a stock tank de-icer, poultry water heater, or comparable heating appliance intended or likely to be used out of doors shall be suitable for outdoor use and have a type letter suffix of "W".

11.1.12 Supplementary insulation, if employed 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 affect adversely the means for providing strain relief.

11.1.13 An attachment plug having an Edison screw shell shall not be supplied with a cord-connected product rated at more than 6 A or 660 W.

11.1.14 If 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 47.25.

11.1.15 In addition to the requirement in 11.1.14, if the power source is not provided with a special connector, or if it is not permanently attached to the product, the power source shall comply with the applicable requirements for that power equipment.

11.2 Strain relief

11.2.1 Strain relief shall be provided to restrict a mechanical stress on an attached power-supply cord from being transmitted to terminals, splices, or interior wiring.

11.2.2 If wood, pressed board, or other fibrous material is used to secure the strain-relief assembly, the fibrous material shall be secured to the product by a pin, setscrew, or other positive means.

11.2.3 Means shall be provided to restrict an attached power-supply cord from being pushed into the enclosure of a product through the cord-entry hole. To determine compliance, the supply cord shall be tested in accordance with the Push-Back Relief Test, Section 42.

11.2.4 If a knot serves as strain relief in an attached power-supply cord, any surface with which the knot may come in contact shall be free from projections, sharp edges, burrs, fins, and the like, that may cause abrasion of the insulation on the conductors.

11.3 Pin terminals

11.3.1 If a heating appliance is provided with pin terminals, the construction of the product shall be such that live parts will not be exposed to unintentional contact both during and after the placement of the plug on the pins, in the intended manner.

11.3.2 A pin guard is required, such that:

a) A straight edge placed in any position, across and in contact with edges of the plug opening without the plug in place, cannot be made to contact any current-carrying pin.

b) With the plug aligned with the pins and the face of the plug in a plane located perpendicular to the end or ends of the farthest projecting current-carrying pin, the probe illustrated in Figure 6.4 should not touch any current-carrying pin while the probe is inserted through any opening with the product in any position.

11.3.3 The plug used in 11.3.2(b) is to be the plug supplied with the product.

11.3.4 If a heating appliance employs three or more pin terminals designed for use with a plug that covers all the pins, the terminals shall be so spaced that they will not accommodate a flatiron or appliance plug or cord connector. The plug which these pins will accommodate shall be acceptable for the particular application.

11.3.5 A pin terminal shall be securely mounted by means other than friction between surfaces, and shall not shift in position.

11.3.6 The requirement in 11.3.5 is intended primarily to provide for the maintenance of spacings as given in 26.1.1.1 and Tables 26.1 and 26.2 and to provide for the maintenance of proper spacings between pin terminals. Under this requirement, consideration is also to be given to the means for locking terminals in position to maintain tightness.

11.3.7 For a household-type heating appliance, the dimensions of pins and their center-to-center spacings – including the corresponding spacings of the female contacts of general-use plugs that these arrangements of pins will accommodate are as indicated in Table 11.4.

11.3.8 If a vaporizer is provided with pin terminals, they may be affected adversely by the steam spray or careless filling of the reservoir, consideration is to be given to:

- a) The material on which the pins are mounted;
- b) The proximity of the vapor outlet to the terminals;
- c) The direction of the vapor spray; and
- d) The likelihood of water being present but not necessarily visible at the terminals.

11.4 Bushings

11.4.1 At a point where a flexible cord passes through an opening in a wall, barrier, or enclosing case, there shall be a bushing or the equivalent that shall be secured in place, and shall have a smooth, well-rounded surface against which the cord may bear. If Type SP-1, SPT-1, SP-2, SPT-2, or other cord lighter than Type HSJ is employed, if the wall or barrier is of metal, and if the construction is such that the cord may be subjected to strain or motion, an insulating bushing shall be provided. The heat- and moisture-resistant properties of the bushing material shall be such that the bushing is acceptable for the particular application.

11.4.2 If the cord hole is in wood, porcelain, phenolic composition, or other nonconducting material, a smooth, well-rounded surface is considered to be equivalent to a bushing.

11.4.3 Ceramic materials and some molded compositions are acceptable generally for insulating bushings, but a separate bushing of wood, hot-molded shellac and tar composition, or rubber material (other than in a motor) is not acceptable. Vulcanized fiber may be employed if the bushing is not less than 3/64 inch (1.2 mm) thick and if it is so formed and secured in place that it will not be affected adversely by moist conditions.

11.4.4 A separate soft-rubber, neoprene, or polyvinyl chloride bushing may be employed in the frame of a motor or in the enclosure of a capacitor physically attached to a motor – but not elsewhere in a heating appliance, except as indicated in 11.4.5 – provided that:

- a) The bushing is not less than 3/64 inch (1.2 mm) thick; and
- b) The bushing is so located that it will not be exposed to oil, grease, oily vapor, or other substance having a deleterious effect on the compound employed.

11.4.5 A bushing of any of the materials mentioned in 11.4.4 may be employed at any point in a product if used in conjunction with a type of cord for which an insulating bushing is not required, and if the edges of the hole in which the bushing is mounted are smooth and free from burrs, fins, and the like.

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

12 Current-Carrying Parts

12.1 Each current-carrying part shall be made of metal that is acceptable for the particular application.

12.2 Current-carrying parts made of corrosion-resistant alloys, for example, stainless steel, are acceptable regardless of temperature. Current-carrying parts made of ordinary iron and steel are not acceptable unless they are rendered corrosion-resistant by a coating and, even then, they are acceptable only as follows:

- a) Pin terminals.
- b) Terminals and other parts of a motor and its governor (if any).
- c) Parts whose normal operating temperature is higher than 100°C (212°F).
- d) Parts of a component that the requirements referred to in 2.1 indicate as being acceptable with coated iron and steel parts.

12.3 A heating appliance that is provided with a reservoir (intended to hold a liquid), shall have all live parts so located or otherwise protected so that they will not be subject to wetting if the reservoir were to leak.

Exception: Live parts need not be so located or protected if the reservoir:

- a) Is resistant to corrosion from the liquid intended for use in it; and*
- b) Complies with the applicable requirements in Resistance to Impact, Section 37.*

13 Internal Wiring

13.1 General

13.1.1 The internal wiring of a heating appliance shall consist of wires of a size and type or types that are acceptable for the particular application, when considered with respect to:

- a) The temperature and voltage to which the wiring is likely to be subjected;
- b) Its exposure to oil or grease; and
- c) Other conditions of service to which it is likely to be subjected.

13.1.2 There is no temperature limit applicable to glass fiber, beads of inorganic material, or the equivalent employed as conductor insulation.

13.1.3 Thermoplastic-insulated wire employed for the internal wiring of a heating appliance shall be standard building wire, fixture wire, or appliance-wiring material acceptable for the particular application.

13.2 Protection of wiring

13.2.1 The wiring and connection between parts of a heating appliance shall be protected or enclosed, except that a length of flexible cord may be employed for external connections, or for internal connections that may be exposed during servicing, if flexibility of the wiring is essential. A bare conductor or a conductor with beads for insulation shall not be used outside an enclosure.

13.2.2 Internal wiring which is exposed through an opening in the enclosure of a heating appliance is considered to be protected as required in 13.2.1 if, when judged as if it were enamel-insulated wire, the wiring would be acceptable according to 6.8 – 6.13. Internal wiring within an enclosure is acceptable if, even though it can be touched with the probe, it is so protected or guarded that it cannot be grasped or hooked in such a manner that it could be subjected to stress.

13.2.3 Internal terminals and wiring of a vaporizer may be adversely affected by the steam spray or careless filling of the reservoir. Accordingly, the items mentioned in 11.3.8 should be given consideration.

13.2.4 If the wiring of a heating appliance is so located that it may be in proximity to combustible material or may be subjected to mechanical injury, it shall be armored cable or in rigid metal conduit, electrical metallic tubing, metal raceway, or shall otherwise be protected.

13.2.5 Wires within an enclosure, compartment, raceway, or the like, shall be so located or protected that damage to conductor insulation cannot result from contact with any rough, sharp, or moving part.

13.2.6 A hole by means of which insulated wires pass through a sheet-metal wall within the overall enclosure of a heating appliance shall be provided with a smooth, well-rounded bushing or shall have smooth, well-rounded surfaces upon which the wires may bear, so as not to abrade the insulation. A flexible cord used for external interconnection as mentioned in 13.2.1 shall be provided with a strain relief and bushings in accordance with 11.2.1 – 11.2.4 and 11.4.1 – 11.4.6 unless the construction is such that the cord will be protected from stress or motion.

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

13.3 Splices

13.3.1 All splices and connections shall be mechanically secure and shall provide good electrical contact. A soldered connection shall be made mechanically secure before being soldered if breaking or loosening of the connection may result in risk of fire or electric shock.

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

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

13.3.4 Where stranded internal wiring is connected to a wire-binding screw, loose strands of wire shall not contact any other uninsulated live part that is not always of the same polarity as the wire, and shall not contact any dead metal part. This may be accomplished by the use of pressure terminal connectors, soldering lugs, crimped eyelets, soldering all strands of the wire together, or other reliable means.

13.4 Separation of circuits

13.4.1 General

13.4.1.1 Unless provided with insulation rated for the highest voltage involved, insulated conductors of circuits connected to separate sources of supply shall be separated by barriers or segregated. Except as described in 13.4.1.3, an insulated conductor of one circuit shall be separated or segregated from any uninsulated live parts of a different circuit.

13.4.1.2 Segregation of insulated conductors may be accomplished by clamping, routing, or an equivalent means that provides permanent separation from insulated or uninsulated live parts of a different circuit.

13.4.1.3 Field-installed conductors of any circuit shall be segregated by barriers from:

a) Field-installation and factory-installed conductors connected to any other circuit, unless the conductors of both circuits are or will be insulated for the maximum voltage of either circuit; and

b) Uninsulated live parts of any other circuit of the product, and from any uninsulated live parts whose short-circuiting would result in a risk of fire or electric shock except that:

1) A construction in which field-installed conductors may make contact with wiring terminals is acceptable provided that Type THHN, TF, or equivalent conductors are or will be installed; and

2) A construction in which field-installed conductors that do or may have insulation less than the types of wire mentioned in (1) may make contact with low-voltage wiring terminals (see 13.4.2.1) is acceptable, provided that the short-circuiting of such terminals would not result in a risk of fire or electric shock.

13.4.1.4 With respect to 13.4.1.3(a), if the intended uses of a product are such that in some applications a barrier is required, a removable barrier or one having opening for the passage of conductors may be employed provided instructions for the use of the barrier are a permanent part of the product, and complete instructions in conjunction with a wiring diagram may be acceptable instead of a barrier if, upon investigation, the combination is found to be adequate.

13.4.1.5 Segregation of field-installation conductors from other field-installation conductors and from uninsulated live parts of a product connected to different circuits may be accomplished by arranging the location of the openings in the enclosure for the various conductors – with respect to the terminals or other uninsulated live parts – so that there is no likelihood of the intermingling of the conductors or parts of different circuits. If the number of openings in the enclosure does not exceed the minimum required for the proper wiring of the product, and if each opening is located opposite a set of terminals, it is to be assumed – for the purpose of determining whether the product complies with the requirement in 13.4.1.3 – that the conductors entering each opening will be connected to the terminals opposite the opening. If more than the minimum number of openings are provided, the possibility of conductors entering at points other than opposite the terminals to which they are intended to be connected and contacting insulated conductors or uninsulated current-carrying parts connected to a different circuit is to be investigated. To determine whether the product complies with the requirement in 13.4.1.3, it is to be wired as it would be in service, and in doing so, a reasonable amount of slack is to be left in each conductor, within the enclosure, and no more than average care is to be exercised in stowing this slack in the wiring compartment.

13.4.2 Low-voltage circuit

13.4.2.1 A low-voltage circuit is one involving a potential of not more than 30 V (42.4 volts peak) and supplied by a primary battery, by a standard Class 2 transformer, or by an impedance which, as a unit, complies with all of the performance requirements for a Class 2 transformer.

13.4.2.2 A circuit derived from a source of supply classified in 13.4.3.1 as a line-voltage circuit, by connecting resistance in series with the supply circuit as a means of limiting the voltage and current, is not considered to be a low-voltage circuit as described in 13.4.2.1.

13.4.3 Line-voltage circuit

13.4.3.1 A line-voltage circuit is one involving a potential of not more than 600 V and having circuit characteristics in excess of those of a low-voltage circuit.