



UL 1278

STANDARD FOR SAFETY

Movable and Wall-or Ceiling-Hung
Electric Room Heaters

UL Standard for Safety for Movable and Wall- or Ceiling-Hung Electric Room Heaters, UL 1278

Fourth Edition, Dated March 21, 2014

Summary of Topics

This revision of ANSI/UL 1278 dated May 29, 2025 replaces the revision dated May 27, 2025. A portion of [33.18](#), and the entirety of [20.3.4](#), [20.3.5](#), [33.19](#), [40.1.15](#), and Sections [42.4A](#) and [42.4B](#) were inadvertently omitted from the May, 27, 2025 revision and needed to be added.

The May 27, 2025 revisions included Portable Electric Heaters; [3.5A](#), [3.5B](#), [3.9A](#), [3.10A](#), [3.13A](#), [3.13B](#), [3.18.1](#), [3.19A](#), [4.9.5](#), [12.1A](#), [12.3](#), [12.4](#), Sections [16](#) – [16D](#), [20.2.7](#), [20.3.1](#), and [28.2.9](#).

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 revised requirements are substantially in accordance with Proposal(s) on this subject dated February 7, 2025.

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The most recent designation of ANSI/UL 1278 as an American National Standard (ANSI) occurred on May 27, 2025. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

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INTRODUCTION

1 Scope

1.1 These requirements cover movable and wall- or ceiling-hung electric room-heating equipment rated 600 volts or less to be employed in ordinary locations in accordance with the National Electrical Code, ANSI/NFPA 70.

1.2 These requirements do not cover fixed heaters, location-dedicated heaters, baseboard heaters, duct heaters, central-heating furnaces, fan-coil units, panel- or cable-type radiant-heating equipment, electric boilers, or any other electric heating equipment or appliances that are covered in or as a part of separate, individual requirements.

2 General

2.1 General

2.1.1 If the operation of a heater 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 an appliance having immersed electrodes, if the electrolysis of water may result in the accumulation of oxygen and hydrogen. The appliance is not acceptable unless its strength is such that it will withstand any risk of explosion that may be involved.

2.1.2 The requirements of this standard are based upon operation of a heater where it is manually placed by the user. The heater shall not be capable of moving autonomously or via remote control from the location in which it is manually placed by the user.

2.2 Terminology

2.2.1 Unless indicated otherwise, all voltage and current values mentioned in this standard are rms.

3 Glossary

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

3.2 **ANGLE OF CRITICAL BALANCE** – The minimum angle through which a heater must be tipped to cause it to tip over due solely to the force of gravity.

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

3.4 **APPLIANCE INLET (Motor Attachment Plug)** – A male contact device mounted on an end product appliance to provide an integral blade configuration for the connection of an appliance coupler or cord connector.

3.5 **APPLIANCE (FLATIRON) PLUG** – An appliance coupler type of device having a cord guard and a slot configuration specified for use with heating or cooking appliances.

3.5A **ATTACHMENT PLUG** – A male contact device which mates with an outlet.

3.5B **BARRIER** – Any part of the product (metallic or nonmetallic) internal to the housing that retards propagation of flame initiated by electrical disturbances or renders inaccessible, parts that may otherwise present a risk of electric shock, injury to persons.

3.6 CHARRING WITH CROSSCHECKING – Manifestation of ignition by separation of wood fibers in the direction with the grain and also in the direction across the grain.

3.7 COMMERCIAL/INDUSTRIAL HEATER – Any heater that is either:

- a) Rated 2 kilowatts or greater and marked as a commercial/industrial heater in accordance with [67.10](#),
- b) Rated greater than 250 volts,
- c) A polyphase heater, or
- d) Rated greater than 6 kilowatts.

3.8 COMPONENT – A device or fabricated part of the appliance covered by the scope of a safety standard dedicated to the purpose. When incorporated in an appliance, equipment otherwise typically field installed (e.g. luminaire) is considered to be a component. Unless otherwise specified, materials that compose a device or fabricated part, such as thermoplastic or copper, are not considered components.

3.9 CONTROL CIRCUIT – A circuit that carries the electric signals directing the operation of a controller which, in turn, governs power delivered to a motor or other load. A control circuit does not carry the main power current.

3.9A CONNECTOR – The connector is intended to contact a matching connector configuration and the integral extension is part, located within the connector, to which the conductor of a flexible cord is connected.

3.10 CORD CONNECTOR – A female contact device wired on flexible cord for use as an extension from an outlet to make a detachable electrical connection to an attachment plug or, as an appliance coupler, to an equipment inlet.

3.10A CRIMPED CONNECTION – An electro-mechanical connection made between a connector and a conductor by compressing the portion of the connector, termed "the integral extension" in [16D.8](#), against the conductor.

3.10.1 ELECTRICAL CONNECTION – The physical interface between two points in a circuit such as spade terminals, pin terminals, micro switch contacts, relay contacts, timer contacts, crimped connections, and connections that are welded or soldered.

3.11 ELEVATED USE LOCATION – A stationary horizontal surface (for example, table, desk or shelf) where a heater is likely to be used if the heater weighs less than 8 lbs (3.6 kg), and:

- a) The heater advertised as being suitable for use at an elevated location in literature or operating instructions furnished with the heater or by marking on the heater or its packaging, or
- b) The overall dimensions of the heater, including any permanently extending handles, grilles, feet or stands do not exceed any one of the following:
 - 1) Total added dimensions of length, height, and depth – 30 inches (76.2 cm).
 - 2) Length – 24 inches (61 cm).
 - 3) Height – 14 inches (35.6 cm).

3.12 FIXED HEATER – A heater that is fastened or otherwise assigned to a specific location, and is permanently wired to the branch circuit.

3.13 FLASH POINT – The minimum temperature of a flammable liquid at which sufficient vapor is given off to form an ignitable mixture with the air near the surface of the liquid or within the vessel used, as determined by appropriate test procedure and apparatus.

3.13A HEATER-USE ATTACHMENT PLUG – An attachment plug intended for use with heater-use power-supply cords.

3.13B HEATER-USE POWER-SUPPLY CORD – A length of flexible cord having a heater-use attachment plug intended for use with 120V portable heaters.

3.14 IGNITION – Glowing, emission of embers, or flaming of the materials described in [42.1.9](#) – [42.1.13](#). Charring without glowing or without emission of embers is not ignition.

3.15 LINE-VOLTAGE CIRCUIT – A circuit involving a potential of not more than 600 volts, and having circuit characteristics in excess of those of a low-voltage or an isolated-limited-secondary circuit.

3.16 LOCATION-DEDICATED HEATER – A cord-connected heater that is normally placed in one location for usage such as:

- a) Cord-connected wall- or ceiling-mounted heater, or
- b) Freestanding cord-connected heater that exceeds the weight and/or dimension limitations of a movable heater.

3.17 LOW-VOLTAGE (SECONDARY) CIRCUIT – A circuit involving a potential of not more than 30 volts alternating-current, (42.4 volt peak or direct-current), and supplied by a primary battery or by a standard Class 2 transformer, or by a combination of transformer and fixed impedance that, as a unit, complies with all the performance requirements for a Class 2 transformer. A circuit derived from a source of supply classified as a line voltage circuit, using resistance in series with the supply circuit as a means of limiting the voltage and current, is not considered to be a low voltage nor an isolated limited secondary circuit.

3.18 MOVABLE HEATER – A freestanding cord and plug connected heater that does not exceed 65 pounds (29.4 kg) and has no dimension greater than 8 feet (2.4 m). A wall- or ceiling-hung heater which may be used as a movable heater without further guiding or propping, is also considered a movable heater.

3.18.1 ENCLOSURES – That part of the product (metallic or nonmetallic) that:

- a) Renders inaccessible all or any parts of the equipment that may otherwise present a risk of electric shock, injury to persons, and
- b) Retards propagation of flame initiated by electrical disturbances occurring within.

3.19 TEMPERATURE CONTROLS – Devices that respond with a change in temperature (thermostatic devices) may be one of the following types:

- a) Regulating – Functions only to regulate the temperature of the heater under intended conditions of use, and whose malfunction would not result in a risk of fire.
- b) Limiting – Functions only under conditions that produce abnormal temperatures. The malfunction of such a device will result in a risk of fire.
- c) Auxiliary – Thermostatic device other than of the regulating or limiting type.

d) Operating Control – A control intended to start or regulate the heater during normal operation. An example would be a temperature-regulating control. An operating control could provide Type 1 or Type 2 action. (See definitions [3.20](#) – [3.23](#)).

e) Protective Control – A control intended to reduce the risk of electric shock, fire, or injury to persons during abnormal operation of the heater. An example would be a temperature limiting control. A protective control always provides Type 2 action. (See definitions [3.20](#) – [3.23](#)).

3.19A TIP-OVER SWITCH – An electro-mechanical switching device or electronic switching circuit that detects if the appliance is not in its intended operating position.

3.20 TYPE 1 ACTION – Automatic action for which the manufacturing deviation and the drift of its operating value, operating time, or operating sequence have not been declared and tested to the Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1.

3.21 TYPE 2 ACTION – Automatic action for which the manufacturing deviation and the drift of its operating value, operating time, or operating sequence have been declared and tested to the Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1.

3.22 TYPE 2.H ACTION – So designed that the contacts cannot be prevented from opening and which may automatically reset to the closed position if the reset means is held in the reset position. The control shall not reset automatically at any temperature above -35°C.

3.23 TYPE 2.J ACTION – So designed that the contacts cannot be prevented from opening, and the control is not permitted to function as an automatic reset device if the reset means is held in the reset position. The control shall not reset automatically at any temperature above -35°C.

3.24 VISIBLY GLOWING HEATING ELEMENT – A heating element whose visible portion attains a temperature of at least 650°C (1202°F) under intended conditions of operation.

3.25 WALL (OR CEILING) HUNG HEATER – A cord-connected heater having a mass not exceeding 50 pounds (22.7 kg) that is attached to the wall (or ceiling) in such a manner that it can be removed without the use of tools.

3.26 WALL (OR CEILING) MOUNTED HEATER – A heater that is permanently attached to the wall (or ceiling) in such a manner that tools are necessary for its removal.

4 Components

4.1 General

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

- a) Comply with the requirements for that component as indicated in [4.2](#) – [4.10](#);
- b) Be used in accordance with its rating(s) established for the intended conditions of use;
- c) Be used within its established use limitations or conditions of acceptability;
- d) Additionally comply with the applicable requirements of this end product standard; and

Exception No. 1: A component of a product covered by this standard is not required to comply with a specific component requirement that:

- a) *Involves a feature or characteristic not required in the application of the component in the product;*
- b) *Is superseded by a requirement in this standard; or*
- c) *Is separately investigated when forming part of another component, provided the component is used within its established ratings and limitations.*

Exception No. 2: A component that complies with a UL component standard other than those specified in [4.2](#) – [4.10](#) is acceptable if:

- a) *The component also complies with the applicable component standard specified in [4.2](#) – [4.10](#); or*
- b) *The component standard:*
 - 1) *Is compatible with the ampacity and overcurrent protection requirements in the National Electrical Code, ANSI/NFPA 70 where applicable;*
 - 2) *Considers long-term thermal properties of polymeric insulating materials in accordance with the Standard for Polymeric Materials - Long Term Property Evaluations, UL 746B; and*
 - 3) *Any use limitations of the other component standard is identified and appropriately accommodated in the end use application. For example, a component used in a household application, but intended for industrial use and complying with the relevant component standard may assume user expertise not common in household applications.*

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

4.1.3 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 UL standard(s) that cover devices that provide those functions.

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

4.1.4 A component not anticipated by the requirements of this end product standard, not specifically covered by the component standards in [4.2](#) – [4.10](#), and that involves a risk of fire, electric shock, or injury to persons, shall be additionally investigated in accordance with the applicable UL standard, and shall comply with [4.1.1](#)(b) – (e).

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

4.2 Attachment plugs, receptacles, connectors, and terminals

4.2.1 Attachment plugs, receptacles, appliance couplers, appliance inlets (motor attachment plugs), and appliance (flatiron) plugs, shall comply with the Standard for Attachment Plugs and Receptacles, UL 498. See [4.2.2](#).

Exception: Attachment plugs and appliance couplers integral to cord sets or power supply cords that are investigated in accordance with the Standard for Cord Sets and Power Supply Cords, UL 817 are not required to comply with UL 498.

4.2.2 Female devices (such as receptacles, appliance couplers, and connectors) that are intended, or that may be used, to interrupt current in the end product, shall be suitably rated for current interruption of the specific type of load, when evaluated with its mating plug or connector. For example, an appliance coupler that can be used to interrupt the current of a motor load shall have a suitable horsepower rating when tested with its mating plug.

4.3 Controls

4.3.1 General

4.3.1.1 Auxiliary controls shall be evaluated in accordance with the applicable requirements of this end product standard unless otherwise specified; see [4.3.1.7](#).

4.3.1.2 Operating (regulating) controls shall be evaluated in accordance with the applicable component standard requirements specified in [4.3.2](#) – [4.3.6](#), if applicable, unless otherwise specified in this end product standard; see [4.3.1.7](#).

4.3.1.3 Operating controls that rely upon software for the normal operation of the end product where deviation or drift of the control may result in a risk of fire, electric shock, or injury to persons, such as a speed control unexpectedly changing its output, shall comply with one of the following:

- a) The Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991, and the Standard for Software in Programmable Components, UL 1998; or
- b) The Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1.

4.3.1.4 Protective (limiting) controls shall be evaluated in accordance with the applicable component standard requirements specified in [4.3.2](#) – [4.3.6](#), unless otherwise specified in this end product standard.

4.3.1.5 Solid-state protective controls that do not rely upon software as a protective component shall comply with one of the following:

- a) The Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991; or
- b) The Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1, except the Controls Using Software requirements, Clause H 11.12.

4.3.1.6 Solid-state protective controls that rely upon software as a protective component shall comply with one of the following:

- a) The Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991, and the Standard for Software in Programmable Components, UL 1998; or
- b) The Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1.

4.3.1.7 An electronic, auxiliary or operating control (e.g. a non-protective control), the failure of which would not increase the risk of fire, electric shock, or injury to persons, need only be subjected to the applicable requirements of this end product standard.

4.3.2 Electromechanical and electronic controls

4.3.2.1 A control, other than as specified in [4.3.3](#) – [4.3.6](#), shall comply with one of the following:

- a) The Standard for Solid-State Controls for Appliances, UL 244A;
- b) The Standard for Temperature-Indicating and -Regulating Equipment, UL 873; or
- c) The Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1.

4.3.3 Liquid level controls

4.3.3.1 A liquid level control shall comply with one of the following:

- a) The Standard for Solid-State Controls for Appliances, UL 244A;
- b) The Standard for Temperature-Indicating and -Regulating Equipment, UL 873;
- c) The Standard for Industrial Control Equipment, UL 508; or
- d) The Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1, and;
 - 1) *Deleted*
 - 2) *Deleted*
 - 3) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Automatic Electrical Air Flow, Water Flow and Water Level Sensing Controls, UL 60730-2-15.

4.3.4 Motor and speed controls

4.3.4.1 A control used to start, stop, regulate or control the speed of a motor shall comply with one of the following:

- a) The Standard for Solid-State Controls for Appliances, UL 244A;
- b) The Standard for Temperature-Indicating and -Regulating Equipment, UL 873;
- c) The Standard for Industrial Control Equipment, UL 508;
- d) *Deleted*
- e) The Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1; or
- f) The Standard for Adjustable Speed Electrical Power Drive Systems – Part 5-1: Safety Requirements – Electrical, Thermal and Energy, UL 61800-5-1.

4.3.5 Pressure controls

4.3.5.1 A pressure control shall comply with one of the following:

- a) The Standard for Temperature-Indicating and -Regulating, UL 873;
- b) The Standard for Industrial Control Equipment, UL 508; or

- c) The Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1; and the Standard for Automatic Electrical Controls – Part 2-6: Particular Requirements for Automatic Electrical Pressure Sensing Controls Including Mechanical Requirements, UL 60730-2-6.

4.3.6 Timer controls

4.3.6.1 A timer control shall comply with one of the following:

- a) The Standard for Solid-State Controls for Appliances, UL 244A; or
- b) The Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1; and the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Timers and Time Switches, UL 60730-2-7.

4.4 Internal wiring

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

Exception No. 1: Insulated conductors need not comply with UL 758 if they comply with one of the following:

- a) *The Standard for Thermoset-Insulated Wires and Cables, UL 44;*
- b) *The Standard for Thermoplastic-Insulated Wires and Cables, UL 83;*
- c) *The applicable UL standard(s) for other insulated conductor types specified in Chapter 3, Wiring Methods and Materials, of the National Electrical Code, ANSI/NFPA 70.*

Exception No. 2: Insulated conductors for specialty applications (e.g. data processing or communications) and located in a low-voltage circuit not involving the risk of fire, electric shock or injury to persons need not comply with UL 758.

4.5 Film-coated wire (magnet wire)

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

4.5.2 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.

4.6 Printed wiring boards

4.6.1 Printed wiring boards, including the coatings, shall comply with the Standard for Printed Wiring Boards, UL 796.

Exception: A printed-wiring board in a Class 2 nonsafety circuit is not required to comply with the bonding requirements in UL 796 if the board is separated from parts of other circuits such that loosening of the bond between the foil conductor and the base material will not result in the foil conductors or components coming in contact with parts of other circuits of the control or of the end-use product.

4.6.2 A printed-wiring board containing circuitry in a line-connected circuit or a safety circuit shall comply with the direct-support requirements for insulating materials in Electrical Insulation, Section [23](#) of this end product standard.

4.6.3 Unless otherwise specified, the flammability class and temperature rating shall be that as specified in Electrical Insulation, Section [23](#) of this end product standard.

4.7 Semiconductors and small electronic components

4.7.1 A power switching semiconductor device that is relied upon to provide isolation to ground shall comply with the Standard for Optical Isolators, UL 1577. The Dielectric Voltage Withstand Tests required by UL 1577 shall be conducted applying the requirements of the Dielectric Voltage Withstand Test, Section [48](#), of this end product standard.

4.7.2 An optical isolator that is relied upon to provide isolation between primary and secondary circuits or between other circuits as required by this end product standard shall comply with the Standard for Optical Isolators, UL 1577. The Dielectric Voltage Withstand Tests required by UL 1577 shall be conducted applying the requirements in Dielectric Voltage Withstand Test, Section [48](#) of this end product standard.

4.7.3 Except as specified in [4.7.4](#), component requirements are not specified for small electronic components on printed wiring boards, including diodes, transistors, resistors, inductors, integrated circuits, and capacitors not directly connected to the supply source.

4.7.4 Where an electronic component is determined to be a critical component during the Abnormal Operation Tests, Section [42](#), one of the following standards shall be applied:

- a) The Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991; and as applicable, the Standard for Software in Programmable Components, UL 1998 for controls that rely upon software as a protective component; or
- b) The Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1.

4.7.5 A critical component, as specified in [4.7.4](#), is a component that performs one or more safety-related functions whose failure results in a condition, such as the risk of fire, electric shock, or injury to persons, in the end product application.

4.7.6 A critical component as specified in [4.7.4](#), may also be identified using a failure-mode and effect analysis (FMEA) in accordance with the Failure-Mode and Effect Analysis (FMEA) requirements in the Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991.

4.7.7 Portions of a circuit comprised of a microcontroller or other programmable device that performs a back-up, limiting, or other safety function intended to reduce the risk of fire, electric shock, or injury to persons shall comply with the Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1, Annex H.

4.8 Supplemental insulation, insulating bushings, and assembly aids

4.8.1 The requirements for supplemental insulation (e.g. tape, sleeving or tubing) are not specified unless the insulation or device is required to comply with [20.3](#) or a performance requirement of this end product standard. In such cases, the insulation shall comply with the following applicable standards:

- a) Insulating tape shall comply with the Standard for Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape, UL 510;
- b) Sleeving shall comply with the Standard for Coated Electrical Sleeving, UL 1441, or

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

4.8.2 Wire positioning devices shall comply with the requirements in Electrical Insulation, Section [23](#). A device that complies with the Standard for Positioning Devices, UL 1565, is considered to comply with this requirement.

4.8.3 Insulating bushings that comply with the requirements in General, Section [4.1](#), of this end product standard, and the Standard for Insulating Bushings, UL 635 are considered to comply with the requirements of this end product standard. Tests specified in this end product standard (e.g. Strain Relief Test, Section [59](#)) may still need to be performed to confirm the combination of the insulating bushing and the supporting part comply with the intent of the requirements.

4.9 Switches

4.9.1 Switches shall comply with one of the following:

- a) *Deleted*
- b) The Standard for Switches for Appliances – Part 1: General Requirements, UL 61058-1;
- c) The Standard for General-Use Snap Switches, UL 20; or
- d) The Standard for Nonindustrial Photoelectric Switches for Lighting Control, UL 773A.

Exception: Switching devices that comply with the applicable UL 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 this requirement.

4.9.2 A clock-operated switch, in which the switching contacts are actuated by a clock-work, by a gear-train, by electrically-wound spring motors, by electric clock-type motors, or by equivalent arrangements shall comply with one of the following:

- a) The Standard for Clock-Operated Switches, UL 917; or
- b) The Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1, and the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Timers and Time Switches, UL 60730-2-7.

4.9.3 A timer or time switch, incorporating electronic timing circuits or switching circuits, with or without separable contacts, shall comply with the requirements for an operating control with Type 1 action for 6000 cycles of operation, or as a manual control for 5000 cycles of operation, in accordance with one of the following:

- a) The Standard for Solid-State Controls for Appliances, UL 244A; or
- b) The Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1; and the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Timers and Time Switches, UL 60730-2-7.

4.9.4 A timer or time switch, incorporating electronic timing circuits or switching circuits, with or without separable contacts, that functions as a protective control, shall comply with the requirements for a protective control; see [4.3.1.3](#).

4.9.5 A moveable heater shall employ a tip-over switch. Wall (or ceiling) hung or mounted heaters need not comply with this requirement. Heaters rated 208 V or more need not comply with this requirement.

4.10 Transformers

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

Exception No. 1: A transformer that is completely enclosed within the end product enclosure, and that complies with the applicable construction and performance requirements of this end product standard when tested in conjunction with the end product, complies with the intent of this requirement.

Exception No. 2: A transformer that complies with the Standard for Transformers and Motor Transformers for Use in Audio-, Radio-, and Television-Type Appliances, UL 1411, and that is used in a circuit involving an audio or video component complies with the intent of this requirement.

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

Exception: Transformers located in a low voltage circuit, and that do not involve a risk of fire, electric shock or injury to persons need not comply with this requirement.

5 Units of Measurement

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

6 References

6.1 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

7 Enclosure

7.1 The enclosure of a heater shall be so formed and assembled that it will have the strength and rigidity necessary to resist the abuses likely to be encountered during its intended service. The degree of resistance inherent in the appliance shall preclude total or partial collapse with the attendant reduction of spacings, loosening or displacement of parts, and other serious defects which alone or in combination constitute a risk of fire, electric shock, explosion, or injury to persons.

7.2 Among the factors taken into consideration if an enclosure is being judged for acceptability are its:

- a) Mechanical strength,
- b) Resistance to impact,
- c) Moisture-absorption properties,
- d) Flammability,
- e) Resistance to corrosion, and
- f) Resistance to distortion at temperatures

to which the enclosure may be subjected under conditions of intended or abnormal use. For the requirements for a polymeric enclosure or part of an enclosure of a polymeric material, see Polymeric Materials, Section [12](#).

7.3 The enclosure of a heater shall prevent molten metal, burning insulation, flaming particles, or similar material from falling on combustible materials, including the surface upon which the heater is supported.

7.4 The requirement in [7.3](#) necessitates use of a barrier:

a) Under a motor unless:

- 1) The structural parts of the motor or of the heater 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 heater if 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 will prevent the temperature of the motor windings from becoming more than 125°C (257°F) under the maximum load under which the motor will run without causing the protector to cycle, and from becoming more than 150°C (302°F) with the rotor of the motor locked, or
- 4) The motor is impedance protected and the locked-rotor temperature of the motor winding is not more than 150°C (302°F) with the heater otherwise operating as intended.

b) Under wiring, unless the wire insulation is of the flame-retardant type, VW-1 (FR-1) or the equivalent.

It will also necessitate that a switch, transformer, relay, solenoid, or similar device be individually and completely enclosed except at terminals, unless it can be shown that malfunction of the component would not result in a risk of 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 connections (splices) or overload or overcurrent protective devices.

7.5 Except as noted in [7.6](#), an opening for ventilation in the enclosure, other than in the bottom, of a heater and an opening associated with the dissipation of heated air from the element shall be provided with one or more baffles that will prevent the emission of flame, molten metal, burning insulation, or similar material from the heater.

7.6 In a compartment other than one that houses an overload or overcurrent protective device, the baffles mentioned in [7.5](#) may be omitted if:

- a) No ventilating opening in a vertical wall, other than one associated with the dissipation of heated air from the elements during intended operation of the heater, is more than 3/8 inch (9.5 mm) in width, or
- b) The heater is constructed to be acceptable for the purpose, as shown by appropriate investigation.

7.7 Cast- and sheet-metal portions of the enclosure shall not be thinner than indicated in [Table 7.1](#) unless the enclosure is found to be acceptable when judged under considerations such as are mentioned in [7.2](#) and [7.8](#).

Table 7.1
Minimum acceptable thicknesses of enclosure metal

Metal	At small, flat, unreinforced surfaces and at surfaces that are reinforced by curving, ribbing, and similar means (or are otherwise of a shape, size or both) to provide mechanical strength		At relatively large unreinforced flat surfaces	
	Inches	mm	Inches	mm
Die-cast metal	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	—	—
Galvanized sheet steel	0.029 ^a	0.74 ^a	—	—
Nonferrous sheet metal	0.036 ^a	0.91 ^a	—	—

^a Thinner sheet metal may be employed if found to be acceptable when the enclosure is judged under considerations such as those mentioned in [7.2](#) and [7.8](#).

7.8 In addition to being considered with reference to the factors mentioned in [7.2](#), an enclosure of sheet metal is to be judged with respect to its size and shape, the thickness of metal, and its acceptability for the particular application, considering the intended use of the heater.

7.9 At points where the face of an attachment-plug receptacle projects through it, the enclosure of a heater shall have a thickness not less than:

- a) 0.032 inch (0.81 mm) if of ferrous metal,
- b) 0.045 inch (1.14 mm) if of nonferrous metal, and
- c) 0.10 inch (2.5 mm) if of insulating material, except that an enclosure of insulating material may be of lesser thickness if formed or reinforced to provide physical strength. The insulating material shall be noncombustible.

7.10 Product enclosures made of non-metallic materials housing current-carrying electrical connections shall have a flammability classification as follows:

- a) A minimum of V-0, VTM-0, or HF-1, in accordance with Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, and IEC Test Flames 60695-11-10, or
- b) A minimum of SC-0 or SCTC-0, in accordance with Tests for Flammability of Small Polymeric Component Materials, UL 1694.

7.11 Product enclosures made of non-metallic materials shall comply with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, Table 4.1, Path II with a Minimum Flammability Rating V-0.

8 Accessibility of Live Parts

8.1 An electrical part of a heater shall be so located or enclosed that protection against unintentional contact with uninsulated live parts will be provided, except that this requirement does not apply to a visibly

glowing open-wire element and the connections immediately adjacent to the element. See [3.1](#), [8.2](#), [33.7](#) and [33.14](#). Insulated motor brush caps do not require additional enclosures.

8.2 The requirement in [8.1](#) does not apply to the sheath of an isolated metal-clad element in a heater having provision for grounding the enclosure, although such a sheath is considered to be a bare live part when spacings are being measured.

8.3 In determining if an opening in an enclosure is acceptable, consideration is to be given to:

- a) The proximity of uninsulated live parts (as determined by applying [8.1](#), [8.2](#), [8.4](#), [8.5](#), and [8.15](#) and
- b) The possibility of the emission of burning insulation, molten metal, and similar materials through the opening (as determined by applying [7.3](#) – [7.6](#).)

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

- a) For an opening that has a minor dimension (see [8.8](#)) less than 1 inch (25.4 mm), such a part or wire shall not be contacted by the probe illustrated in [Figure 8.3](#).
- b) For an opening that has a minor dimension of 1 inch or more, such a part or wire shall be spaced from the opening as specified in [Table 8.1](#).

Exception: An integral enclosure of a motor need not comply with these requirements if it complies with the requirements in [8.5](#).

8.5 With respect to a part or wire as mentioned in [8.4](#), in an integral enclosure of a motor as mentioned in the exception to [8.4](#):

- a) An opening that has a minor dimension (see [8.8](#)) less than 3/4 inch (19.1 mm) is acceptable if:
 - 1) Film-coated wire cannot be contacted by the probe illustrated in [Figure 8.2](#);
 - 2) In a directly accessible motor (see [8.9](#)), an uninsulated live part cannot be contacted by the probe illustrated in [Figure 8.4](#); or
 - 3) In an indirectly accessible motor (see [8.9](#)), an uninsulated live part cannot be contacted by the probe illustrated in [Figure 8.1](#).
- b) An opening that has a minor dimension of 3/4 inch (19.1 mm) or more is acceptable if a part or wire is spaced from the opening as specified in [Table 8.1](#).

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

Minor dimension ^a of opening		Minimum distance from opening to part	
Inches ^b	mm ^b	Inches ^b	mm ^b
3/4 ^c	(19.1)	4-1/2	(114.0)
1 ^c	(25.4)	6-1/2	(165.0)
1-1/4	(31.8)	7-1/2	(190.0)
1-1/2	(38.1)	12-1/2	(318.0)

Table 8.1 Continued on Next Page

Table 8.1 Continued

Minor dimension ^a of opening		Minimum distance from opening to part	
Inches ^b	mm ^b	Inches ^b	mm ^b
1-7/8	(47.6)	15-1/2	(394.0)
2-1/8	(54.0)	17-1/2	(444.0)
d		30	(726.0)

^a See 8.8.

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

^c Any dimension less than 1 inch applies to a motor only.

^d More than 2-1/8 inches, but not more than 6 inches (152.0 mm).

Figure 8.1

Probe for uninsulated live parts

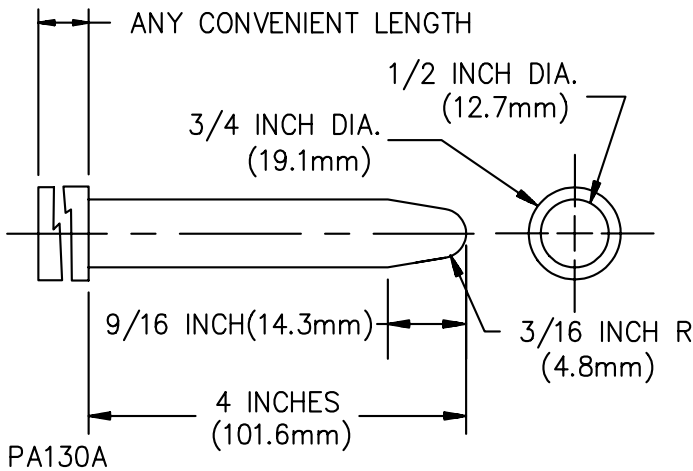


Figure 8.2

Probe for film-coated wire

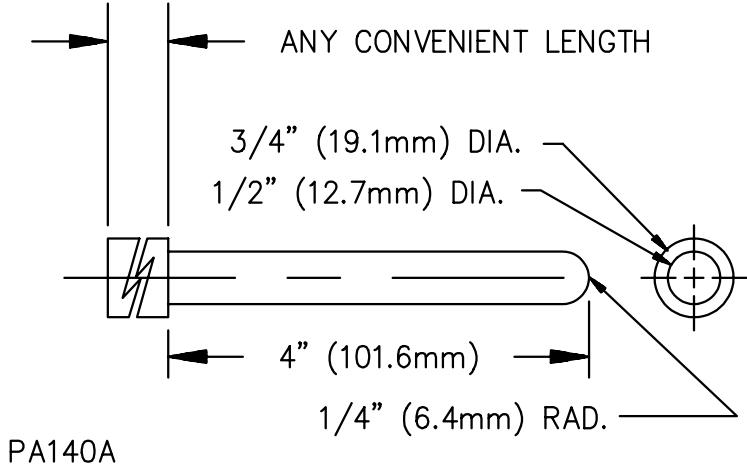
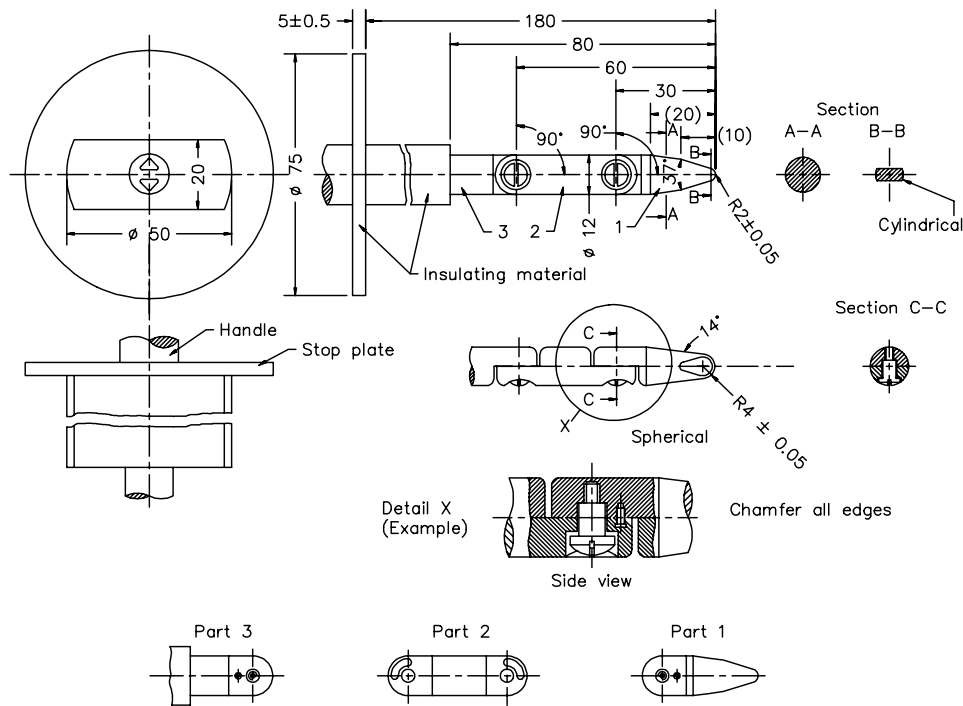


Figure 8.4
Articulate probe



SA1788A

All dimensions in millimeters

8.6 The probes mentioned in [8.4](#) and [8.5](#) and illustrated in [Figure 8.1](#) – [Figure 8.4](#) shall be applied to any depth that the opening will permit; and shall be rotated or angled before, during, and after insertion through the opening to any position that is necessary to examine the enclosure. The probes illustrated in [Figure 8.3](#) and [Figure 8.4](#) shall be applied in any possible configuration; and, if necessary, the configuration shall be changed after insertion through the opening.

8.7 The probes mentioned in [8.6](#) and [8.8](#) shall be used as measuring instruments to judge the accessibility provided by an opening, and not as instruments to judge the strength of a material; they shall be applied with a force of 1 lb (4.4 N) through any opening.

8.8 With reference to the requirements in [8.4](#) and [8.5](#), the minor dimension of an opening is the diameter of the largest cylindrical probe having a hemispherical tip that can be inserted through the opening.

8.9 With reference to the requirements in [8.5](#), an indirectly accessible motor is a motor:

- a) That is accessible only by opening or removing a part of the outer enclosure, such as a guard or panel, that can be opened or removed without using a tool, or
- b) That is located at such a height or is otherwise guarded or enclosed so that it is unlikely to be contacted.

A directly accessible motor is a motor:

- c) That can be contacted without opening or removing any part, or
- d) That is located so as to be accessible to contact.

8.10 During the examination of a heater in connection with the requirements in [8.1](#) – [8.9](#), a part of the outer enclosure that may be removed without the use of tools by the user of the heater (to permit the attachment of accessories, to allow access to means for making operating adjustments, or for other reasons) is to be disregarded – that is, it will not be assumed that the part in question affords protection against the risk of electric shock. A warning marking such as that specified in [67.4](#) is not considered to adequately protect against this risk of electric shock.

8.11 With reference to the requirements in [8.4](#) and [8.5](#), insulated brush caps are not required to be additionally enclosed.

8.12 During the examination of a heater in connection with the requirements in [8.1](#) – [8.9](#), a part of the outer enclosure that is removed with the use of tools by the user of the heater to permit resetting of the resettable temperature control is to be disregarded – that is, it will not be assumed that the part in question affords protection against the risk of electric shock, or injury to persons. A warning marking such as that specified in [67.4](#) is not considered to adequately protect against this risk of electric shock, or injury to persons.

Exception: A heater marked in accordance with [67.4](#) and that complies with [8.13](#) need not comply with this requirement.

8.13 A product may employ a resettable temperature control when the reset means is inaccessible if designed in a manner that the product cannot be disassembled with readily available tools, such as screw drivers, wrenches, and similar tools, and the product or instruction sheet is marked in accordance with [67.4](#). Such fasteners as rivets, one way screws, tamper resistant type screws, fasteners not readily accessible after assembly, and similar fasteners would be considered as causing the product to be not readily disassembled.

8.14 Any manual adjustable controls shall be resettable or adjustable so that electrical or moving parts will not cause a risk of fire, or electric shock, to occur during the resetting or adjustment procedure. See [8.10](#), [8.12](#), and [Figure 8.5](#).

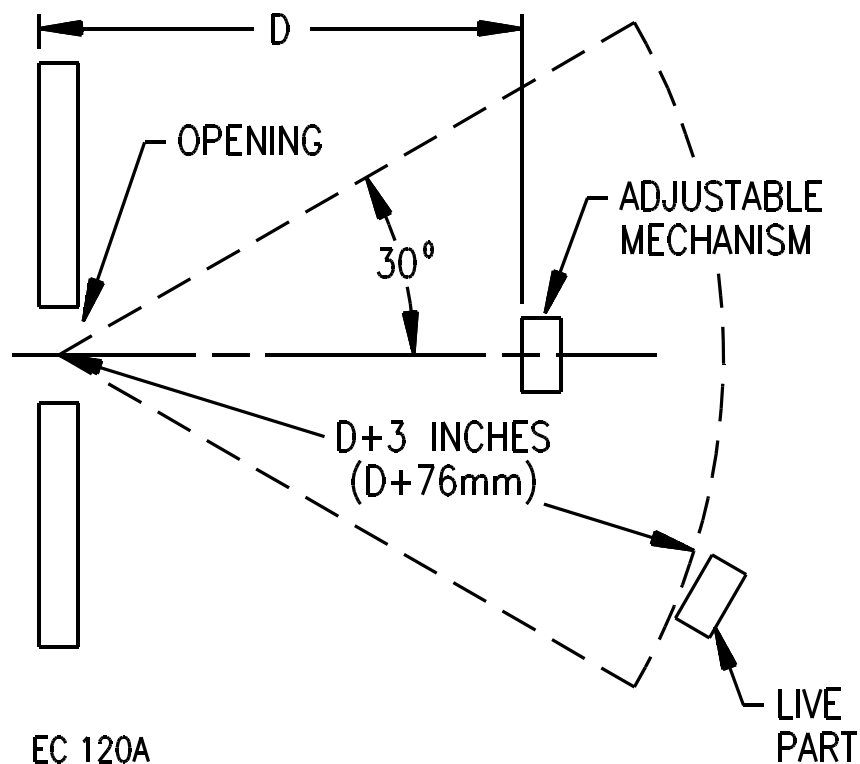
8.15 An uninsulated live part shall not be located behind an opening that may be used to make a user service function such as adjusting or resetting a manual limit control if a 1/8-inch (3.2-mm) diameter straight rod can be made to touch the live part when the rod is inserted through the opening and moved to all positions possible without producing an angle of more than 30 degrees between the rod and the line drawn between the center of the opening and the center of the face of the part to be adjusted. The length of the rod beyond the opening is not to exceed the distance between the opening and the face of the adjustable mechanism by more than 3 inches (76 mm). See [Figure 8.5](#).

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

8.17 The door or cover of an enclosure shall be hinged if it gives access to any fuse, circuit breaker, or manually resettable temperature control and if uninsulated live parts are exposed during the replacement of the fuse or resetting of the manually resettable temperature control. Such a door or cover shall also be provided with a latch or the equivalent and a captive screw to secure the door or cover in place.

Figure 8.5

Accessibility of live or moving part through enclosure opening



8.18 A door or cover giving access to any overload-protective device in other than a low-voltage circuit shall be tight fitting and shall suitably overlap the surface of the enclosure around the opening.

8.19 A spring latch, a magnetic latch, a dimple, or any other mechanical arrangement that will hold the door in place and would require some effort on the user's part to open it is considered to be an acceptable means for holding the door in place as required in [8.17](#).

8.20 A component of a heater that is likely to need inspection, replacement, cleaning, or other servicing shall be as accessible as practicable, and shall be accessible without the use of special tools if it is intended to be manually operated or adjusted or if it will definitely require periodic servicing.

9 Accessibility of Moving Parts

9.1 The rotor of a motor, a pulley, a belt, a gear, a fan, or other moving parts shall be enclosed or guarded to reduce the risk of injury to persons.

Exception: This requirement does not apply to a part or portion of a part that must be exposed to enable a heater to perform its intended function.

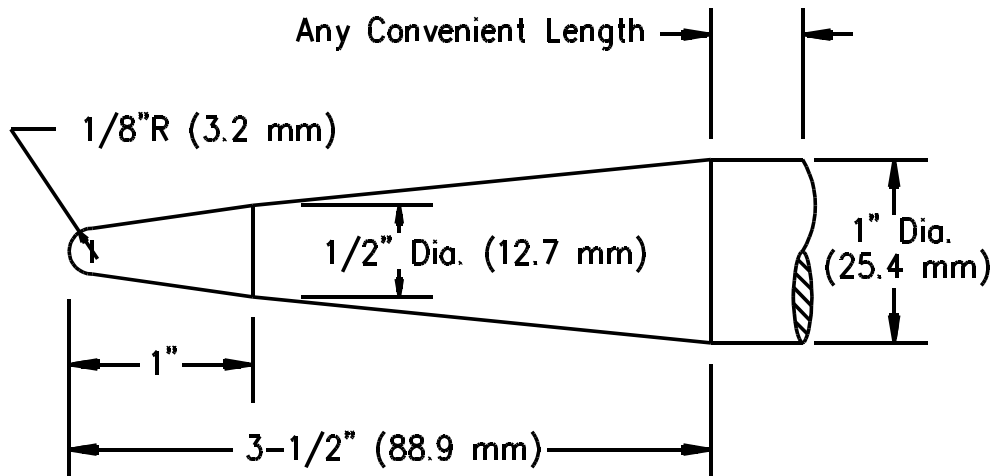
9.2 A fan blade shall be constructed of a material and in such a manner to reduce the risk of its breakage or its release of parts that could cause a risk of injury to persons.

9.3 The portion of a fan blade that can cause a risk of injury to persons shall be guarded so that the probe shown in [Figure 9.1](#) cannot touch the part when inserted with a force of 1 lb (4.4 N) through any opening in the guard.

9.4 If a part used to comply with the requirement in [9.3](#) is made of a polymeric material, a piece of the material is to be re-examined for compliance with this requirement after being subjected to the Mold Stress-Relief Distortion Test as described in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. See [12.1](#). While in the oven the part is to be assembled to the heater and the heater is to be in its intended operating position.

Figure 9.1

Probe for fan blades of air heaters



PA 160

9.5 A guard employed to comply with the requirement in [9.3](#) shall be either attached to the heater or shall require the use of a tool or tools for removal.

9.6 An enclosure, a frame, a guard, a handle, or other part of the heater that is exposed to contact during intended operation shall not be sufficiently sharp to constitute a risk of injury to persons.

9.7 Any manual adjustable controls shall be resettable or adjustable so that moving parts will not cause a risk of injury to persons to occur during the resetting or adjustment procedure. See [8.10](#), [8.12](#) and [Figure 8.5](#).

10 Guarding of Heating Elements

10.1 General

10.1.1 The heating element and any part of the element assembly (such as an element support, sheath, and similar parts) shall be so guarded that flammable material as well as persons will be protected against contacting it.

10.1.2 Any heater projections such as guards or grilles that are intended to guard hot heater surfaces shall be positively secured to the heater such as by screws, rivets or welding or being engaged in slots so that they cannot be removed without the use of tools, breaking or permanent bending or distortion.

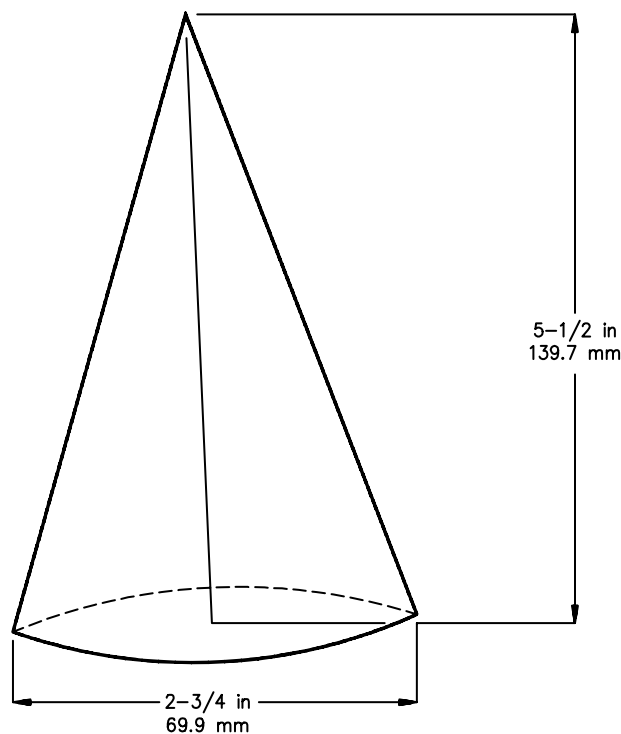
10.1.3 The acceptability of a guard is judged with respect to its general serviceability and with respect to the shape and size or both of the openings in it, in conjunction with the distance of the guard from the heating element and the other high-temperature parts mentioned in [10.1.1](#). Except as noted in [10.1.5](#), an

opening in a guard is considered to be acceptable if, with the heater in any intended operating position, the following conditions are met:

- a) The shape and size of an opening are such that a test gauge in the form of a right-circular cone having a base diameter of 2-3/4 inches (69.9 mm) and an altitude of 5-1/2 inches (139.7 mm), see [Figure 10.1](#), is prevented from touching the heating element and the other high-temperature parts when the cone probe is inserted, apex first, in any manner. See [10.1.4](#).
- b) The shape and size of an opening which permits the vertically downward entrance of a bar probe 1/2 inch (12.7 mm) wide and 1/16 inch (1.6 mm) thick, see [Figure 10.2](#), are such that a triangle probe 1/16 inch thick and in the form of an isosceles triangle having a base of 2-3/4 inches and an altitude of 5-1/2 inches, see [Figure 10.3](#), is prevented from touching the heating element and the other high-temperature parts when the triangle probe is inserted, apex first, in any manner. The testing of an opening with the triangle probe applies also where the vertically downward insertion of the bar is prevented by the construction of the guard, the use of an additional barrier, or both, unless the vertically applied bar tends to be deflected outward – that is, away from the guard.
- c) The area of an opening in a substantially vertical face of a guard is not more than 3-1/4 square inches (2100 mm²) if the size and/or shape of the opening permits the entrance from any horizontal direction of a vertically oriented rod probe 1/16 inch in diameter and 2-3/4 inch long, see [Figure 10.4](#). Also, see [Figure 10.5](#).

Figure 10.1

Cone probe



SM206

Figure 10.2
Bar probe

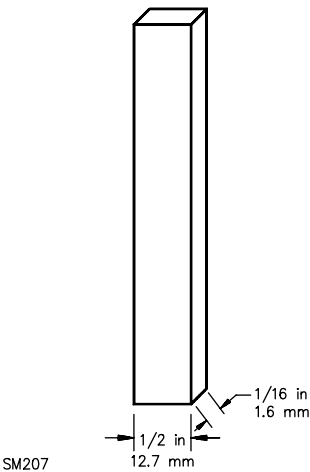


Figure 10.3
Triangle probe

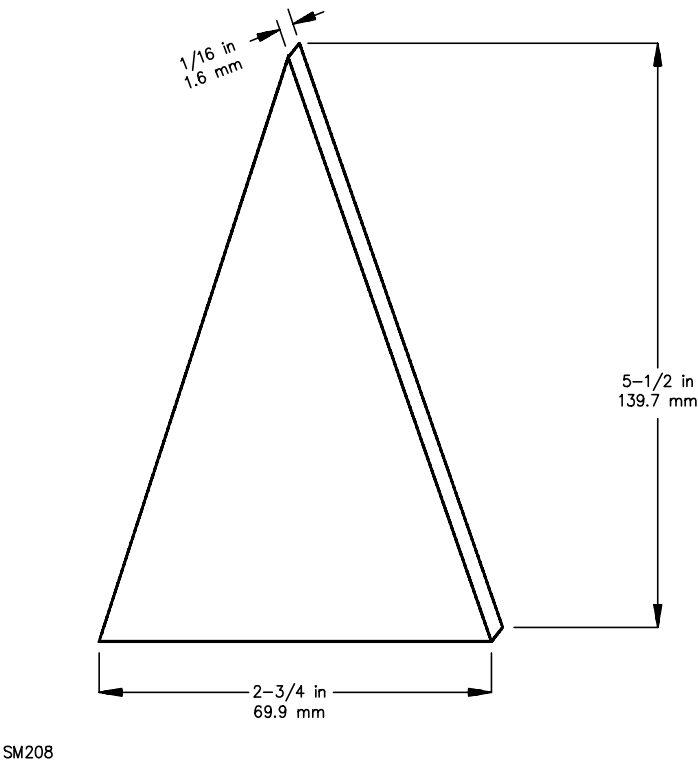
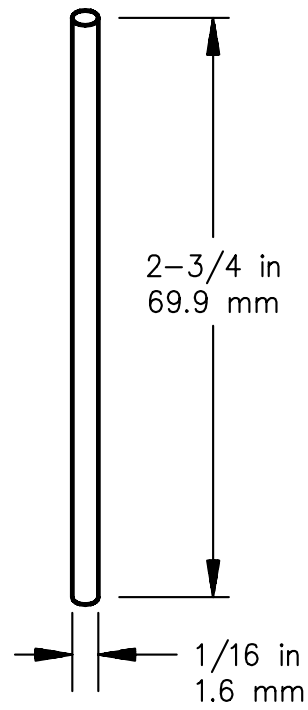


Figure 10.4

Rod probe

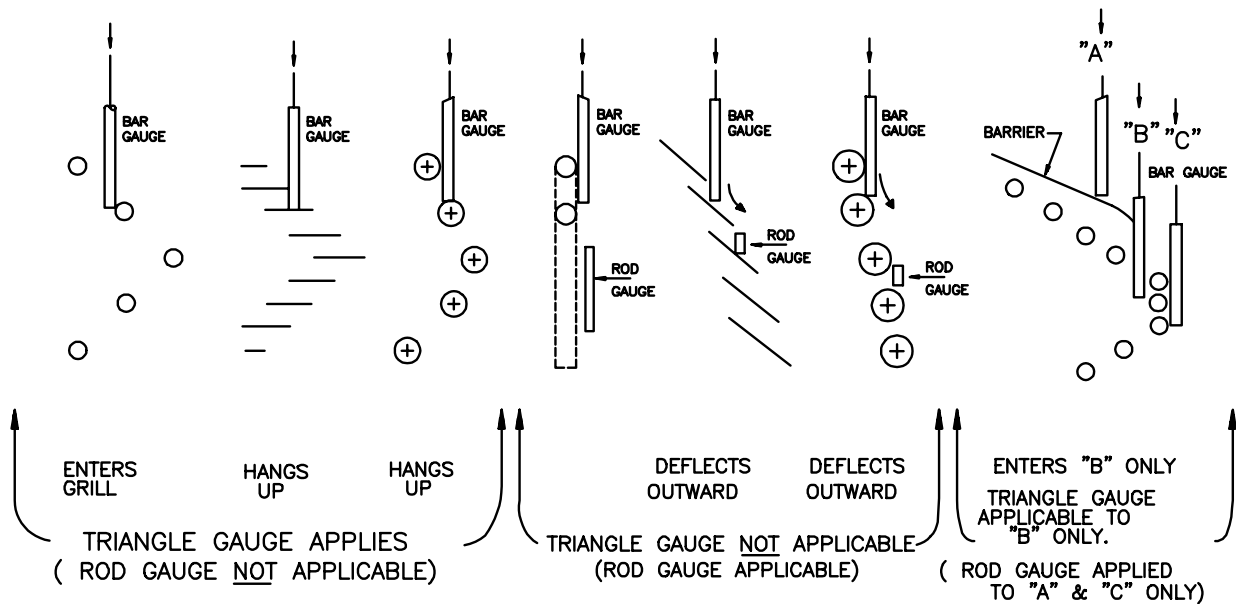


SM209

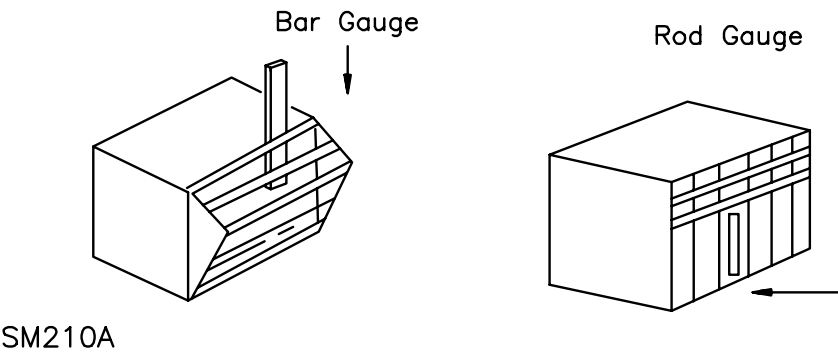
Figure 10.5
Guarding of heating elements

Application of bar gauge and rod gauge

ARROW INDICATES DIRECTION OF APPLICATION OF GAUGES



NOTE: ROD GAUGE APPLIED TO "SUBSTANTIALLY VERTICAL" GRILLS.



10.1.4 The fins of a metal-clad element are considered to be element-guarding members, and need not comply with the provisions in [10.1.3\(a\)](#) if the temperature of the exposed edges (outer perimeter) of the fins is not more than 280°C (536°F).

10.1.5 Openings in the guard complying only with of [10.1.3\(a\)](#) are acceptable for the following:

- a) Except for a panel-type heater (see [10.2.1](#)), an air heater in which the temperature of the heating element is not higher than 280°C (536°F) under conditions of intended operation, or
- b) A fan-type heater in which the fan is always in operation when the heating element is on (energized) and the air current prevents clothing and the like from entering the guard.

10.1.6 A guard shall comply with one of the following if the switching arrangement on a grounded heater does not comply with [33.14](#) or the design employs a through-cord switch as described in [33.15](#).

- a) No opening in the guard will permit passage of a rod having a diameter of 3/8 inch (9.5 mm).
- b) No opening in the guard will permit passage of a rod having a diameter of 3/4 inch (19.1 mm) and no uninsulated live part or isolated metal-clad element is less than 4 inches (102 mm) from the nearest point on the guard at any opening which will permit the entrance of a rod having a diameter of 3/8 inch (9.5 mm).

10.1.7 If a heater is required to have a guard, and if the guard is readily removable, the heater and the guard shall be contained in the same carton as shipped from the factory. See also [67.17](#).

10.1.8 A heater in which the heating element is constructed for use only in an air current shall be so wired or controlled that the element can be operated only while under the cooling effect of the air stream. A heater in which the cooling effect of the motion of a part is necessary to limit temperatures shall be so wired or controlled that the element cannot be operated without such motion.

10.2 Panel-type heaters

10.2.1 A panel-type heater shall be provided with a guard that will prevent a test surface, in the form of a 6-inch square (a square 152 mm on a side) parallel to the element panel, from being brought closer than 1/2 inch (12.7 mm) to the plane of the front of the heater, excluding the guard.

Exception No. 1: A heater having an element panel operating at a temperature higher than 280°C (536°F) shall be guarded as described in [10.1.3](#).

Exception No. 2: A heater that will not cause glowing or flaming of the cheesecloth or the felt when subjected to the padded surface and blanketing test in [42.8.2](#).

11 Parts Subject to Pressure

11.1 Except as noted in [11.2](#) a pressure vessel having an inside diameter, width, height or cross-section diagonal of more than 6 inches (152 mm) with no limitation on length of vessel and subject to a pressure of more than 15 pounds force per square inch gauge (psig) (103 kilonewtons per square meter or 105 grams force per square millimeter) shall be certified by the National Board of Boiler and Pressure-Vessel Inspectors and marked in accordance with the appropriate boiler and pressure vessel code symbol of the American Society of Mechanical Engineers (ASME) – "H", "M", "S", or "U" – for a working pressure not less than the pressure determined by applying [11.2](#).

11.2 Except as noted in [11.3](#), a part of a heater that is subject to pressure (including the vapor pressure of a superheated fluid) shall comply with the Hydrostatic Test, Section [58](#).

11.3 A test need not be performed to determine whether or not a part complies with the requirement in [11.2](#) if the strength of the part is acceptable for the purpose as a result of its material and dimension – for example, copper or steel pipes of standard sizes and provided with standard fittings might be considered to have the necessary strength if they comply with [Table 11.1](#).

Table 11.1
Minimum wall thickness^a for copper and steel tubing

Outside diameter		Copper				Steel	
		Protected within the enclosure		Unprotected			
inches	mm	inches	mm	inches	mm	inches	mm
1/4	6.35	0.0245	0.623	0.0265	0.673	0.025	0.635
5/16	7.94	0.0245	0.623	0.0265	0.673	0.025	0.635
3/8	9.53	0.0245	0.623	0.0265	0.673	0.025	0.635
1/2	12.70	0.0245	0.623	0.0285	0.724	0.025	0.635
5/8	15.88	0.0315	0.799	0.0315	0.799	0.032	0.813
3/4	19.05	0.0315	0.799	0.0385	0.978	0.032	0.813
7/8	22.23	0.0410	1.041	0.0410	1.041	0.046	1.168
1	25.40	0.0460	1.168	0.0460	1.168	—	—
1-1/8	28.58	0.0460	1.168	0.0460	1.168	0.046	1.168
1-1/4	31.75	0.0505	1.283	0.0505	1.283	0.046	1.168
1-3/8	34.93	0.0505	1.283	0.0505	1.283	—	—
1-1/2	38.10	0.0555	1.410	0.0555	1.410	0.062	1.575
1-5/8	41.28	0.0555	1.410	0.0555	1.410	—	—
2-1/8	53.98	0.0640	1.626	0.0640	1.626	—	—
2-5/8	66.68	0.0740	1.880	0.0740	1.880	—	—

^a Nominal wall thickness of tubing will have to be greater than the thickness indicated to maintain the minimal wall thickness.

11.4 A means for safely relieving pressure shall be provided for all parts in which pressure might be generated in the event of fire.

11.5 Pressure-relief devices (see [11.10](#)), fusible plugs, soldered joints, spot or rolled weld joints, nonmetallic tubing, or other equivalent pressure-relief means may be employed to comply with the requirement in [11.4](#).

11.6 There shall be no shut-off valve between the pressure relief means and the parts that it is intended to protect.

11.7 A vessel having an inside diameter, width, height or cross-section diagonal of more than 3 inches (76.2 mm) and subject to air or steam pressure generated or stored within the appliance shall be protected by a pressure-relief device.

11.8 The start-to-discharge pressure setting of the pressure-relief device shall not be higher than the maximum working pressure of the vessel. The discharge rate of the device shall be great enough to relieve the pressure.

11.9 A pressure-relief device shall:

- a) Be connected as close as possible to the pressure vessel or parts of the system that it is intended to protect,
- b) Be so installed that it is accessible for inspection and repair and cannot be readily rendered inoperative,
- c) Have its discharge opening so located and directed that the risk of scalding has been reduced to an acceptable degree, and
- d) Have its discharge opening so located and directed that operation of the device will not deposit moisture on uninsulated live parts, or on insulation or components affected detrimentally by moisture.

11.10 A pressure-relief device having an adjustable setting is to be judged on the basis of its maximum setting unless the adjusting means is sealed at a lower setting.

11.11 A pressure-relief device is considered to be a pressure-actuated valve or rupture member designed to relieve excessive pressures automatically.

11.12 If a pressure-relief device is required, the electrical control responsible for limiting the pressure in the vessel shall be capable of performing under rated load for 100,000 cycles of operation and shall prevent the pressure from exceeding 90 percent of the relief-device setting under any condition of intended operation.

12 Polymeric Materials

12.1 Determination of the acceptability of a polymeric material shall be made based on the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

12.1A Barriers made of non-metallic materials shall have a flammability classification as follows:

- a) The barrier material shall not be a flammability classification HB. The alternate path of Section 5 of UL 746C is not applicable; and
- b) One of the following:
 - 1) A minimum of V-0, VTM-0, or HF-1, in accordance with Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, and IEC Test Flames 60695-11-10; or
 - 2) a minimum of SC-0 or SCTC-0, in accordance with Tests for Flammability of Small Polymeric Component Materials, UL 1694.

12.2 For the purposes of conducting the Resistance to Impact Test in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, a heater intended for indoor use that is provided with a polymeric enclosure shall be considered a floor-supported appliance even if it is specifically intended for use at elevated locations and be evaluated for use in locations where the temperature is capable of being less than normal room temperature, such as unheated warehouses or rooms.

12.3 Enclosures shall be subject to the requirements in Section [7](#).

12.4 Any non-metallic part external to the external enclosure shall have a minimum flammability classification of V-2.

Exception 1: The part is permitted to be a minimum flammability classification of HB as follows:

a) Greater than 20 mm above any openings in the enclosure used for venting, air inlet, or air outlet, or greater than 5 mm from the sides or bottom of any openings in the enclosure used for venting, air inlet, or air outlet; and

b) Located so it cannot propagate flame from one area to another or bridge between a possible source of ignition and other ignitable parts in accordance with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, 50 Flammability – 12 mm Flame Test.

Exception 2: The part is not required to be made of a material classed 5VA, 5VB, V-0, or V-1, if it meets the following:

a) The part does not occupy a volume greater than 2 cubic centimeters (0.122 cubic inch), does not have any dimension greater than 3 cm (1.18 inch); and

b) Located so it cannot propagate flame from one area to another or bridge between a possible source of ignition and other ignitable parts in accordance with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, 50 Flammability – 12 mm Flame Test or IEC 60695-11-5 Test flames – Needle-flame test method.

13 Heat Transfer Fluids

13.1 In a heater which uses a heat transfer fluid in its heating process, the fluid shall have a flash point (see [3.13](#)) that is higher than the maximum operating temperature of the fluid measured during the Normal Temperature Test, Section [40](#).

14 Assembly of Components

14.1 A switch, a lampholder, a temperature control, an attachment-plug receptacle, a motor-attachment plug, or similar component shall be mounted securely and, except as noted in [14.2](#) and [14.3](#), shall be prevented from turning.

14.2 The requirement that a switch or a temperature control be prevented from turning may be waived if all five of the following conditions are met:

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

b) The means for mounting the switch or the temperature control is not subject to loosening as the result of its operation,

c) The spacings are not reduced below the minimum acceptable values if the switch or the temperature control rotates,

d) The operation of the switch or the temperature control is by mechanical means rather than direct contact by persons, and

e) The shifting of the switch or the temperature control in position does not result in false indication of its setpoint with respect to the setpoint markings.

14.3 A lampholder of a type in which the lamp cannot be replaced (such as a neon pilot or indicator light in which the lamp is sealed in nonremovable jewel) need not be prevented from turning if rotation cannot reduce spacings below the minimum acceptable values.

14.4 The means for preventing the turning mentioned in [14.1](#) is to consist of more than friction between surfaces – for example, a toothed lock washer which provides both spring take-up and an interference lock

is acceptable as means to prevent turning of a small stem-mounted switch or other device having a single-hole mounting means.

14.5 Uninsulated live parts shall be secured to the base or mounting surface that they will be prevented from turning or shifting in position if such motion may result in a reduction of spacings below the minimum acceptable values indicated in [35.1](#) – [35.6](#).

14.6 Friction between surfaces is not acceptable as a means to prevent shifting or turning of live parts, but a toothed lock washer which provides both spring take-up and an interference lock is acceptable.

15 Protection Against Corrosion

15.1 Except as noted in [15.2](#), iron and steel parts shall be protected against corrosion by enameling, galvanizing, plating, or other equivalent means if the deterioration of such unprotected parts would be likely to result in risk of fire, electric shock, explosion, or injury to persons.

15.2 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.

15.3 The aging characteristics of plating or other finish used in a heater shall be such that deterioration of the finish will not result in unacceptable performance of the heater.

15.4 The sheath of an immersion-type heating element shall be of a metal resistant to corrosion by the liquid in which the element is intended to be immersed.

16 Supply Connections

Section 16 deleted

16A Mounting Means

16A.1 The mass of a wall or ceiling hung heater shall not exceed 50 pounds (22.7 kg).

16A.2 Hanging brackets and any necessary fasteners required for hanging the heater shall be provided as part of the product. Optional hanging kits may be available if marked in accordance with [67.10](#).

16A.3 A wall-hung heater shall not have provisions for permanent mounting. Keyhole slots, not accessible for tightening of screws, or provisions for hanging on a bracket furnished with a heater would be acceptable for mounting such heaters.

16B Supply Connections

16B.1 Power-supply cords

16B.1.1 A heater shall be provided with a power-supply cord consisting of a length of attached flexible cord as described in [16B.2](#) and an attachment plug as described in Section [16C](#) for connection to the supply circuit. The length of the attached power-supply cord (including fittings) shall not be less than 6 feet (1.8 m) and not more than 8 feet (2.4 m).

Exception No. 1: The length of cord for Types SRDT and SPT-3 is specified in note b of [Table 16B.1](#).

Exception No. 2: Ceiling-hung heaters may have a cord not more than 17 feet (5.2 m) in length.

Table 16B.1
Acceptable types of cord

Type of heater	Temperature of more than 121°C (250°F) on any heater surface likely to be contacted by cord ^{c,d}	Temperature of 121°C (250°F) or less on any heater surface likely to be contacted by cord ^{a,c,d}
1. Household heaters not intended for outdoor use	HPD, HPN, HSJO, HSJ	SP-2, SPT-2, SVO, SV, SVTO, SVT, SJO, SJ, SJTO, SJT, SRDT ^b , SPT-3 ^b
2. Commercial heaters not intended for outdoor use	HSJO, HSJ, HSO, HS	SJO, SJ, SJTO, SJT, SO, S, STO, ST
^a Cords of the types indicated in the adjacent column may also be used.		
^b Restricted to a wall supported or a freestanding heater having a minimum cord length of 3 feet (0.9 m) and a maximum cord length of 6 feet (1.8 m).		
^c On a movable heater it is considered that any external surface that can be contacted by the cord is likely to be contacted by the cord.		
^d The maximum temperature on a heater is to be determined in accordance with the Normal Temperature Test (Section 40).		

16B.1.2 All power-supply cords shall comply with the requirements of the Standard for Cord Sets and Power-Supply Cords, UL 817.

16B.1.3 A heater-use power-supply cord supplied as part of an appliance as described in [Table 16B.1](#), row 1 shall employ flexible cord with the suffix -R in accordance with the Standard for Flexible Cords and Cables, UL 62.

16B.1.4 A power-supply cord supplied as part of an appliance as described in [Table 16B.1](#), row 1 shall employ soldered, brazed, or welded blade and terminal connections in compliance with the requirements for Heater-Use Power-Supply Cords in the Standard for Cord Sets and Power-Supply Cords, UL 817.

16B.2 Flexible cords

16B.2.1 The flexible cord shall comply with the Standard for Flexible Cords and Cables, UL 62, and shall be of the type cord as indicated in [Table 16B.1](#) or another type cord of equal or harder usage.

16B.2.2 The flexible cord provided with a heater intended for outdoor use shall be marked with the suffix letter "W".

16B.2.3 The size of the flexible cord, based on the current rating of a 120 volt the heater, shall be in accordance with [Table 16B.2](#).

Table 16B.2
Cord wire size based on 120 volt appliance current and wattage rating

Cord wire size AWG ^a	Maximum allowable marked appliance wattage	Maximum current rating of heater, amperes	
		Cord types SJ, SJO, SJT, SJTO, SP-2, SPT-2, SPT-3, SRDT, SV, SVO, SVT, SVTO	Cord types HPD, HPN, HSJ, HSJO
18	1,000	10	10
16	1,500	13	15
14	1,800	18	20

NOTE: This table limits the heater current and wattage on the basis of cord wire size, type of cord, type of connection between the cord wires and blades of the attachment plug and connections of power supply cord to internal wiring of a heater. For current limitation based on the attachment plug rating, see [16C.1](#).

^a The maximum current rating for other cord sizes can be determined from Table 400-5(A), Ampacity of Flexible Cords and Cables, National Electrical Code, NFPA 70. When the attachment plug is connected by crimping only, the current rating of the heater is not to exceed 80 percent of the rating of the corresponding wire sizes of Type S Cord, regardless of the type of cord used.

16B.2.4 The size of the flexible cord, based on the current rating of 208/240 volt heater, shall be in accordance with [Table 16B.3](#).

Table 16B.3
Cord wire size based on 208/240 volt appliance current and wattage rating

Cord wire size AWG ^a	Maximum allowable marked appliance wattage	Maximum current rating of heater, amperes	
		Cord types S, SJ, SJO, SJT, SJTO, SO, SPT-3, SRDT, ST, STO	Cord types HS, HSJ, HSJO, HSO
16	2,400	10	15
14	3,600	15	20
12	4,800	20	30
10	6,000	25	35
8	8,400	35	—
6	10,000	45	—

NOTE: This table limits the heater current and wattage on the basis of cord wire size, type of cord, type of connection between the cord wires and blades of the attachment plug and connections of power supply cord to internal wiring of a heater. For current limitation based on the attachment plug rating, see [16C.1](#).

^a The maximum current rating for other cord sizes can be determined from Table 400.5(A)(1), Ampacity of Flexible Cords and Cables, National Electrical Code, NFPA 70. When the attachment plug is connected by crimping only, the current rating of the heater is not to exceed 80 percent of the rating of the corresponding wire sizes of Type S Cord, regardless of the type of cord used.

16B.2.5 Supplementary insulation on a flexible cord shall not extend more than 1/2 inch (12.7 mm) outside the heater (unless provided with additional mechanical protection), shall be prevented from fraying or unraveling, and shall not affect adversely the means for providing strain relief.

16B.2.6 Strain relief shall be provided to prevent a mechanical stress on a flexible supply cord from being transmitted to terminals, splices, or interior wiring.

16B.2.7 Means shall be provided to prevent the flexible cord from being pushed into the enclosure of a heater through the cord-entry hole if such displacement is likely to subject the cord to mechanical damage or to expose the cord to a temperature higher than that for which it is acceptable, or if it is likely to reduce spacings (such as to a metal strain-relief clamp) below the minimum acceptable values.

16B.2.8 If a knot serves as strain relief in an attached flexible cord, any surface with which the knot may come in contact shall be free from projections, sharp edges, burrs, fins, and the like, which may cause abrasion of the insulators on the conductors.

16B.2.9 At 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, rounded surface against which the cord may bear. If Type 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 acceptable for the particular application.

16B.2.10 If the cord hole is in wood, porcelain, phenolic composition, or other nonconducting material, a smooth, rounded surface is considered to be equivalent to a bushing.

16B.2.11 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 conditions of ordinary moisture.

16C Attachment Plugs

16C.1 The current rating of the attachment plug shall not be less than 125 percent of the current rating of the heater except as follows:

- a) A 15-ampere attachment plug is acceptable for a heater rated at not more than 1500 watts at 120 volts, or 3000 watts at 240 volts;
- b) A 20-ampere attachment plug is acceptable for a heater rated at not more than 2000 watts at 120 volts or 4000 watts at 240 volts;
- c) A 30-ampere attachment plug is acceptable for a heater rated at not more than 6,000 watts at 240 volts; or
- d) A 50-ampere attachment plug is acceptable for a heater rated at not more than 10,000 watts at 240 volts.

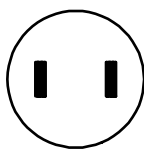
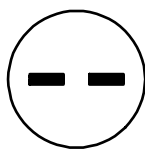
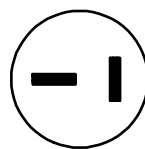
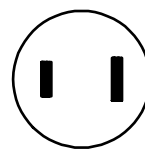
16C.2 An electrical connection of an attachment plug provided as integral with the heater-use power-supply cord described in [16B.1.4](#) shall be soldered, brazed, or welded to the flexible cord conductor as described in [16D.8](#), except that the method of mechanical securement for a soldered connection shall be made by crimping.

16C.3 The attachment plug (of a permanently attached cord or of a cord set) shall be acceptable for its intended use. Some of the more common plug configurations are shown in [Figure 16C.1](#).

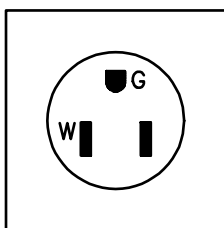
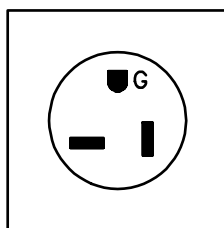
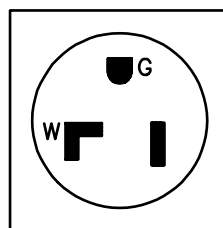
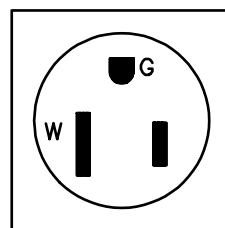
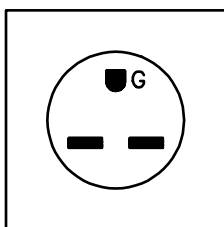
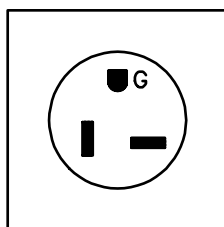
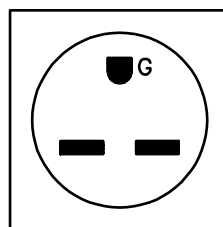
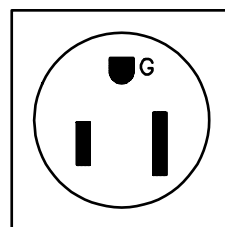
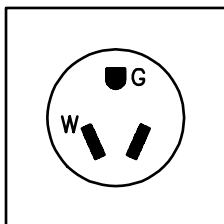
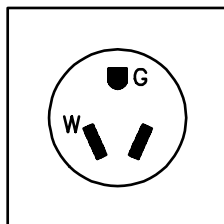
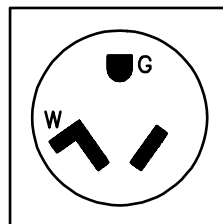
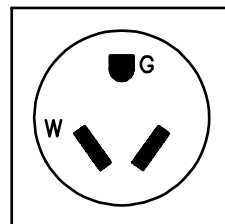
Figure 16C.1

Attachment plug configurations

2-POLE, 3-WIRE, NONGROUNDING:

15 amperes,
125 volts15 amperes,
250 volts20 amperes,
250 volts30 amperes,
250 volts

2-POLE, 3-WIRE, GROUNDING:

15 amperes,
125 volts20 amperes,
125 volts30 amperes,
125 volts50 amperes,
125 volts15 amperes,
250 volts20 amperes,
250 volts30 amperes,
250 volts50 amperes,
250 volts15 amperes,
277 volts20 amperes,
277 volts30 amperes,
277 volts50 amperes,
277 volts