UL 499

STANDARD FOR SAFETY

Electric Heating Appliances

UL Standard for Safety for Electric Heating Appliances, UL 499

Fourteenth Edition, Dated November 7, 2014

Summary of Topics

This revision of ANSI/UL 499 dated May 31, 2023 includes the following:

– Addition of new reference standards for battery chargers for heat guns operating from rechargeable battery power; SB3.1

– Clarification on Stability Test; 9.1 and 9.2

– New Supplement SD – Industrial Blanket Heaters;

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

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated April 14, 2023.

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Standard for Electric Heating Appliances

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The most recent designation of ANSI/UL 499 as an American National Standard (ANSI) occurred on May 31, 2023. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

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 ULSE at any time. Proposals should be submitted via a Proposal Request in the Collaborative Standards Development System (CSDS) at https://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 Except as noted for steam-bath generators, 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 53.42.

1.7 These requirements do not cover charcoal ignitors that have an integral electrically heated vessel.

2 Glossary

2.0 CHARCOAL IGNITORS – A handheld wand type of appliance with exposed sheath heating element for heating charcoal within a non-electric grill. This does not include charcoal igniters with an integral electrically heated vessel for charcoal preparation.

2.1 FLEXIBLE PET HEATING MATS/PADS – A pet heating mat/pad which employs a non-metallic enclosure (envelope) and can be easily bent or folded for storage.

2.2 HYBRID ADHESIVE GUN – An adhesive gun which can be operated under mains, battery, and mains-plus-battery inputs. Adhesive guns are also known as “hot melt guns” and “glue guns”. The requirements for hybrid adhesive guns do not currently contemplate battery recharging or trickle charging constructions.

2.3 INSTANTANEOUS WATER HEATER, BARE-ELEMENT – A water heater in which uninsulated heating elements are immersed in the water.

2.4 PET HEATING MATS/PADS – A heating appliance intended to provide warmth to a pet. Such a device may be used with or without additional fabric and fill based bedding.

2.5 RIGIDLY ENCLOSED PET HEATING MATS/PADS – A pet heating mat/pad which employs a stiff thermoplastic enclosure or metal enclosure such that the appliance can not be folded or rolled for storage when not in use.

2.6 SEMI-RIGID PET HEATING MATS/PADS – A pet heating mat/pad which employs a thermoplastic enclosure (envelope) or internal structure that allows the appliance to be rolled but not easily folded for storage.

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.

5.4 Adhesive guns shall be constructed such that adhesive is not discharged on the user's hand during normal operation.

6 Components

6.1 General

6.1.1 Except as indicated in 6.1.2, a component of a product covered by this Standard shall comply with the requirements for that component as indicated in 6.2.

6.1.2 A component of a product covered by this standard 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,

b) Is superseded by a requirement in this standard, or

c) Is separately investigated when forming part of another component, provided the component is used within its established rating and limitations.

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

6.1.4 A component that is also intended to perform other functions, such as over current protection, ground-fault circuit-interruption, surge suppression, any other similar functions, or any combination thereof, shall comply additionally with the requirements of the applicable Standard(s) that cover devices that provide those functions.

Exception: Where the other functions are not required for the application and not identified as part of markings, instructions or packaging for the appliance, the additional Standard(s) need not be applied.

6.1.5 Unless they also comply with the requirements of 6.2, components complying with standards other than those cited are not acceptable.

Exception: Other standards for components may fulfill these requirements provided that the standards:

a) Are compatible with the ampacity and overcurrent protection requirements in the National Electrical Code, NFPA 70, where appropriate,

b) Consider long-term thermal properties of polymeric insulating materials in accordance with the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B, and

c) Any use limitations of the other standards are identified and appropriately accommodated in this application. For example, components intended for industrial use and complying with relevant standards may assume user expertise not common in consumer applications.

6.1.6 Components not anticipated by the requirements of this Standard, not specifically covered by a component standard of 6.2, and which pose a potential risk of electric shock, fire or casualty hazard shall be additionally investigated. Reference to other product standards is appropriate where those standards anticipate normal and abnormal use conditions consistent with the application of this Standard.

6.1.7 Components shall not contain mercury.

6.2 Requirements for Components

6.2.1 Insulated Wire, Cable and Cords

6.2.1.1 A cord set or power supply cord shall comply with the Standard for Cord Sets and Power Supply Cords, UL 817.

6.2.1.2 Flexible cord and cables shall comply with the Standard for Flexible Cords and Cables, UL 62. Flexible cord and cables are considered to fulfill this requirement when preassembled in a cord set or power supply cord complying with Standard for Cord Sets and Power Supply Cords, UL 817.

6.2.1.3 Internal wiring composed of insulated conductors shall comply with the Standard for Appliance Wiring Material, UL 758.

Exception No. 1: Insulated conductors complying with the Standard for Thermoset-Insulated Wires and Cables, UL 44, the Standard for Thermoplastic-Insulated Wires and Cables, UL 83, or other types specified in Chapter 3 of the National Electrical Code, NFPA 70 complying with the appropriate standard, need not comply with UL 758.

Exception No. 2: Insulated conductors complying with the Standard for Fixture Wire, UL 66, need not comply with UL 758.

Exception No. 3: Insulated conductors for specialty applications (e.g. data processing or communications) need not comply with UL 758.

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

6.2.1.5 Film coated wire in intimate combination with one or more insulators, and incorporated in an insulation system rated Class 120 (E) or higher, shall comply with the magnet wire requirements in the Standard for Systems of Insulating Materials – General, UL 1446.

6.2.2 Attachment Plugs, Receptacles, Connectors and Terminals

6.2.2.1 Attachment plugs (including appliance and flat iron plugs) and receptacles that may be detached during use shall comply with the Standard for Attachment Plugs and Receptacles, UL 498, or as appropriate, the Standard for Plugs, Receptacles and Cable Connectors of the Pin and Sleeve Type, UL 1682.

Exception No. 1: Attachment plugs that are integral to cord sets and power supply cords need not comply with UL 498 or UL 1682.

Exception No. 2: Multi-pole connectors that may be detached during field wiring that comply with the Standard for Insulated Multi-Pole Splicing Wire Connectors, UL 2459 need not comply with UL 498 or UL 1682.

6.2.2.2 Electrical splices and connections accomplished via devices complying with the Standard for Electrical Quick – Connect Terminals, UL 310.

Exception: Electrical connections accomplished via devices complying with the Standard for Wire Connectors, UL 486A-486B, the Standard for Splicing Wire Connectors, UL 486C, the Standard for Sealed Wire Connector Systems, UL 486D, or the Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors, UL 486E.

6.2.2.3 Insulated splices complying with the Standard for Splicing Wire Connectors, UL 486C, (or the Standard for Electrical Quick-Connect Terminals, UL 310, are considered to fulfill the requirement of Section 16.

6.2.2.4 Terminal blocks shall comply with the Standard for Terminal Blocks, UL 1059, and where appropriate be indicated as suitable for field wiring.

6.2.3 Switches

6.2.3.1 Switches shall comply with the Standard for Switches for Appliances – Part 1: General Requirements, UL 61058-1.

Exception No. 1: Switches that comply with the Standard for General Use Snap Switches, UL 20; the Standard for Clock-Operated Switches, UL 917; the Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1, with the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Timers and Time Switches, UL 60730-2-7; or the Standard for Nonindustrial Photoelectric Switches for Lighting Control, UL 773A, are considered to fulfill this requirement.

Exception No. 2: Circuit breakers that comply with the Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures, UL 489, need not comply with UL 61058-1.

Exception No. 3: Switching devices that comply with appropriate standards for specialty applications (e.g. transfer switch equipment), industrial use (e.g. contactors, relays, auxiliary devices) or are integral to another component (e.g. switched lampholder) need not comply with UL 61058-1.

Exception No. 4: Switching devices that comply with Sections 26 and 43 need not comply with UL 61058-1.

6.2.4 Low-Voltage Circuit Transformers

6.2.4.1 A transformer complying with the Standard for Low Voltage Transformers – Part 1: General Requirements, UL 5085-1 and the Standard for Low Voltage Transformers – Part 3: Class 2 and Class 3 Transformers, UL 5085-3, need not comply with 14.4.2.

6.2.5 Light Sources and Associated Components

6.2.5.1 Lampholders and indicating lamps with integral lamp/lampholder (e.g. neon pilot lamp) shall comply with the Standard for Lampholders, UL 496. Lampholders forming part of a luminaire that complies with an appropriate luminaire standard are considered to fulfill this requirement.

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

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

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

Exception: Individual LED light sources mounted on printed wiring boards and intended for indicating purposes need not comply with UL 8750.

6.2.6 Heating Devices

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

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

Exception: For an indoor household handheld glue gun, the heater endurance is required to comply with a minimum 6,000 cycles with respect to Table 15.1 the Standard for Thermistor-Type Devices, UL 1434.

6.2.6.3 A flexible heating device shall comply with applicable requirements in the Standard for Electric Heating Pads, UL 130.

6.2.7 Controls

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

6.2.7.2 Except where superseded in this standard, a temperature control that complies with the construction requirements of the Standard for Temperature-Indicating and -Regulating Equipment, UL 873; the Standard for Limit Controls, UL 353; or the Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1, and the Standard for Automatic Electrical Controls – Part 2-9: Particular Requirements for Temperature Sensing Controls, UL 60730-2-9, is considered to comply with

the construction requirements of this standard. See Testing of Component Switches and Control Devices, Section 43 for performance requirements.

6.2.8 Cord Reel

6.2.8.1 A cord reel shall comply with “special use cord reel” requirements of the Standard for Cord Reels, UL 355.

6.2.9 Overcurrent Protection

6.2.9.1 Fuses shall comply with the Standard for Low-Voltage Fuses – Part 1: General Requirements, UL 248-1, and the applicable subsequent part (e.g. UL 248-5). Defined use fuses that comply with UL 248-1 and another appropriate standard for the fuse are considered to fulfill this requirement.

6.2.9.2 Fuseholders shall comply with the Standard for Fuseholders – Part 1: General Requirements, UL 4248-1, and applicable subsequent part (e.g. UL 4248-9).

6.2.9.3 Circuit breakers shall comply with the Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures, UL 489.

Exception: Circuit breakers used in telecommunications circuitry that comply with the Standard for Circuit Breakers For Use in Communications Equipment, UL 489A, need not comply with UL 489.

6.2.9.4 Circuit breakers having integral ground fault circuit interrupter capability for protection against electrical shock shall additionally comply with the Standard for Ground-Fault Circuit-Interrupters, UL 943.

6.2.10 Ground-Fault, Arc-Fault and Leakage Current Detectors/Interrupters

6.2.10.1 Ground-fault circuit-interrupters (GFCI) for protection against electrical shock shall comply with the Standard for Ground-Fault Circuit-Interrupters, UL 943.

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

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

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

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

6.2.11 Power Supplies

6.2.11.1 A Class 2 power supply shall comply with the Standard for Class 2 Power Units, UL 1310.

6.2.11.2 A non-Class 2 power supply shall comply with one of the following:

a) Standard for Power Units Other Than Class 2, UL 1012; or

b) Standard for Information Technology Equipment – Safety – Part 1: General Requirements, UL 60950-1; or

c) Standard for Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements, UL 62368-1.

6.2.11.3 Limited Power Source (LPS) power supplies shall comply with the Standard for Information Technology Equipment – Safety – Part 1: General Requirements, UL 60950-1 or the Standard for Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements, UL 62368-1.

6.2.12 Supplemental Insulation, Insulating Bushings and Assembly Aids

6.2.12.1 The requirements for supplemental insulation (e.g. tape, sleeving or tubing) are not specified unless the insulation or device is required to fulfill 14.3.3 or a performance requirement of this Standard. In such cases:

a) Sleeving shall comply with the Standard for Coated Electrical Sleeving, UL 1441,

b) Tubing shall comply with the Standard for Extruded Insulating Tubing, UL 224.

6.2.12.2 Wire positioning devices shall comply with Sections 15 and 17. A device that complies with the Standard for Positioning Devices, UL 1565, is considered to fulfill this requirement.

6.2.12.3 Insulating bushings that comply with the Standard for Insulating Bushings, UL 635, and 6.1.3 are considered to fulfill the requirements of this Standard. Tests specified in this standard (e.g. Strain Relief Test) may still need to be performed to confirm the combination of the insulating bushing and the supporting part are suitable.

6.2.13 Gaskets and Seals

6.2.13.1 Gaskets and seals that comply with the Standard for Gaskets and Seals, UL 157, are considered to fulfill the requirements of 36.1.4 and 36.1.5.

6.2.14 Printed Wiring Boards

6.2.14.1 Printed wiring boards shall comply with the Standard for Printed-Wiring Boards, UL 796. Unless otherwise specified, the flammability class shall be that specified for insulating materials.

7 Frame and Enclosure

7.1 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.

7.2 Pet heating mats/pads are evaluated as follows:

a) Rigidly enclosed pet heating mats/pads are evaluated to the applicable requirements detailed in this Standard.

b) Semi-rigid pet heating mats/pads are evaluated to the applicable requirements detailed in this Standard including the performance testing of 32.2, Sections 36.14 and 37; and the construction

requirements for Envelope and Insulation in Sections 6 and 7 of the Standard for Electric Heating Pads, UL 130. These appliances are for indoor use only.

c) Flexible pet heating mats/pads are evaluated to the applicable requirements of this Standard including the performance test of Section 37; and the Standard for Electric Heating Pads, UL 130. These appliances are for indoor use only.

Exception: Flexible pet heating mats/pads are not required to comply with the marking requirements in 46.2 – 46.12 in the Standard for Electric Heating Pads, UL 130.

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

7.4 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 15.3, 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.

7.5 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.

7.6 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.

7.6A With respect to 7.6, thermoset materials are considered suitable with respect to thermal aging if:

a) The thermoset material does not exceed 150°C (302°F) when subjected to the Normal Temperature Test the Normal Temperature Test, Section 36; or

b) The thermoset materials need not be subjected to the relative thermal capability requirements of Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. For a thermoset material operating at a temperature above its temperature rating, the Thermal Degradation Test of Section 49A, shall be conducted.

7.6B A nonmetallic enclosure, shall comply with the enclosure requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. A metal enclosure or shall be tested in accordance with Resistance To Impact Tests, Section 40.

7.7 A polymeric enclosure of outdoor use equipment shall comply with requirements contained in the Standard for Polymeric Materials – Use in Electrical Equipment, UL 746C, outdoor use requirements.

Exception: Enclosures identified as 3R enclosures complying with the Standard for Enclosures for Electrical Equipment, Non-Environmental Considerations, UL 50, or the Standard for Enclosures for Electrical Equipment, Environmental Considerations, UL 50E, are considered to comply with this requirement.

7.8 Outdoor use equipment shall be subjected to the Test of Insulation Resistance and Leakage Current as a Result of Moisture, Section 37, with acceptable results.

7.9 The enclosures of semi-rigid enclosed and flexible pet heating mats/pads shall have a minimum V-2 enclosure.

Exception: Semi-rigid enclosed and flexible pet heating mats/pads may employ a HB enclosure material if they comply with alternative path requirements detailed in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

7.10 Rigid molded enclosure parts of a semi-rigid enclosed or flexible pet heating mat/pad shall comply with the requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

7.11 Cast- and sheet-metal portions of the enclosure shall be no thinner than indicated in Table 7.1 unless the enclosure complies with 7.6 and 7.12.

Table 7.1
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 7.6.

7.12 In addition to the factors in 7.6, 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.

7.13 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 25.6). Insulated motor brush caps do not require additional enclosure.

7.14 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.

7.15 The requirement in 7.14 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.

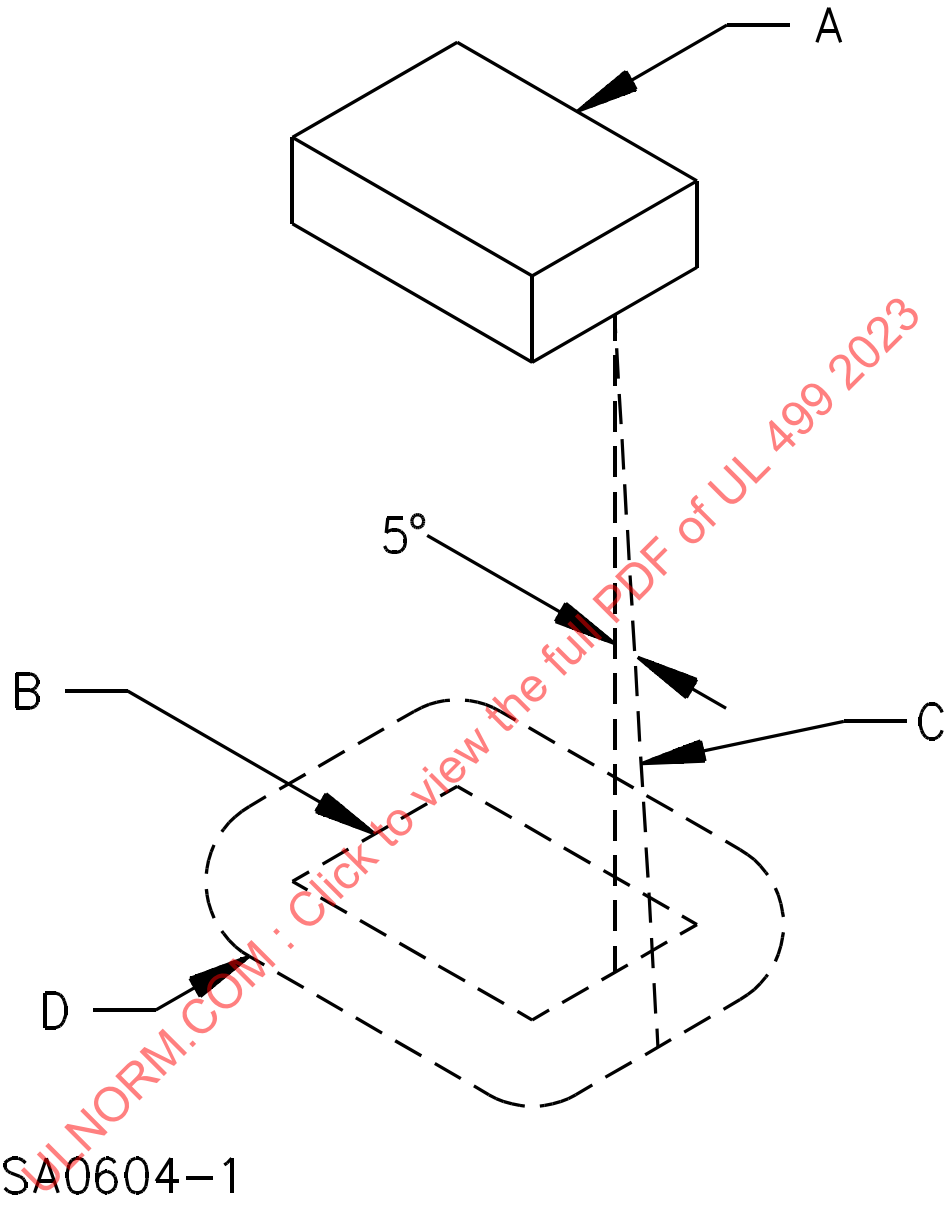
b) Under wiring, unless it complies with the VW-1 (Vertical-Specimen) Flame Test described in the Reference Standard for Electrical Wires, Cables, and Flexible Cords, UL 1581.

7.16 The requirement in 7.14 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.

7.17 The barrier mentioned in 7.15 shall be horizontal, shall be located as indicated in Figure 7.1, 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 7.1

Location and extent of barrier



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.

7.18 The criteria for judging a heating appliance enclosure, other than as described in 7.13, are given in 7.20 and 7.21 and in the following items and related illustrations:

a) An opening in the enclosure is acceptable if the probe (illustrated in Figure 7.2), 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 7.3.

Figure 7.2

Articulate probe with web stop

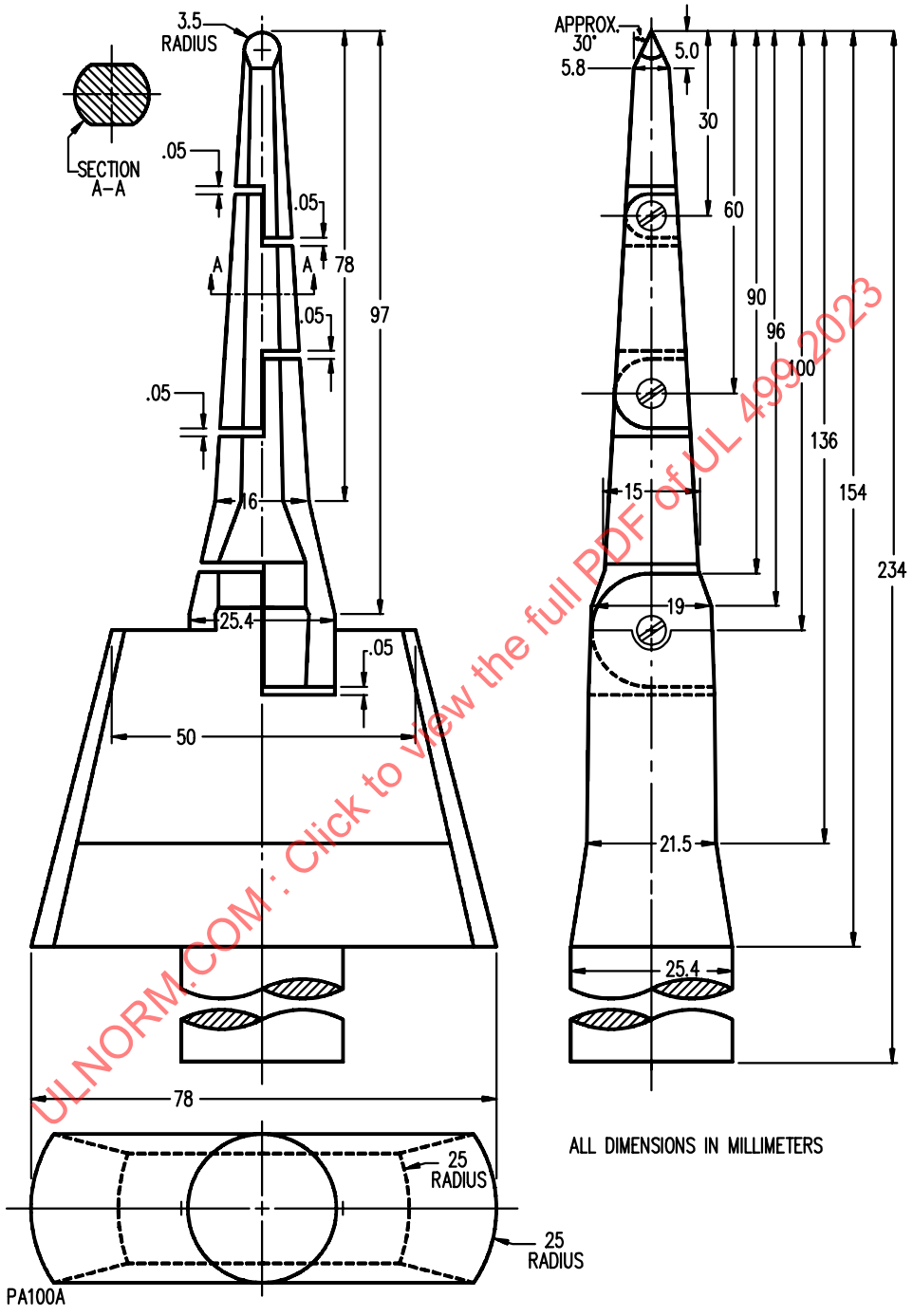
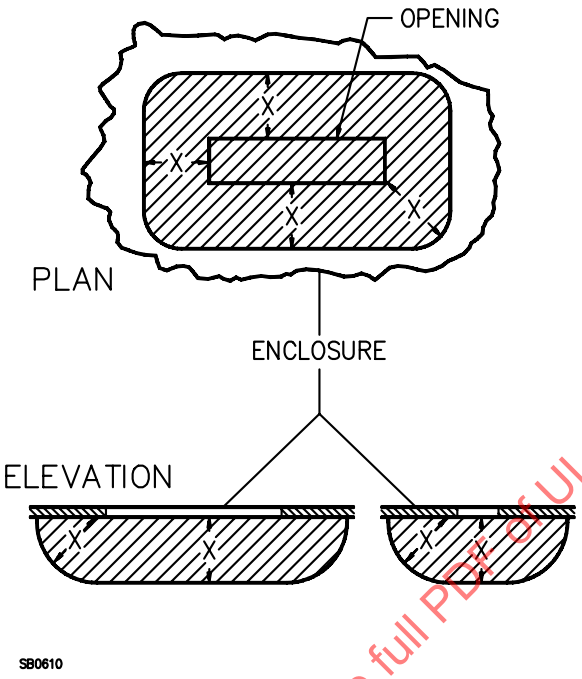


Figure 7.3

Opening in enclosure



proportions exaggerated for clarity

7.19 The opening illustrated in Figure 7.3 is acceptable if, within the enclosure, there is no uninsulated live part or enamel-insulated wire less than X distance from the perimeter of the opening, as well as within the volume generated by projecting the perimeter X distance perpendicular to its plane. X equals five times the diameter of the largest diameter rod which can be inserted through the opening, but not less than 4 inches (102 mm). In evaluating an opening, any barrier located within the volume usually is ignored unless it intersects the boundaries of the volume in a continuous, closed line.

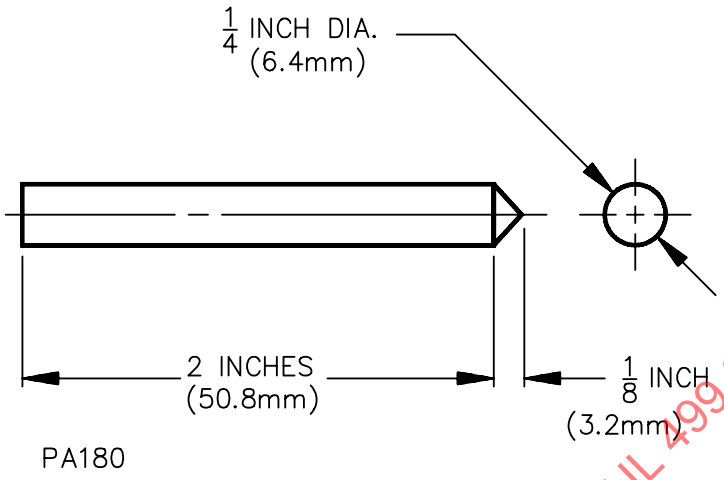
7.20 Although meeting the requirements in 7.18, an opening is unacceptable:

a) Anywhere in the enclosure of a hand-supported product; or

b) In any portion of a product hand-held during use if a probe as illustrated in Figure 7.4, when inserted point first a maximum distance of 2 inches (50.8 mm) into the opening touches any uninsulated live part or touches any enamel-insulated wire.

Figure 7.4

Probe for hand-supported enclosure



7.21 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.

7.22 During the examination of a heating appliance in connection with the requirements in 7.13 – 7.18, 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 53.6 is not considered to eliminate this risk of electric shock.

7.23 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.

7.24 With reference to the requirement in 7.23, 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.

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

7.26 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.

7.27 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 7.28, the component shall be readily accessible without the use of special tools – tools not available to other than service personnel – if it is intended to be manually operated or adjusted or periodically serviced.

7.28 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.

7.29 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.

7.30 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.

7.31 With reference to the requirement in 7.30, 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.

7.32 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.

7.33 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.

7.34 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.

7.35 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.

7.36 When determining compliance with 7.35, 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.

7.37 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.

8 Assembly

8.1 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.

8.2 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.

8.3 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.

8.4 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 27.1.1.1 – 27.1.1.4.

8.5 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.

9 Stability

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

Exception No. 1: A heating appliance that is completely hand supported, without the need of stand in normal use, need not be tested.

Exception No. 2: A heating appliance that is intended to be mounted to a supporting surface such as the floor, wall, or ceiling need not be tested.

Exception No. 3: An upright-type portable appliance that is hand guided while in use need not be tested. An upright-type appliance provided with facilities for non-hand guided operation, such as a hose, shall be tested with the appliance arranged for such non-hand guided operation.

9.2 An appliance shall be placed on a plane inclined at an angle of 10 degrees to the horizontal, except, 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. A product intended to hold liquid shall 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.

9.3 To determine if a vaporizer in which water is heated complies with the requirements of 9.1, the product shall not overturn when subjected to the test described in 9.4.

9.4 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.

10 Corrosion Protection

10.1 Except as noted in 10.2, 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.

10.2 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.

10.3 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.

11 Supply Connections – Permanently-Connected Products

11.1 General

11.1.1 Except as noted in 11.1.2 and 12.1.5, 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.

11.1.2 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.

11.1.3 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.

11.1.4 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.

11.1.5 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 44.2;

d) The minimum size of the component leads is 18 AWG (0.82 mm^2); 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.

11.2 Wiring terminals

11.2.1 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.

11.2.2 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.

11.2.3 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 mm^2) or smaller conductor if upturned lugs or the equivalent are provided to hold the wire in position.

11.2.4 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.

11.2.5 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 mm^2) 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 mm^2) control-circuit conductor.

11.2.6 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.

11.2.7 Upturned lugs or a cupped washer shall be capable of retaining a conductor of the size mentioned in 11.2.1, but not smaller than 14 AWG (2.1 mm^2), under the head of the screw or the washer.

11.2.8 A wire-binding screw shall thread into metal.

11.2.9 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 26.2.

11.2.10 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